MEASURING FACULTY-STUDENT INTERACTION IN ONLINE COURSES USING ASYNCHRONOUS DISCUSSION BOARDS: A CAMPUS-WIDE ANALYSIS

by

Crystal Gasell

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The following individuals read and discussed the dissertation submitted by student Crystal Gasell, and they evaluated their presentation and response to questions during the final oral examination. They found that the student passed the final oral examination.

Patrick Lowenthal, Ph. D.	Chair, Supervisory Committee
Lida Uribe-Flórez, Ph. D.	Member, Supervisory Committee
Yu-hui Ching, Ph. D.	Member, Supervisory Committee

The final reading approval of the dissertation was granted by Patrick Lowenthal, Ph. D., Chair of the Supervisory Committee. The dissertation was approved by the Graduate College.

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ABSTRACT

Online learning is growing. As such, institutions want to grow programs, while ensuring quality. Part of ensuring quality in online courses is ensuring that there is regular and substantive interaction (RSI) between students and instructors. Discussion boards are often used in online courses as a way to promote social exchange, interaction, and the discussion of course concepts. Therefore, discussion board activity can provide a glimpse into the RSI that occur between students and instructors. Until recently, data from learning management systems was difficult to access and analyze. However, advances in technology and an increased interest in learning analytics provides researchers and institutions with billions of data points about student and instructor activity within a learning management system (LMS). This study used LMS data to explore the frequency of interaction between instructors and students in discussion boards in online courses at one institution. 415 courses were selected for the study, spanning two semesters. Results from the study found that the average number of posts by an instructor was 32.9. The average instructor interaction was 1.49 instructor posts per student. 23% of courses had no instructor posts. Student posts averaged 470 per course and the average posts per student was 19.9. Based on the discussion board activity, the most discussion interaction occurred during the first two weeks of the semester. Results suggested that there is no relationship between student satisfaction and the number of total posts in a course.

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CHAPTER ONE: INTRODUCTION

The number of students taking online courses in higher education and the number of online courses being offered continues to grow (Seaman, Allen, & Seaman, 2018). In fact, the number of online students in both undergraduate and graduate levels of higher education have increased steadily from 2012 to 2016 (Seaman et al., 2018). Traditional and non-traditional students are choosing online courses, among other reasons, to fit within their busy schedules (Ortagus, 2017). Recently, Seaman et al. (2018) reported that 52.8% of online students also took at least one course on campus, which suggests that an increasing number of online students live close enough to attend face-to-face classes on campus. Additionally, and perhaps related to the number of local students taking online courses, more institutions report that online education is critical to their long-term institutional strategy (Allen & Seaman, 2016). In other words, institutions now see online courses and online programs as not only a way to reach more geographic areas, but also a way to meet the demands of residential students, to address space shortages of classrooms, and as a way to address budget issues (Allen & Seaman, 2016). For these reasons, institutions are increasingly investing in online courses and online programs.

Statement of the Problem

Despite the popularity and increased investments from universities, online courses have been criticized for being inferior in quality to face-to-face courses (Allen & Seaman, 2016; Singh & Hurley, 2017). For example, in 2015, 25% of academic leaders reported they believed online learning outcomes were “somewhat inferior” or “inferior” to face-to-

face instruction (Allen & Seaman, 2016). Public opinion of online education appears to be similarly mixed. For instance, in 2013, a Gallup poll revealed that 34% of Americans rated online courses as "excellent" or "good." However, 68% rated traditional courses taught at a four-year college or university as "excellent" or "good" (Saad, Busteed, & Ogisi, 2013). This suggests the majority of people still feel that traditional face-to-face education is better than online education. However, it is important to point out that instructors who have experience teaching online, generally believe that it is equivalent to face-to-face instruction (Jaschik & Lederman, 2018). This suggests that as more instructors are exposed to teaching online, perceptions may improve. Nevertheless, the perception that online education is inadequate or of low quality has institutions seeking ways to validate online education and improve the quality of online courses.

Research suggests that one critical variable that influences students' perception about online courses is the interactions that take place between a student and an instructor (Battalio, 2007; Richardson & Swan, 2003; Stein, Wanstreet, Calvin, Overtoom, & Wheaton, 2005). Interactions between a student and an instructor has been linked to learner satisfaction and student achievement (Lee, Srinivasan, Trail, Lewis, & Lopez, 2011; Sher, 2009). This information has led to the development of a number of standards, or best practices, which are used to guide online teaching (Chickering & Ehrmann, 1996; Pina & Bohn, 2014). Each of these standards or best practices include learner-instructor interaction as a key component. In fact, federal policy requires institutions who participate in the student financial assistance programs, authorized by Title IV of the Higher Education Act (HEA), to demonstrate that online courses and programs "support regular and substantive interaction between the students and the instructor, synchronously

or asynchronously" (Legal Information Institute, n.d., 7Aii). The U.S. Department of Education's position, currently, is that courses without regular and substantive interaction between students and instructors are considered correspondence courses and therefore not eligible for financial assistance (U.S. Department of Education, 2014). However, despite this position, there is currently not a standard definition of regular and substantive interaction (RSI) (Protopsaltis & Baum, 2019).

In 2017, Western Governors University (WGU) responded to allegations that they were not eligible to participate in Title IV programs primarily due to not meeting the "regular and substantive interaction" requirement as described in the HEA (Office of the Inspector General, 2017). In the response to the audit, WGU defended their model of regular and substantive interaction, stating that the review

> limited what it counted as regular and substantive interaction to what the OIG personnel found in the WGU course outlines; however, WGU is explicit in its educational model that significant interactions between faculty and students regularly take place that are not spelled out in the course syllabus. (Office of the Inspector General, 2017, p. 68)

This, and other similar cases, raised a number of concerns from the online education community about the lack of clarity regarding the meaning of regular and substantive interaction (Protopsaltis & Baum, 2019). Specifically, researchers have attempted to establish best practices or standards which outline the need for student-instructor interaction but are not explicit in how the student-instructor interaction occurs. Since there are numerous ways that student-instructor interaction can occur (e.g. email,

synchronous chat, discussion, etc.) institutions must understand how interaction occurs in online courses at their institution or face similar scrutiny.

Purpose of Study

Given the aforementioned problem, the purpose of this study was to explore the frequency of interaction between instructors and students in discussion boards in online courses at the University of Colorado Denver. The results will help instructors and administrators at the CU Denver better understand how instructors and students are interacting in online courses. This research can be used to inform instructional designers and instructors and guide instructional strategies for online courses at CU Denver as well as other institutions. Additionally, this exploratory research can serve as an example of how data from Canvas (a leading LMS) can be used to inform practice that supports quality teaching and learning.

Theoretical Framework

This study was framed by Moore's (1989) theory of interaction in distance learning. While Moore was originally focused on distance learning in general, his theory of interaction is relevant and applicable to online learning. Moore (1989) identified three types of interaction: learner-content interaction, learner-instructor interaction, and learner-learner interaction. Learner-content interaction refers to the interaction of the learner with the subject matter. Moore (1989) described student-content interaction as "… the process of intellectually interacting with the content that results in changes in the learner's understanding, the learner's perspective, or the cognitive structures of the learner's mind" (p. 2). Learner-instructor interaction references the dialogue between the instructor and student, but also includes how the instructor motivates the learners,

presents or demonstrates information, provides feedback, and supports and encourages the learners (Moore, 1989). The separation of instructor and student in online courses creates gaps in communication between the student and instructor, but also creates psychological challenges for the student (Moore, 1997) In order to address the challenges of separation, Moore (1997) suggested an increase of dialogue between student and instructor could create a decreased sense of transactional distance. Finally, the third type of interaction is learner-learner interaction. According to Moore (1989), learner-learner interaction is important in the learning process and challenges traditional ideas of teaching and learning. Together, the three types of interaction provide a framework that can enable educators to be more thoughtful and purposeful about how they teach online (Falloon, 2011).

Although all three types of interaction are equally important to the online learning experience, when considering student perception of learning, learner-instructor interaction has been found to be the most important type of interaction for predicting satisfaction (Hong, 2002; Jung, Choi, Lim, & Leem, 2002; Kuo, Walker, Bellard, Schroder, & Kuo, 2014; Swan, 2004). Hong (2002) concluded that "interaction with the instructor was the most significant contributor to satisfaction and learning in web-based courses" (p. 278). Based on these results, Hong (2002) concluded that active participation by the instructor could increase student participation and would increase learning. Similarly, Dennen, Darabi, and Smith (2007) found that "posting to discussion board" was ranked by students as the second most important action by an instructor, below checking email (p. 74). Therefore, Dennen et al. (2007) recommended that instructors

prioritize interactions and focus on maintaining frequency of contact, having a regular presence in class discussion spaces, and making expectations clear to learners.

Moore's theory offers a lens which can be used to identify ways in which students and instructors interact. Interactions can occur synchronously or asynchronously, and instructors can facilitate these interactions with a variety of technologies, such as web conferencing, chat, discussion boards, and email (Sher, 2009). Discussion boards are widely used in online teaching, allowing interaction to occur without being limited by time or space (Hew, Cheung, & Ng, 2010). In discussion boards, participants are able to see discussion posts of others, organized by author, topic, and date/time and respond to them on their own time (Brown & Green, 2009). Several studies have found that when instructors participate in discussion boards students are more motivated (Xie, DeBacker, & Ferguson, 2006), students are more satisfied (Sher, 2009), and instructor participation is highly valued by students (Nandi, Hamilton, & Harland, 2012). This increase in dialogue between student and instructor can not only reduce transactional distance but serve as a way to meet regular and substantive interaction requirements for online courses.

Overview of Research Methods

This study was conducted at the University of Colorado Denver. Like many institutions, CU Denver has been challenged with how to increase online enrollments while continuing to provide quality online courses among increased competition from other institutions. Since learner-instructor interaction has been found to be an important factor for improving student satisfaction, this study explored the frequency of interaction between instructors and students in discussion boards in online courses at the University

of Colorado Denver. The following paragraphs provide a brief overview of the methods used to conduct this study.

Research Questions

This exploratory study specifically aimed to provide a campus wide analysis of the student-instructor interactions in online discussion boards in fully online courses. More specifically, this study sought to answer the following questions:

1. How do instructors interact in asynchronous discussions in online courses?
2. How do students interact in asynchronous discussions in online courses?
3. How do students and instructors interact each week in asynchronous discussions in online courses?
4. Is there a relationship between asynchronous discussion interaction measures and student satisfaction?

Sample

This study examined discussion board interactions in online courses, taught during two semesters, fall and spring, at CU Denver. In an effort to maintain the privacy of the instructors and students, the academic year was not disclosed. All courses at CU Denver are populated into the LMS; thus, courses that were not online or that were not active in the LMS were excluded from the sample. The courses selected for the study met the following criteria: had only one instructor, did not have teacher assistants (TAs) assigned to the course, had more than five students, and had end-of-course evaluation scores published in the public database. Courses that did not meet the criteria were removed from the sample. 415 courses met the criteria of the sample.

Data Collection and Analysis

This study utilized archival data from two sources, Canvas Data and end-of-course evaluation data. Data from the LMS, Canvas, was exported from the Amazon cloud and imported into Exasol, a high performance, in-memory database. End-of-course evaluation data was downloaded into a spreadsheet from a publicly accessible database. A query was run in Exasol to create a comprehensive list of online courses offered during the period of the study. In addition to course data, unidentified discussion data from each course was extracted. This data was combined to create the data set for this study. Courses that did not meet the requirements of the study, or courses with missing data were removed from the sample. In addition, all identifying information was removed from the data.

Preliminary data analysis was performed using Tableau. Tableau makes it easy to explore the variables in the dataset through frequencies, descriptive statistics, and cross-tabulations. Each analysis is a visualization designed to improve the interpretation of the data. Once the initial analysis was complete, the dataset was exported to an Excel file and imported into IBM SPSS Statistics for the statistical analysis. To determine if there was a relationship between discussion board interaction measures and student satisfaction, a Spearman correlation was selected as the non-parametric technique to determine if a correlation existed between the two variables. A Spearman correlation was selected due to the not normal distribution of the variables (Pallent, 2013).

Chapter Summary

The number of students taking online courses continues to grow and institutions are investing in their online courses and programs. However, online courses are often

criticized for being inferior to face-to-face courses. One way to increase student satisfaction is through learner-instructor interaction. Therefore, the purpose of this study was to explore the frequency of interaction between instructors and students in discussion boards in online courses at the University of Colorado Denver. Based on Moore's (1989) theory of interaction in distance learning, this exploratory study conducted a campus wide analysis of the learner-instructor interactions in online discussion boards. This study used Canvas Data and end of course student evaluations at CU Denver. Descriptive statistics were used to answer the first three research questions. The fourth question was answered by a Spearman correlation test.

CHAPTER TWO: LITERATURE REVIEW

As institutions continue to increase the number of online courses they offer to meet growing demand, many have struggled with how to ensure student satisfaction and quality online learning experiences. One solution is to examine the interactions between instructors and students in these online courses since researchers have established the importance of interaction in online learning (Anderson, 2003; Bates, 1990; Moore, 1989; Muirhead & Juwah, 2004). While there are different types of interaction noted in the literature, learner-instructor interaction has been found to be the most important type of interaction for predicting student satisfaction (Hong, 2002; Jung et al., 2002; Kuo et al., 2014; Swan, 2004). Discussion boards are a tool within the learning management system which are widely used to facilitate learner-instructor and learner-learner interaction (Nandi et al., 2012; Zhou, 2015). This exploratory study explored how instructors and students interacted in online courses and the relationship between these interactions and student satisfaction.

The literature reviewed in this chapter provides further insight into how discussion boards are used to facilitate interactions in online courses. Additionally, this chapter discusses the need for further research to identify quantifiable measures for online course quality in order to assist institutions in developing standards for interaction between students and instructors in online courses.

Online Learning

With an extended history of nearly two centuries, distance education has evolved with changing technological and pedagogical advances (Kinshuk, Chen, Cheng, & Chew, 2016). Distance education was first established as correspondence courses in the 1800s (AECT, 2017). Correspondence courses are courses delivered outside the regular classroom (AECT, 2017). Correspondence courses, for the first time, enabled students to learn at a distance. Distance education grew in popularity with the introduction of radio and television in the 1950s (AECT, 2017). However, even with addition of radio and television to transmit content, the interaction between instructors and students in correspondence courses took considerable time, as the courses usually relied on postal services to exchange learner-instructor communications (Aydemir, Ozkeskin, & Akkurt, 2015). The introduction of personal computers and computer-mediated communication technologies (e.g, email) sped up this communication between student and instructor throughout the 1980s and 1990s and in many ways transformed early correspondence distance education (Aydemir et al., 2015).

Most recently, increased access to the Internet, the ability to communicate using a variety of tools, and evolving technology has created a variety of different opportunities for teaching and learning at a distance (Adams Becker, Cummins, Davis, Freeman, Glesinger Hall, & Ananthanarayanan, 2017). As technology has evolved, though, practitioners and researchers have found it difficult to agree on common terminology in the field of distance education (Lowenthal, Wilson, & Parrish, 2009). Online education is the most commonly used term to describe technology-mediated distance education—that is, teaching and learning that usually takes place in some type of learning management

system (Lowenthal et al., 2009). Nowadays, learning management systems offer both synchronous and asynchronous methods of communication; however, asynchronous methods are still the dominant form of communicating in online learning (Hrastinski, 2008; Parry, 2009). The asynchronous format allows learners to participate on their own time, increasing the flexibility and fulfilling the initial purpose of distance education, the ability to learn anytime, anywhere. Particularly in higher education, most online courses rely predominately, if not solely, on asynchronous communication (Fadde & Vu, 2014).

In this type of online education, which is sometimes referred to as asynchronous online learning, the course is led by an instructor, has a set schedule, and is conducted in a learning management system (Lowenthal et al., 2009). This delivery method is popular in higher education because learners have the convenience of engaging with course materials and activities in a controlled environment, which takes into account issues of privacy while providing a common structure between courses (Fadde & Vu, 2014). However, Fadde and Vu (2014) note that asynchronous online instruction lacks social and personal engagement and can feel impersonal and lack meaningful and substantial interaction. Feelings of an impersonal experience and limited interactions contributes to the ongoing criticism of online learning, which is still believed by many to be poor quality and inferior to face-to-face teaching (Shelton, 2011; Singh & Hurley, 2017).

Quality Concerns

As online learning continues to grow, it still struggles to build credibility with its critics. An increased demand for institutional accountability and continued skepticism of a new way of teaching and learning are two challenges that online learning continues to face (Shelton, 2011). Some critics believe that online learning is not as rigorous as face-

to-face education (Singh & Hurley, 2017), while others point to issues of quality, that range from students to the curriculum, and from instructional design and instructor characteristics to technology (Meyer, 2002). Kebritchi, Lipschuetz, and Santiague (2017) recently identified the issues and challenges raised in the research about the quality of online learning and categorized them into the following three areas: learner issues, content issues, and instructor issues.

Learner Issues

Kebritchi et al. (2017) identified these four issues under the category of learner issues: expectations, readiness, identity, and participation (see Table 2.1). Expectations refers to what the student expects from the course or instructor. For instance, students might expect online learning to be easier than traditional face-to-face courses. Or students might expect 24/7 access to their instructor with immediate grading and feedback. In some cases, these expectations can appear rude or demanding in asynchronous forms of communication, such as email (Kebritchi et al., 2017). Readiness refers to a student's ability to be successful in an online course. Readiness includes being self-motivated and self-directed, as well as the skills and abilities needed to be successful learning online (Kebritchi et al., 2017). Most students have little experience learning online in a formal setting and therefore it is often an adjustment for most students. On top of this, some research suggests that lack of motivation alone is the primary reason why students drop online courses (Morris, Finnegan, & Wu, 2005). Identity in the context of learner issues refers to students feeling a sense of belonging and a part of an online community in the online courses they take (Kebritchi et al., 2017). Without a strong sense of identity, learners often report feeling isolated and disconnected (Gillett-Swan, 2017). Last but not

least, participation refers to how a student interacts with peers and the instructor in their online courses but can also refer to the time they spend reading or completing other activities (Kebritchi et al., 2017). In order to increase interaction, participation is sometimes a graded requirement in online courses. Grading may be based on the number of discussion board posts or some other measure identified by the instructor. The importance of participation, student discussions, and the creation of meaningful learning environments has been written about extensively in the literature (Morris et al., 2005).

Table 2.1 Learner Issues in Online Courses as Described by Kebritchi et al. (2017)

Issue	Description
Expectations	Some learners may have inappropriate expectations, such as response times for feedback and assignment deadlines.
Readiness	Learners may not be prepared for online learning. Learners must be self-motivated and self-directed as well as have the technical skills and communication to participate in an online course. Additionally, learners must be able to direct their own learning to some degree.
Identify	Learners may feel isolated and disconnected, which may affect learning.
Participation	Learners must participate and engage in the online course. There is not a clear guideline to the type or amount, but is identified as a major issue.

Content Issues

Kebritchi et al. (2017) also identified the following four issues in terms of content issues with online learning: the role of the instructors in content development, integration

of multimedia in content, role of instructional strategies in content development, and considerations for content development (see Table 2.2). The role of the instructor in content development has two distinctly different issues. Increasingly, online instructors teach online courses that have been developed by someone else with predefined content, which in turn reduces the online instructors' ability to shape the course by their own experiences and the experiences of the students in the class (Kebritchi et al., 2017). However, in cases where the instructor is responsible for planning and creating content, many instructors lack the skills, support or proper training to develop online courses (Kebritchi et al., 2017). The integration of multimedia can also be an issue in online courses. This refers to the use of best practices to incorporate multimedia into online courses (Kebritchi et al., 2017). The use of multiple types of learning tools and specifically media has been identified as an important aspect of improving student engagement (Hathaway, 2014). In fact, the Universal Design for Learning framework highlights the importance of providing content in multiple modalities (Tobin & Behling, 2018). However, despite the importance of this, most online instructors lack the experience or expertise to meaningfully integrate multimedia into the courses that they teach. Kebritchi et al. (2017) also found that there are quality issues with the content and instructional strategies used in online learning. A number of best practices have been developed that includes strategies for designing and delivering online learning. For example, the Quality Matters (QM) Course Design Rubric is a set of eight standards with 42 specific standards used to evaluate the design of an online course (Quality Matters, n.d.-a). Alternatively, the California State University system (CSU) created the Quality Learning and Teaching framework which contains 53 items spanning both design and

delivery (California State University, n.d.-a). The last quality issue Kebritchi et al. found related to content was focused on content development (Kebritchi et al., 2017). The literature suggests that online learning suffers from poor course organization as well as the lack of meaningful content and assignments that align to learning outcomes and course objectives (Kebritchi et al, 2017).

Table 2.2 Content Issues in Online Courses as Described by Kebritchi et al. (2017)

Issue	Description
Development and instructors	In some cases, content is predefined, causing a lack of empowerment. In other cases, instructors are responsible for preparing and planning content which is challenging. Additionally, instructors may not wish to change their teaching strategies when transitioning to teaching online or may not have the training and support or incentives to design and deliver an online course.
Content and multimedia	Multimedia needs to be thoughtfully and strategically incorporated in the design of an online course.
Content and instructional strategies	Best practices for designing and delivering an online course should be utilized. Instructors must receive training and support when incorporating best practices into an online course.
Content and consideration	Courses should be laid out clearly and presented in a meaningful way. All assignments, outcomes, and objectives should be aligned. Both formative and summative assessment is important in online learning.

Instructor Issues

Kebritchi et al. (2017) also identified the following four issues instructors face when teaching online: changing role of the faculty, transition from face-to-face to online,

time, and teaching styles (see Table 2.3). The changing role of the faculty refers to the multiple skills needed by online instructors. For instance, Berge (1998) identified four different roles of online instructors: pedagogical, social, managerial, and technical. A pedagogical role includes the delivery of content and teaching. A social role includes relationship building, while a managerial role would include management and organizational skills. A technical role would include providing technical support to students and being able to use technology. Many instructors have prior experience serving in some of these roles but others such as the technical are new for many instructors. Related to the changing roles, the literature suggests that many instructors find it challenging to transition from face-to-face to online teaching because teaching online requires a difference set of skills than they had previously used teaching face-to-face (Kebritchi et al., 2017). Time is another issue faced by online instructors. Developing online courses and teaching online takes time. In fact, many online instructors report that it takes more time than teaching face-to-face. Some online instructors find themselves neglecting their online teaching roles or not spending enough time on them simply because designing the course in the first place took much more time than they originally anticipated (Jacobs, 2013). The last issue reported in the literature with online learning focuses on teaching styles. An instructor's teaching style is influenced by their beliefs about teaching and learning as well as how they deliver content, interact with and mentor students (Quitadamo & Brown, 2001). Teaching styles includes the use of best practices to support student learning and improve online instructors' teaching effectiveness (Kebritchi et al., 2017).

Table 2.3 Instructor Issues in Online Courses as Described by Kebritchi et al. (2017)

Issue	Description
Changing role of the faculty	Online instructors hold a variety of roles and can be challenged by designing, delivering, and following up.
Transition from face-to-face to online	Online instructors are challenged by effectively transferring their face-to-face classroom to an online environment. Instructors often struggle with the delivery of content and engagement of their students without visual cues and face-to-face contact. Instructors may have difficulty adjusting content to a more student-centered model. Some instructors are not interested in teaching online or are not comfortable with the technology.
Time	Teaching online is very demanding and often requires a greater commitment of time.
Teaching styles	Online instructors must adopt effective teaching styles and improve their effectiveness.

Due to increased accountability and competition among online programs, institutions recognize the need to continue to improve the quality of online education (Shelton, 2011). However, as Kebritchi et al. (2017) pointed out, there are a range of factors which influence course quality including the student, instructional design, course content, and instructor characteristics. Although the number of factors which affects the quality of online learning seems daunting, institutions are looking for ways to evaluate online learning quality and continue to improve their online courses and programs. One way institutions are supporting quality online learning is through the implementation of online teaching standards or guidelines for teaching. Online teaching standards can be

used in the creation of online courses or as a method to evaluate the quality of online learning (Lowenthal & Davidson-Shivers, 2019). Furthermore, instructor support in the form of training, compensation, and policy, and student support in the form of student services are other ways institutions are working to improve online learning (Shelton, 2011).

Online Teaching Standards

Even though a lack of "quality" is often cited when confronted with the challenges of online education, Meyer (2002) was quick to point out that quality is a complex and difficult concept with no one single definition. However, with the increased growth and interest in online learning, coupled with the continued criticism that online learning is not as good as face-to-face learning, practitioners and researchers have developed standards or quality assurance frameworks to facilitate both the development but also evaluation of online learning. These standards and frameworks are often shared as rubrics or checklists and are often developed for a specific purpose (e.g., quality course design) or context (e.g., higher education) (Lowenthal & Davidson-Shivers, 2019). In the following paragraphs, some popular online learning standards are discussed.

Seven Principles of Good Practice

One of the oldest and widely accepted guidelines for both online and face-to-face teaching is Chickering and Gamson's Seven Principles of Good Practice (Chickering & Gamson, 1999; Hathaway, 2014; Johnson, 2014; Lai & Savage, 2013; Tobin, Mandernach, & Taylor, 2015) Chickering and Gamson (1987) did not intend to make recommendations about "what" should be taught, but rather "how" undergraduate

education should be done (p. 2). Working with a group of researchers, they identified seven guiding principles of good practice:

1. Encourage contact between students and faculty
2. Develop reciprocity and cooperation among students
3. Encourage active learning
4. Gives prompt feedback
5. Emphasizes time on task
6. Communicates high expectations
7. Respects diverse talents and ways of learning (Chickering & Gamson, 1987).

While these guidelines were created to help instructors teaching undergraduate face-to-face courses, online educators quickly began applying them to online learning (Bangert, 2004). For example, Graham, Cagiltay, Craner, Lim, and Duffy (2000) used the seven principles to evaluate four online courses at a large midwestern university. Graham et al. (2000) were hoping to provide recommendations regarding the strengths and areas for improvement in the online courses offered by the university. They analyzed the courses and conducted instructor interviews. The evaluation tool that they used to analyze the courses provided a description of each of the seven principles of good practice, outlined the strengths identified by the researchers, and offered areas for improvement and recommendations (Graham et al., 2000). Since the seven principles of good practice focus on teaching, the researchers also used some Human Computer Interface design principles to evaluate and identify areas for improvement and recommendations based on the design of the course as well (Graham et al., 2000). As a result of this research, Graham, Cagiltay, Lim, Craner, and Duffy (2001) were able to identify behaviors of

instructors which correlated to the seven principles, such as setting clear standards for responding to messages. For example, an instructor might put in writing, "I will make every effort to respond to email within two days of receiving it" (Graham et al., 2001, p. 2). Another behavior Graham et al. (2001) observed was instructors providing both information feedback and acknowledgement feedback. Information feedback provided information, such as an answer to a question or a grade on an assignment. Acknowledgement feedback was confirmation that an event, like an email, had occurred. Graham et al. (2001) found that acknowledgement feedback was used less frequently but suggested that instructors should use acknowledgement feedback because it translates to implicit actions in a face-to-face classroom such as eye contact to acknowledge an instructor heard a student.

Later, Bangert (2004) clarified the relationship between constructivist-based teaching practices and the seven principles as they relate to online design and delivery. While Graham et al. (2001) focused more on evaluating the design of online courses, Bangert's work is one of the first examples of using the seven principles to evaluate online teaching. Bangert (2004) used the seven principles of good practice to design a 35-item questionnaire to assess the effectiveness of an online statistics course. The survey was designed to provide online instructors better feedback about the effectiveness of their teaching practices. Results from the study suggested that the seven principles of good practice could be used as an effective way to improve student satisfaction; the results from the survey also demonstrated that students in this sample valued the online learning experience. While a number of the more recent standards and quality assurance frameworks have moved beyond simply relying on Chickering and Gamson's seven

principles, a number of the current online teaching standards were influenced in some way by Chickering and Gamson's work (Baldwin & Trespalacios, 2017).

Quality Learning and Teaching (QLT) Framework

The California State University system (CSU) created the Quality Learning and Teaching (QLT; formerly QOLT) framework. The QLT framework was informed by the seven principles as well as other popular models for assessing teaching (California State University, n.d.-a). The instrument contains 53 items across the following nine sections, with an optional tenth section containing four items. The ten sections are:

1. Course overview and introduction
2. Assessment of student learning
3. Instructional materials and resources
4. Students interaction and community
5. Facilitation and instruction (course delivery)
6. Technology for teaching and learning
7. Learner support and resources
8. Accessibility and universal design
9. Course summary and wrap-up
10. Optional: Mobile platform readiness (California State University, n.d.-a).

In order to determine the impact of this framework, CSU is currently researching teaching performance and student success in online courses taught at CSU (California State University, n.d.-b). According to their website, the project aims to determine if "instructors who complete QA professional development and obtain course certification are better able to design and deliver online courses, more effectively engaging students

and resulting in higher grades, improved course completion rates, higher student satisfaction, and ultimately a reduction in equity gaps" (California State University, n.d.-b). According to the website, the research will conclude in June 2020. However, some preliminary results show that DFW rates, i.e., the number of students earning a D, F, or W, was less in courses taught by instructors who completed the rigorous QA professional development and had obtained a course certification (California State University, n.d.-b).

OLC Course Design Review Scorecard

The Online Learning Consortium (OLC) is a leader in online learning and partners with institutions and higher education leaders to advance the quality of online learning (Online Learning Consortium, n.d.-a). The OLC developed the Five Pillars of Quality Online Education framework based on the following five building blocks: learning effectiveness, faculty satisfaction, student satisfaction, scale, and access (Online Learning Consortium, n.d.-b). The OLC provides institutions with criteria and benchmarking tools to assist in providing institution wide online learning excellence which cover administration, blended learning, quality course teaching and instructional practices, digital courseware, and online student support (Online Learning Consortium, n.d.-a). This comprehensive approach is for institutions interested in implementing best practices and improving the quality of online education across many areas of the institution.

For individual course evaluation, the OLC has partnered with the SUNY system to create the OSCQR Course Design Review scorecard (Online Learning Consortium, n.d.-a). This scorecard focuses on the instructional design and accessibility of online courses in the following six key areas:

1. Course overview and information
2. Course technology and tools
3. Design and layout
4. Content and activities
5. Interaction
6. Assessment and feedback (Online Learning Consortium, n.d.-c).

The scorecard, like most current standards and quality assurance frameworks, can be used to identify and target areas for improvement. For example, Baker College used the OLC Quality Scorecard to benchmark and determine gaps in their current online courses (Online Learning Consortium, n.d.-d). Then, after prioritizing areas of improvement, made changes to their online courses. After reevaluating their courses using the rubric, they received OLC's Exemplary Endorsement which spoke to the improvement of their online courses (Online Learning Consortium, n.d.-d). In another case study, Middle Tennessee State University used the OLC Quality Scorecard for the Administration of Online Programs to evaluate and benchmark their online courses (Online Learning Consortium, n.d.-d). After seeing the results, the university is committed to hiring a dedicated manager of program quality and continuing to improve their online courses and programs (Online Learning Consortium, n.d.-d).

Quality Matters Course Design Rubric

Currently in its sixth edition, the Quality Matters (QM) Course Design Rubric is a set of eight standards with 42 specific standards used to evaluate the design of an online course (Quality Matters, n.d.-a). According to the QM website, the rubric should be used

in the creation of online courses and can also be used for assessment or to identify areas for improvement. The eight standards of the rubric are:

1. Course overview and introduction
2. Learning objectives (competencies)
3. Assessment and measurement
4. Instructional materials
5. Learning activities and learner interaction
6. Course technology
7. Learner support
8. Accessibility and usability (Quality Matters, n.d.-a).

In the United States, QM is a widely used rubric to help create and evaluate the design of online courses (Lowenthal & Davidson-Shivers, 2019). Developed out of a grant from the U.S. Department of Education in 2003, the program has grown into a global organization focused on using research-supported and practice-based quality standards with over 60,000 members (Quality Matters, n.d.-b). Over 500 articles reference QM in their work and over thirty articles and presentations are identified on the Quality Matter website as addressing the impact of QM on online teaching (Quality Matters, n.d.-c). For example, in 2016, Kwon, DiSilvestro, and Treff conducted a small study comparing student evaluation to peer instructor evaluations of the same course using Quality Matter standards. Kwon et al. (2016) identified Quality Matters as the basis for the study because Quality Matters had a significant body of research surrounding its standards. Results from this study revealed a few areas of improvement for the courses in the study including accessibility, technical support, course orientation, and explanation of

instructional materials (Kwon et al., 2016). In a study to evaluate if a sample of MOOCs (Massively Open Online Course) could meet the same quality standards as traditional online courses, researchers Lowenthal and Hodges (2015) used the Quality Matters rubric to evaluate six MOOCs from three companies, Coursea, edX, and Udacity. Following a standard QM review process, three trained reviewers reviewed six MOOCs and discovered that although no MOOC met the standards, with revision, at least two of the six courses could have been determined "quality" based on the QM standards (Lowenthal & Hodges, 2015).

Similarities and Differences in Online Teaching Standards

One can look at the four standards described above and see some similarities as well as differences that exist (see Table 2.4). For example, the Quality Matters course design rubric primarily focuses on the course organization and instructional design of the course, while the Seven Principles of Good Practice emphasizes the standards to evaluate teaching. And although a course must be well-designed and taught well, the majority of these rubrics tend to focus more on the design of the course, than teaching (Lowenthal & Davidson-Shivers, 2019).

Table 2.4 Comparison of Popular Frameworks for Online Teaching Standards

Seven Principles of Good Practice	Quality Learning and Teaching (QLT)	OLC Course Design Review Scorecard	Quality Matters Course Design Rubric
Encourage contact between students and faculty Develop reciprocity and cooperation among students Encourage active learning Gives prompt feedback Emphasizes time on task Communicates high expectations Respects diverse talents and ways of learning	Course overview and introduction Assessment of student learning Instructional materials and resources Students interaction and community Facilitation and instruction (course delivery) Technology for teaching and learning Learner support and resources Accessibility and universal design Course summary and wrap-up Optional: Mobile platform readiness	Course overview and information Course technology and tools Design and layout Content and activities Interaction Assessment and feedback	Course overview and introduction Learning objectives (competencies) Assessment and measurement Instructional materials Learning activities and learner interaction Course technology Learner support Accessibility and usability

One commonality across all four rubrics is the importance of interaction. In fact, Baldwin, Ching, and Hsu (2018) recently compared the quality assurance rubrics discussed so far, as well as some others, and identified similarities across online quality assurance rubrics; they noted that learner-learner interaction was identified in all the rubrics they reviewed. In the case of the Seven Principles of Good Practice, interaction is explicit in the first principle, which states to "encourage contact between students and

faculty" and the second principle which states to "develop reciprocity and cooperation among students." While each principle stands on its own, interaction is an important theme throughout all of the Seven Principles of Good Practice (Chickering & Gamson, 1987). In the QLT framework, interaction between students' and instructor's participation are referenced in section 4 and section 5 of the rubric. In section four, the rubric states to "addresses the opportunities students have to interact with the content, their peers, and their instructor" (California State University, n.d.-a); section five includes ways the instructor might communicate with students, including by focusing discussions and providing feedback (California State University, n.d.-a). The OLC Course Design Review Scorecard lists interaction as its fifth key area. The rubric lists seven sub areas of interaction including: expectations around timely and regular feedback from the instructor, clearly stated expectations for interaction, opportunities to get to know the instructor, resources and activities that are intended to build a sense of class community, open communication and trust, opportunities for learner to learner interaction, and finally an opportunity for learners to share resources and inject knowledge in their course interactions. Finally, in the Quality Matters standards, interaction is identified in the fifth standard, learning activities and learner interaction. In this standard, interaction is observed through ensuring learning activities provide opportunities for interaction and that the instructor's plan for interacting with learners during the course is clearly stated (Quality Matters, n.d.-d).

In all of these popular rubrics for evaluating online learning quality in higher education, as well as various others (see Baldwin et al., 2018), interaction is identified as an important component. However, each rubric provides a slightly different description

of what interaction means and how it is measured or observed, thus further complicating a foundational aspect of quality online learning.

Interaction in Online Learning

Although interaction has been found to be critical for learning and is an element in all of the mainstream quality assurance frameworks for evaluating online learning, interaction has been difficult to define (Anderson, 2003; Bates, 1990; Bowers & Kumar, 2015; Moore, 1997). In an effort to more clearly define "interaction," Moore (1989) introduced three types of interaction as a way to build a common vocabulary around education at a distance, regardless of the media used—that is, learner-content interaction, learner-instructor interaction, and learner-learner interaction. In particular, learner-instructor interaction has been found to be the most important type of interaction for predicting student satisfaction (Hong, 2002; Jung et al., 2002; Kuo et al., 2014; Swan, 2004). In fact, Moore (1989) highlighted the importance of learner-instructor interaction when he stated that, "...frequency and intensity of the teacher's influence on learners when there is learner-teacher interaction is much greater than when there is only learner-content interaction" (p. 2).

One of the challenges of interaction in online learning is the feeling of disconnect both instructors and students sometimes report feeling (Gray & DiLoreto, 2016). Classroom instructors are experienced at scanning the classroom for body language, facial expressions, and other cues which may signal students' understanding (Li, Moorman, & Dyjur, 2010); this behavior becomes second nature as does other techniques, such as pausing for understanding, asking clarifying questions, and engaging students in active learning (Gray & DiLoreto, 2016). Online instructors teaching

primarily asynchronous courses, on the other hand, are not able to rely on body language as clues to a student's comprehension (Huang & Hsiao, 2012). Not being able to rely on this type of feedback can leave an online instructor feeling unsure if their teaching is effective. For example, Huang and Hsiao (2012) found that although instructors enjoyed online teaching because it offered flexibility and a diverse student population, instructors struggled with asynchronous communication because they believed it created a disconnect between the students and the instructor. However, instructors who used synchronous web conferencing believed the medium helped them reduce communication barriers and addressed feelings of "distance" between instructors and students (Huang & Hsiao, 2012).

At the same time, and sometimes due to an instructor's inability to read students' body language, students regularly report feeling disconnected and alienated and therefore dissatisfied with online learning (Bowers & Kumar, 2015). Bowers and Kumar (2015) explained how the absence of face-to-face contact with peers and the instructor can create a psychological distance which leads to feeling disconnected or isolated. This feeling, felt by both instructors and students, aligns with transactional distance theory; the idea that the increased physical distance that is a part of online education requires a shift in the elements of structure, dialogue, and autonomy in order to compensate for the physical distance (Moore, 1997).

Transactional Distance Theory

Moore's transactional distance theory is an important theory in describing the interactions of instructors and students who are separated by time and space (Gorsky & Caspi, 2005). According to Moore (1997), transactional distance is the interplay between

the environment, individuals, and behaviors in a situation. In an online learning environment, the instructor and students and their behaviors associated with the experience of teaching and learning at a distance, makes up the transactional distance. Moore (2012) claimed that the ability for variable transactional distance allows for the flexibility of online learning. The variations of dialogue, structure, and autonomy within an online course defines the extent of transactional distance (Moore, 2012). This idea is a basic framework for understanding how to design and deliver an online course and is defined by three variables: dialogue, structure, and learner autonomy.

Moore (1997) explained that dialogue refers to the interpersonal interaction that occurs in a course between the instructor and student. Dialogue and interaction are often used interchangeably. However, Moore (1997) defined dialogue "to describe an interaction or series of interactions having positive qualities that other interactions might not have" (p. 23). Moore (1997) explained that dialogue is a respectful and purposeful conversation between two parties, where each contributes and listens to the other. In earlier work, Moore (1989) referred to this interaction as learner-instructor interaction and learner-learner interaction. The frequency and quality of these interactions vary depending on other course variables, but may include counsel, support, or encouragement (Moore, 1989, 2012). Different types of communication mediums (e.g., text, audio, synchronous video, asynchronous video) will also have an effect on the quality of dialogue between instructor and learner (Moore, 1997, 2012).

As defined by Moore (1997), structure refers to the elements of course design in an attempt to determine the rigidity or flexibility of the educational objectives, teaching strategies, and evaluation methods. The structure is often related to the design of the

course. For example, the course may require all students to follow a schedule for reviewing course materials and offer specific timing on discussion activity (Moore, 2012). Moore (2012) provided the example of a recorded video program as a highly structured, since there are no opportunities for students to explore the video based on personal needs. A course with less structure may have multiple paths for students to explore. The tasks and assignments in the course may be more flexible, allowing students more autonomy in their learning (Moore, 2012).

Learner autonomy refers to the learners' ability to control their own learning. According to Moore (1997), full autonomy means that the learner has control over what they learn, the methods in which they learn, has the motivation to learn, and can evaluate their own learning. Even in a fully autonomous learning environment, dialogue and structure may exist. Specifically, in online learning, learners need to at least have self-management and self-motivation (Moore, 2012). The concept of learner autonomy is important in describing transactional distance because as transactional distance increases, the more learners must act autonomous (Moore, 2012).

Interaction is a defining feature of Moore's theory. Interaction occurs in terms of dialogue- communication between student and instructor or between student and student. The structure of an online course is described as the experience of the learner at a distance. Autonomy can be tied to the interactions that occur between the learner and the content. The give and take of these interactions influence student engagement, the learning experience, and student satisfaction. (Anderson, 2003; Bower & Kumar, 2015; Garrison, Anderson, & Archer, 2000). Moore (2012) describes the relationship between the variables and their effects on interaction, by explaining as dialogue decreases,

transactional distance increases, as the opposite is true, as dialogue increases transactional distance decreases. For example, a self-paced course, one that allows a student to work through content at their own pace, likely is highly structured, but has little or no dialogue with an instructor. Whereas a virtual conference, where students and the instructor meet synchronously via a web conferencing platform, likely has less structure and allows for more dialogue to occur between the students and the instructor (Moore, 2012). However, synchronous exchange is not the only way to lower transactional distance, as described by the differences in learner autonomy in an online class.

Three Types of Interaction

Interaction has been identified as a major theory in distance education research (Moore, 1989; Wagner 1994). As previously mentioned, Moore (1989) identified three types of interaction: learner-content interaction, learner-instructor interaction, and learner-learner interaction. Learner-content interaction refers to the interaction of the learner with the subject matter. Learner-instructor interaction references the dialogue between the instructor and student, but also includes how the instructor motivates the learners, presents or demonstrates information, provides feedback, and supports and encourages the learners (Moore, 1989). Finally, the third type of interaction is learner-learner interaction which describes interaction among individual students or among students working in a group.

Learner-content interaction

Learner-content interaction refers to the time a learner spends with course content or subject of study, such as reading textbooks or articles, reviewing PowerPoints and web pages, or watching videos (Zimmerman, 2012). As Moore (1989) described, interaction with content is in some sense the internal didactic conversations learners have with themselves. Even though interaction with content is the basis of learning, little research has been done on how learner-content interaction applies to course success (Xiao, 2017; Zimmerman, 2012). In a small study, results from correlating weekly quiz grades and time spent completing the quiz suggested that learners who spent more time interacting with content, spent less time on open book quizzes and scored higher (Zimmerman, 2012). The thought was that learners who knew the content from previous interactions with the content, took less time on the quizzes and scored higher (Zimmerman, 2012). Few other studies have focused on the impact of learner-content interaction in distance education (Xiao, 2017). Xiao (2017) laments that learner-content interaction has been taken for granted, when in fact so much is unknown about how learners process learning materials, from printed to video and audio to interactive course materials.

Learner-instructor interaction

Learner-instructor interaction is interaction between the learner and the subject matter expert or instructor (Moore, 1989). Learner-instructor interaction has been found to be the most important type of interaction for predicting learner satisfaction in distance learning (Hong, 2002; Jung et al., 2002; Kuo et al., 2014; Swan, 2004). So much so, that Moore (1989) argued that learner-instructor interaction was essential and highly desirable by learners. Researchers consistently highlight the importance of learner-instructor

interaction throughout the literature (Flottemesch, 2000; Wanstreet, 2006). For example, in a small study, Sher (2009) discovered learner-instructor interaction to be critical in enhancing student satisfaction in an online course. Not only did students appreciate the interaction with the instructor in direct learning, but also in communication around the instruction. In a more recent study, Nandi et al. (2012), discovered that periodic feedback from instructors in discussions was highly valued by students. From this work, Nandi et al. (2012) was able to identify examples of how instructors interacted with students in discussions and noted the various interaction types, from providing guidelines and declaring expectations to promoting deeper learning and providing direct answers or feedback. However, it was unclear if the type of interaction had any positive or negative effect on the value students placed on the interaction.

Kang and Im (2013) researched the types of interactions between learners and instructors. Results from Kang and Im (2013) found that instructional interactions, such as guidance and facilitation of learning, instructional communication, and instructional support, along with the presence of the instructor were more likely to predict learner satisfaction, than social interaction and social intimacy. In fact, social interaction and social intimacy could decrease a learners' perceived satisfaction (Kang & Im, 2013). However, the negative effects of social intimacy are inconsistent with previous research (Kang & Im, 2013). With contradictory research, it may be assumed that all interactions, regardless of the type, can assist in increasing learner satisfaction in online learning.

Learner-learner interaction

Learner-learner interaction is the third type of interaction identified by Moore (1989). In early distance learning, such as correspondence courses, interaction between

learners did not often exist. However, as technology advanced, synchronous and asynchronous ways of two-way communication became common (Abrami, Bernard, Bures, Borokhovski, & Tamin, 2011). Advances in technology allowed students to work in small groups more easily (Moore, 1989). For example, learners may use synchronously technology, such as video chat or asynchronously communication such as email or discussion boards to collaborate or share knowledge.

However, the importance of learner-learner interaction is still up for debate (Battalio, 2007). Some studies suggest that learner-learner interaction is key to a quality learning experience and can increase student satisfaction and student success. For example, Sher (2009) had students measure their perceived learning and satisfaction as it related to learner-learner interactions and learner-instructor interactions. Both learner-learner and learner-instructor interactions were significant contributors to satisfaction and perceived learning. In addition, in an open-ended response, students specifically enjoyed working with their peers and found it helpful (Sher, 2009). However, not all researchers agree. For example, in a 2017 study, Kurucay and Inan investigated the effects of learner-learner interactions on perceived learning, achievement, and satisfaction. While they did not find a relationship between learner-learner interaction and student satisfaction, they did find that learner-learner interaction had a significant impact on student achievement. In another study, however, Kuo et al. (2014) reported that although learner-instructor and learner-content interactions were important in predicting student satisfaction, learner-learner interaction was not. The lack of agreement on the importance of learner-learner interaction could stem from the challenges of communication, collaboration, and feelings of connectedness when learners are separated by time and space.

Interaction Equivalency Theorem

Moore's three types of interaction was the first model to systematically define interaction. However, Anderson (2003) later developed the interaction equivalency theorem to examine the different types of interactions that occur in online courses and the role these types of interactions on student learning and satisfaction. The equivalency theorem states that in order for deep and meaningful learning to occur, at least one of the three types of interaction must be at a high level (Anderson, 2003). However, high levels of more than one type of interaction will likely be a more satisfying experience. Anderson (2003) acknowledged the value of learner-instructor interaction, but the equivalency theorem showed that even if there was little learner-instructor interaction, high quality learning could still occur if the other types of interaction were at a higher level. Ultimately, more variation and greater amounts of interaction types likely leads to higher satisfaction (Miyazoe & Anderson, 2010).

Using Discussion Boards to Facilitate Interaction

Learning management systems (LMS) are widely used in higher education to facilitate online learning (Zhou, 2015). The LMS provides a variety of tools to facilitate interaction. However, the discussion board is the most commonly used tool within the LMS (Dawley, 2007; Gao, Zhang, & Franklin, 2013; Levine, 2007). Discussion boards are most often used to facilitate interaction, communication, and collaboration within an online course (Gao et al., 2013). Facilitating and participating in discussions is an example of regular and substantive interaction (Poulin, 2016).

Discussion Board Mechanics

Discussion boards allow for communication between two or more people. There are essentially two main components of a discussion board: the discussion topic and the reply. A new discussion is typically started by the instructor. The topic is the focus or question posed for the discussion. When someone replies to the topic, a post is created. However, a student or instructor can choose to reply to the topic or to a previous post. Figure 2.1 shows a screenshot of a discussion board in the Canvas LMS. Each board contains one discussion topic and can have an infinite number of posts. A post can be a reply to the original discussion topic or a reply to another person's post.

Figure 2.1 A Screenshot of a Discussion Board in Canvas

Discussion board functionality varies depending on the learning management system. The Canvas LMS offers additional functionality that expands the capability of discussion boards beyond posting text. For example, the Canvas learning management system allows for features such as embedding images or attaching files, "liking" a post, recording audio or video in addition to written text, and forcing students to post a response before they see the posts of other students. These nontraditional features of

discussion boards allow for alternative communication to occur. In fact, Levine (2007) believed that not only are discussion boards a tool to make online learning comparable to face-to-face learning, but that discussion boards offer unique opportunities for teaching and learning.

Discussion Board Best Practices

Discussion boards provide an asynchronous way for instructors and students to exchange information, elicit responses, create spontaneity, and provide continuous feedback on given topics, much like the features of face-to-face instruction (Darabi, Liang, Suryavanshi, & Yurekli, 2013). Discussion boards are widely used to facilitate learner-instructor and learner-learner interaction (Nandi et al., 2012; Zhou, 2015). However, there are countless suggestions as to the best practices for designing and facilitating online discussions (Levine, 2007). A Google search for "best practices for online discussions" results in millions of results with nearly every institution producing their own curated list of best practices.

For example, The University of Florida's Center for Instructional Technology and Training breaks the best practices down into three categories: (1) Foundation, (2) Moderation, and (3) Focus on the Objective (Center for Instructional Technology and Training, 2016). As described in a 2016 blog post on the University of Florida website, the foundation focuses on making sure students are comfortable accessing and posting to the discussion and encourages clear and specific grading criteria. It is suggested that instructors start off with a low-stakes discussion to get the conversation started. Best practices for moderation of discussions suggests that the instructor participates in discussions by modeling the level and format of responses that is expected of the

students, but also maintain a healthy distance to ensure students have space and time to respond. In addition, it is suggested that a rubric be used for grading and encourages peer review of discussion participation as an added motivator for students. Finally, focusing on the objective encourages instructors to carefully align learning objectives with discussion activities and encourage higher order thinking. Suggestions also include attaching a grade to discussions posts to encourage dialogue and thoughtful contribution.

Purdue University offers more detailed "tips and tricks" for the management and facilitation of online discussions. In a two-page guide, Richardson, Caskurlu, and Ashby (2018) outline 16 suggestions for instructors regarding online discussions. When setting up a course, Richardson et al. (2018) recommends not only setting expectations for what is required for the students, but also setting parameters of how often the instructor will post. For example, the instructor may state, "I'll be in the discussion three times a week." Additionally, they recommend varying discussion prompts to encourage continued engagement from students. During the discussion, Richardson et al. (2018) recommends instructors use student's names, participate often, and ask questions to deepen learning. Among other recommendations, Richardson et al. (2018) encourages instructors to "balance group dynamics" by making sure quiet students participate and no one student dominates the conversation. These strategies are meant to encourage participation and get students reflecting on the course content.

These, and other best practices for online discussions, supports the importance of interaction by both the students and the instructor in online discussions. According to Zhou (2015), "the common understanding of discussion is a conversation or exchange of information on given topics" (p. 2). Therefore, both students and instructors have

responsibilities when it comes to online discussions. In addition to interaction, best practices for designing discussions can assist in fostering community and communication (Covelli, 2017).

Researchers have also looked at best practices for creating and facilitating online discussions. Thompson (2006) identified a number of best practices for discussions to increase active participation in the course from suggestions for structure, to modeling quality responses, to setting expectations and requirements around discussion activity. Similar to the best practices outlined by the University of Florida and Purdue University, Thompson (2006) found that setting up discussions, student participation and instructor participation were key to successful discussion boards. Rovai (2002) focused specifically on strategies that would improve a sense of classroom community, which can decrease the feelings of isolation by students and increase their sense of connectedness. Specifically, Rovai (2002) focused on the instructor's role in the facilitation of discussions and in the course design that would encourage the development of a learning community. Similarly, Fleming (2008) echoed the importance of using best practices for discussions in order to enhance collaborative learning. Specifically, Fleming (2008) suggested that quality discussions took time to design and required more preparation than lecture-based activities.

Several researchers have looked at how grading discussions affects student motivation. Rovai (2003) studied the effects of grading student discussions on student motivation. Results indicated that grading motivated students to increase the number of posts made each week (Rovai, 2003). Not only did students post more when they were being graded but the level of connectedness also increased in courses where students

were graded for discussions. In the study, instructors continued to post the same amount regardless of if the discussion was graded or not. Results from the study suggested that grading discussions was a more effective way to increase student participation than the number of instructor posts (Rovai, 2003). Swan, Schenker, Arnold, and Kuo (2007) found that students who were graded on specific criteria, such as number of posts and quality, were more actively engaged in discussions than students who were just graded on participation. Swan et al. (2007) found that students not only posted more frequently when they had specific criteria to follow, but also posted longer replies. Results from this study indicated that grading criteria for discussions can have an impact on student participation (Swan et al., 2007).

Impact of Using Discussion Boards for Interaction

Researchers have attempted to study the impact of using discussion boards for interaction in online courses. Xie et al. (2006) aimed to uncover the relationship between students' intrinsic motivation and other critical issues affecting participation in discussion boards. The findings indicated that students were more likely to participate in discussions that they perceived as valuable, interesting, and enjoyable. However, students also had increased motivation when the instructor actively engaged in the discussion and guided interactions with other students (Xie et al., 2006). In interviews, most students felt they were more motivated to participate in discussions when the instructor also participated (Xie et al., 2006). Other relevant findings found that instructor's attitude and policies for discussions influenced student motivation. Xie et al. (2006) found some correlations which "seem to suggest that, with instructor emphasis on the value of online discussion, explicit course requirements, and active participation in the discussion, students perceive

the online discussion as valuable and interesting, and will persist in participating" (p. 86). Overall, many factors which affected students' motivation to participate in discussions were linked to the instructor.

However, when Hew et al. (2010) reviewed two case studies where students facilitated their own discussions, it was discovered that many students preferred instructors did not participate in discussions and instead encouraged learner-led discussions. In some cases, students felt the instructor's involvement in discussions was oppressive (Hew et al., 2010). The first case study was of 16 pre service teachers. Approximately half the students felt they learned more and had to "work harder" as the facilitator of their own discussion (p. 586). The majority of students, 88% agreed or strongly agreed that they enjoyed participating more in discussions when the discussion was led by another student. The second case study looked at why students were motivated to participate in student facilitated discussions. Results from this study showed that students were more motivated to participate in discussions where they knew the facilitator, the facilitator encouraged participation, and the facilitator acknowledged and responded to their contributions. Although in the second case study discussions were facilitated by other students, the motivators reflected results from Xie et al. (2006) and other research on student motivation.

Many other researchers, including Nandi et al. (2012) and Darabi et al. (2013) highlight the importance of instructor active participation in discussion boards. Through a case study, Nandi et al. (2012) was able to confirm prior research which validated the fact that instructors must play an active role in online discussions. An active role can vary depending on the subject and context; however, Nandi et al. (2012) found that a balance

of direct answers and facilitation of the conversation through extending or redirecting the discussion were most effective. Lastly, Nandi et al. (2012) emphasized the importance of setting expectations and modeling those expectations is most effective. Darabi et al. (2013) reviewed over 120 publications which examined the use of online discussions as an instructional tool in online learning. Results from their review indicated that instructors who designed discussions which were purposefully structured, monitored and mentored by the instructor saw increased performance by students. Additionally, Darabi et al. (2013) believes that incorporating instructional and pedagogical recommendations, such as regular instructor participation, monitoring, and mentoring led to increased learning by students.

Chapter Summary

Distance education has evolved for nearly two centuries with the introduction of new technological and pedagogical advances. In particular, online learning continues to grow, but struggles to be credible. A lack of quality is often cited as a reason for online learning's subpar reputation. However, quality is difficult to define. A number of frameworks have been developed to assist with assessing the quality of online courses. The Seven Principles of Good Practice, the Quality Learning and Teaching Framework, the OLC Course Design Review Scorecard, and the Quality Matters Course Design Rubric are four of the more popular frameworks. Between the four rubrics, many similarities exist, such as the importance of interaction. However, interaction is difficult to define, and each framework describes it slightly differently. Moore (1997) has explored the importance of interaction when instructors and students have been separated by time and space. Moore (1997) believes in the importance of interaction and has further

defined three types of interactions that are important in distance education. In online learning, interaction often occurs within a learning management system, which offers discussion boards, sometimes referred to as threaded discussions, as one way to interact in an online course. Although other tools exist to facilitate interaction in online courses, discussion boards remain the most popular tool. There are many suggestions for best practices for doing online discussions with the hopes of improving student learning, engagement, and satisfaction.

CHAPTER THREE: METHOD

Enrollments in online courses continue to grow. At the same time, many still remain skeptical of online learning. Given this, institutions of higher education continue to place greater emphasis on ensuring that they are offering quality online learning experiences to the students they serve. One way that they are trying to do this is to ensure that there are regular and substantial interactions in the online courses they offer.

Unfortunately, while the literature acknowledges and emphasizes the importance of interaction in online learning, as described in Chapter 2, there is little consensus on how much interaction is needed in online courses. Therefore, in many ways it is incumbent on institutions of higher education to explore and identify baseline data about learner-instructor interaction and student-student interaction at their own institutions. Aware of this need, this study set out to explore learner and instructor interactions in discussion boards at one institution. More specifically, using data from the learning management system and from end-of-course evaluations, this study investigated how students and instructors at one institution used discussion boards and if there was any relationship between discussion board interaction measures and end-of-course student survey scores.

Research Questions

The focus of this study was to identify how instructors and students interact in the discussion boards in the online courses at CU Denver. More specifically, this study sought to answer the following research questions:

1. How do instructors interact in asynchronous discussions in online courses across an entire semester?
2. How do students interact in asynchronous discussions in online courses across an entire semester?
3. How do students and instructors interact each week in asynchronous discussions in online courses (average number of posts)?
4. Is there a relationship between asynchronous discussion interaction measures and student satisfaction?

Research Design

A quantitative exploratory research design was used in this study to investigate the four research questions. Exploratory studies are conducted to better understand a problem and are not meant to provide conclusive evidence (Creswell & Plano Clark, 2003). The research is considered exploratory since it merely explores the research questions and the results provide a wide range of future research directions (Singh, 2007). This research design was selected because there was little known about learner-instructor interactions in discussion boards in online classes at CU Denver. In an attempt to have unbiased data, numeric data was collected from the learning management system and used in the analysis for this study.

In order to answer the research questions for this study, Table 3.1 shows the data that was used to answer each research question. Each question was answered using an appropriate data analysis technique.

Table 3.1 Alignment of Research Questions to Data Analysis

Research Questions	Data Source	Data Analysis
How do instructor interact in asynchronous discussions in online courses?	Number of Instructor Posts Instructor Interaction Rate Score	Descriptive
How do students interact in asynchronous discussions in online courses?	Total Number of Students in the Course Number of Student Posts Average Number of Posts Per Student	Descriptive
How do students and instructors interact each week in asynchronous discussions in online courses (average number of posts)?	Number of Instructor Posts (by Week) Number of Student Posts (by Week)	Descriptive
Is there a relationship between asynchronous discussion board interactions and student satisfaction?	Student Satisfaction Ranking Total Number of Posts	Spearman's Rho

Sample of the Study

The University of Colorado Denver (CU Denver) offers courses, programs, and degrees from seven schools and colleges. Located in Denver, Colorado, CU Denver is connected to the community and businesses within the downtown area. CU Denver has a decentralized approach to online education; instructors at CU Denver design, develop, and deliver their online courses. Professional development, training, and technical support are provided by an internal organization who supports online teaching and learning. However, there are no mandatory training requirements in order to teach online.

Archival data was collected about online courses at CU Denver. In order to respect the privacy of the instructors and students, the academic year of the data was not disclosed. A total of 6,152 courses were listed in Canvas during the academic year of the study; 675 of those courses were online courses. It is standard practice at CU Denver for a course shell to be created in the LMS for all courses (whether online or not) each semester; the following criteria was used to select the sample for this study:

a. The course is identified as an online course (identified through the course short code).
b. The course has been published in the LMS (unpublished courses are assumed inactive and will not be a part of the study).
c. The course has only one instructor (courses with multiple instructors will be removed from the sample, as this study will not account for shared duties in teaching).
d. The course does not have a TA (courses with TAs will be removed from the sample, as this study will not account for shared duties in teaching).
e. The course has five or more students (classes smaller than 5 students are generally self-study or higher-level courses which may not interact in traditional methods).
f. The course has end-of-course evaluation data in the publicly accessible database.
g. The course was not combined, for teaching or convenience purposes within the LMS. Courses combined in the student information system were included

in the study since end of course evaluation data would mirror the student information system data.

Data Collection

The learning management system has a lot of information about the behaviors of instructors and students; however, most educational institutions do not use the data to improve teaching and learning (Teasley, 2019). This study combined data from the learning management system with end-of-course evaluation data to create the dataset for this study.

Data Sources

This study used archival data from two systems: Canvas Data and end-of-course evaluation data. The advancements in educational technology products and services, such as the Canvas learning management system and Canvas Data, has created new opportunities for researchers to explore activity and behaviors within the learning management system. End-of-course evaluations, on the other hand, are evaluations students complete at the end of a course to evaluate the course and the teaching. While these evaluations are often contested because many question whether they are valid instruments to assess the quality of teaching (Boysen, Kelly, Raesly, & Casner, 2013), they are commonly used at most institutions and are increasingly conducted online, increasing the ability to conduct large scale comparisons and evaluations across a college or university. Further, despite criticisms of their ability to evaluate teaching, most agree that they are a valid source of student satisfaction data (Boysen et al., 2013). Each data source is described in more detail below.

Archival Canvas Data

CU Denver has been using Canvas as the official learning management system (LMS) since 2014. Canvas Data is a service from Canvas that provides tab delimited (.txt) flat files or hosted view files of aggregated data generated by user activity within the LMS (What is Canvas Data, 2019). Canvas Data is available to all customers; however, due to the size and complexity of the data, CU Denver like many other institutions lacked the resources or infrastructure to utilize the data provided by Canvas Data. However, in March 2018, the university made a significant investment in data infrastructure and resources to support the reporting and analytics needs of the university. A high performance, in-memory massively parallel processing database, Exasol, was implemented in May 2018. In June 2018, archival Canvas data was loaded into Exasol to be used for analytics and reporting. The data manager exported a subset of Canvas data from Exasol to be analyzed for this study.

End-of-Course Evaluations

At CU Denver, students are asked to complete an end-of-course evaluation called a faculty course questionnaire (FCQ) at the end of each semester. The FCQ has eight questions which asks the student to rate different parts of the course on a scale from 1-6. In addition, there are several open-ended questions (see Appendix). For this study, the eight rating questions were combined to create a student satisfaction score. This score was used in the study to quantify students' satisfaction of each online course. It is important to note that although end-of-course evaluations may be used by institutions for other purposes, such as tenure and promotion decisions, this research used the average score from end-of-course evaluation as a measure of student satisfaction. This is

consistent with research which identifies end-of-course evaluations as a valid measure of student satisfaction (Boysen et al., 2013).

Selecting the Population

With billions of rows of data available from archival Canvas Data, the first step was to determine which courses would be used in the study. The data manager first identified a list of all courses in a single academic year (N = 6152). Next, the list was filtered to only include online courses (N = 675). The final step in obtaining the data set used for this study was to remove courses that didn't meet the inclusion criteria for the study. This meant removing courses with multiple course sections, courses with multiple instructors or TAs, and any courses with less than five students. Furthermore, several courses did not have end-of-course evaluation data available, so those courses were also removed from the data set. After cleaning the data set, there were 415 courses in the dataset, representing six schools or colleges. Table 3.2 shows the breakdown of courses by school or college.

Table 3.2 Courses in the Study by School or College

School/College	Number of Courses	Percentage of Study
College of Engineering and Applied Science	9	2%
College of Arts and Media	38	9%
School of Public Affairs	43	10%
School of Education and Human Development	52	13%
Business School	88	21%
College of Liberal Arts and Sciences	185	45%
Total	415	100%

Collecting the Data

Once the courses were selected for the study, the next step was to pull specific data for each course. Course information from Canvas Data was combined with end-of-course evaluation data to create a list of demographic variables for the study. As shown in Table 3.3, course information was identified for each course in the study. This information was used to describe the demographics of the research population. Additionally, each course was given a research ID, which was used to anonymize the data.

Table 3.3 Course Demographic Variables

Variable Name	Variable Description	Variable Type
Research ID	Assigned to each course to anonymize the data for research purposes.	Nominal
Instructor Group	Identifies instructor as tenure / tenure track or primary instructor (GPTI, adjunct, visiting, honoraria, etc).	Nominal / Binary
School/College	Identifies the school or college from which the course resides.	Nominal
Course Level	Identifies if the course is undergraduate or graduate.	Nominal
Number of Students	Number of students in the course.	Interval

Table 3.4 show the variables related to discussion board interactions. These variables are derived from calculations executed using SQL scripts within Exasol to provide numeric values for each variable. For number of posts per week, calculations were performed by the data manager to ensure anonymity of the data. Instructor interaction rate and average number of posts per student were calculated using the variable values provided by the data manager.

Table 3.4 Discussion Board Data Variables

Variable Name	Variable Description	Variable Type
Total Number of Discussions	Total number of published discussions in course with at least one response.	Continuous
Number of Instructor Posts	Number of instructor responses to published discussions in the course.	Continuous
Number of Student Posts	Number of student responses to published discussions in the course.	Continuous
Total Number of Posts	Total number of responses to published discussions in the course.	Continuous
Number of Instructor Posts (by Week)	One column per week which calculates the number of posts by the instructor that week.	Continuous
Number of Student Posts (by Week)	One column per week which calculates the number of posts by all students that week.	Continuous
Instructor Interaction Rate	Calculated Field; Number of Instructor Posts / Number of Students in a Course	Continuous
Average Number of Posts Per Student	Calculated Field; Number of Student Posts / Number of Students in a Course	Continuous

As shown in Table 3.5, the end-of-course evaluation has eight questions which are answered on a scale of 1 (low) to 6 (high). Since no single question asks about student satisfaction, the score on the eight questions were combined and averaged to create a student satisfaction score.

Table 3.5 End-of-Course Evaluation Data Variables

Variable Name	Variable Description	Variable Type
Personal Interest	Scale = 1 (low) to 6 (high); Rate your personal interest in this material before you enrolled.	Ordinal
Instructor Effectiveness	Scale = 1 (low) to 6 (high); Rate your instructor's effectiveness in encouraging interest in the subject.	Ordinal
Instructor Availability	Scale = 1 (low) to 6 (high); Rate your instructor's availability for course-related assistance such as email, office hours, individual appointments, phone contact, etc.	Ordinal
Intellectual Challenge	Scale = 1 (low) to 6 (high); Rate the intellectual challenge of this course.	Ordinal
Learning	Scale = 1 (low) to 6 (high); Rate how much you have learned in the course.	Ordinal
Instructor Respect	Scale = 1 (low) to 6 (high); Rate the instructor's respect and professional treatment of all students.	Ordinal
Course Overall	Scale = 1 (low) to 6 (high); Rate the course overall.	Ordinal
Instructor Overall	Scale=1 (low) to 6 (high); Rate the instructor overall.	Ordinal
Student Satisfaction Score	Calculated Field; Scale = 1 (low) to 6 (high); Average of the eight end-of-course evaluation questions.	Ordinal

Data Analysis

As an exploratory study, the data analysis occurred in two steps. Descriptive statistics were used to answer the first three research questions. Using demographic data about the online course and discussion board data from the LMS, descriptive statistics provided frequencies, means, percentages, and standard deviations used in establishing how instructors and students interact in discussion boards. The second step was correlation testing to determine if a relationship existed between the variables.

Descriptive Statistics

Descriptive statistics were calculated using Tableau. Tableau is a powerful analytics platform. It provides visual analytics which can be used to gain insight into data. Tableau is also the university's preferred data visualization tool. Tableau was selected because of its ease of use in exploring variables in the dataset, as well as its ability to provide analytics and high-quality visualizations. Once the descriptive analysis was complete, the dataset was exported to an Excel file and imported into IBM SPSS Statistics for the statistical analysis.

Statistical Analysis

IBM SPSS Statistics, version 26, was used to perform the statistical analysis to determine if there was a relationship between discussion board interactions and student satisfaction. After exploring the variables, it was determined that a Spearman's Rho test would be used to determine if a relationship existed. Spearman's Rho is the non-parametric test to Pearson correlation (Pallent, 2013). A Spearman's Rho test was selected because the assumptions regarding normality were not met. According to Pallent (2013), there are several options for statistical analysis when the variables violate

assumptions. First, a parametric technique could have been used. Secondly, the variables could have been transformed to meet the assumptions needed to run a Pearson correlation. This could be done by removing outliers or transforming the variables. Therefore, a non-parametric technique was selected because although not as powerful as a parametric test, it was a more appropriate test due to the not normal distribution of the variables (Pallent, 2013).

Reliability

Evaluating teaching, whether face-to-face or online, is difficult. Very few universities have robust faculty evaluation processes and therefore, mainly rely on end-of-course student evaluations to evaluate online teaching (Thomas, 2018). Many question this common practice and instead advocate, like Pina (2017), using multiple measures in the evaluation of online teaching. Advances in LMS data have the potential to provide additional measures to evaluate online teaching. LMS data can serve as the kind of objective data that Pina and Bohn (2014) call for, in the continuous improvement of online learning. However, the use of quantitative data eliminates bias but introduces new complexities in analysis and interpretation.

With such a large amount of data, there is a possibility for missing or incorrect data. The data used in this study was validated upon input into Exasol through a series of validation processes which included validating data against actual courses in the Canvas LMS, creating visualizations to check for missing or incorrect data, and defining fields with the help of a content expert. Given limited resources, every effort was made to ensure that data from Canvas Data and the end-of-course evaluation database were matched correctly through the use several variables available in both datasets. In any

cases where there was not a guaranteed match in the two datasets, those courses were removed from the study. Given that this study was the first attempt to create actionable and meaningful data from Canvas Data, this study should be used to provide general trends and observations. The data should not be used in the individual evaluation of a single course or instructor.

Chapter Summary

With the continued growth of online education, there is a pressing need to ensure quality of online education and meet federal regulations for regular and substantial interactions between students and instructors. The quantitative exploratory study will investigate discussion board activity to better understand how students and instructors using discussion boards to interact in online courses. Archival data from online courses at CU Denver was used along with end-of-course evaluation data. Descriptive statistics and a Spearman's Rho test were used to answer the research questions of this study. Given limited resources, every effort was made to ensure the data used in this study was accurate.

CHAPTER 4: RESULTS

The purpose of this study was to explore the frequency of interaction between instructors and students in discussion boards in online courses at the University of Colorado Denver. This campus-wide analysis provides an analysis of discussion board interactions. Using descriptive statistics and data visualizations, this study explored current practices around discussions at CU Denver. The following research questions guided this study:

1. How do instructors interact in asynchronous discussions in online courses?
2. How do students interact in asynchronous discussions in online courses?
3. How do students and instructors interact each week in asynchronous discussions in online courses (average number of posts)?
4. Is there a relationship between asynchronous discussion interaction measures and student satisfaction?

The results from the analysis from two semesters of online courses at CU Denver and are presented in this chapter.

Demographics of the Courses

A total of 415 online courses, taught over a single academic year, were identified for the study. As shown in Table 4.1, the study population represented six schools and colleges. The majority of the courses were taught in the College of Liberal Arts and Sciences (44.6%) which serves not only a diverse student population but offers a diverse

number of online programs at the university. The other schools and colleges made up the remaining 55% of the courses in the study.

Table 4.1 Courses in the Study by School or College

School/College	Number of Courses	Percentage of Tenure-Track Instructors	Percentage of Population
College of Engineering and Applied Science	9	0.2%	2.2%
College of Arts and Media	38	2.2%	9.2%
School of Public Affairs	43	0.96%	10.4%
School of Education and Human Development	52	3.4%	12.5%
Business School	88	5.8%	21.2%
College of Liberal Arts and Sciences	185	5.3%	44.6%
Total	415	17.86%	100%

Tenure-Track vs Non Tenure-Track Instructors

The percentage of tenure-track vs non tenure-track instructors is shown in Figure 4.1. At CU Denver, tenured instructors have demonstrated excellence in teaching, research/creative work, and leadership and service; once attained, tenure remains in effect until retirement or resignation. Instructors in the tenure track are working toward tenure status. Instructors identified as at will employees, not eligible for tenure, or teach on a course-by-course basis are considered non-tenure track. Non-tenure track instructors include part-time lecturers, full-time instructors, senior instructors and clinical teaching track faculty. In the study, 82% of the instructors were non tenure-track. Less than 20% of the instructors were tenure-track. However, the Business School (27%), the College of Arts and Media (23%), and the School of Education and Human Development (26%) had

slightly higher percentages of tenure-tracked faculty compared to the other schools and colleges.

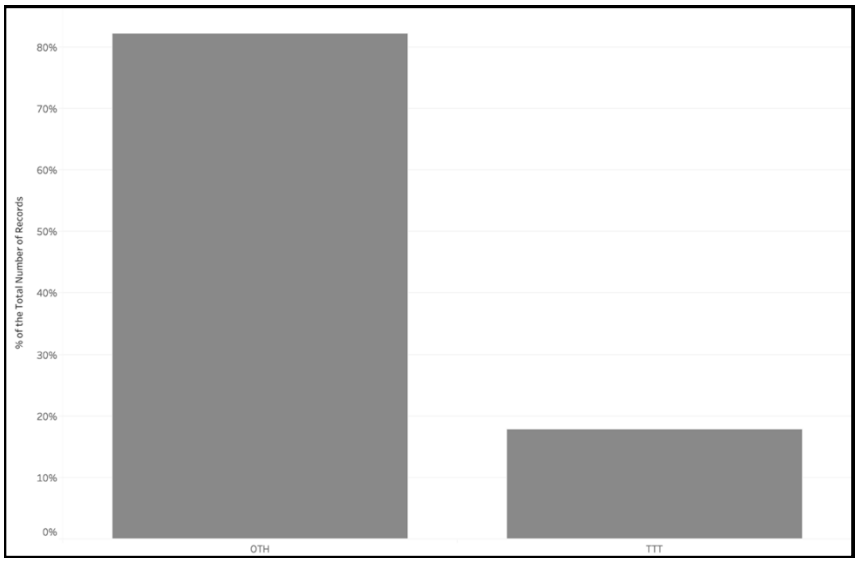

Figure 4.1 Distribution of Non Tenure-track (OTH) vs Tenure-track (TTT) Instructors

Course Levels

The distribution of course levels is shown in Table 4.2. Courses are categorized as lower division, upper division, and graduate. For the study, 27.71% (N = 115) of the courses were lower level undergraduate courses, 38.07% (N = 158) of the courses were upper level undergraduate courses, and 34.22% (N = 142) were graduate level courses.

Table 4.2 Distribution of Courses by Level and School/College

School/College	Lower Division	Upper Division	Graduate
College of Engineering and Applied Science	0	0	9
College of Arts and Media	19	10	9
School of Public Affairs	4	12	27
School of Education and Human Development	1	4	47
Business School	7	33	48
College of Liberal Arts and Sciences	84	99	2

Note. N = 415.

Instructors and TAs

Courses in the study only had one instructor and no teaching assistants (TA). This decision was made to eliminate courses from the study that had multiple instructors or a TA. Courses with TAs were also removed since a TA can have a combination of roles in a course, from designer to facilitator, to teacher.

Students

Descriptive statistics were analyzed for the number of students enrolled in each course. The results are shown in Table 4.3. Generally, the number of students in a course ranged from five to 79 students (N = 415, M = 25.43, SD = 11.32). As seen in Figure 4.2, the number of students in a course is reasonably normally distributed.

Table 4.3 Descriptive Statistics of Student Enrollments

Variable			Statistic	Standard Error
Number of Students	Mean		25.43	.556
	95% Confidence Interval for Mean	Lower Bound	24.34	
		Upper Bound	26.53	
	5% Trimmed Mean		24.92	
	Median		25.00	
	Variance		128.183	
	Std. Deviation		11.322	
	Skewness		.627	.120
	Kurtosis		.892	.239

Note. N = 415.

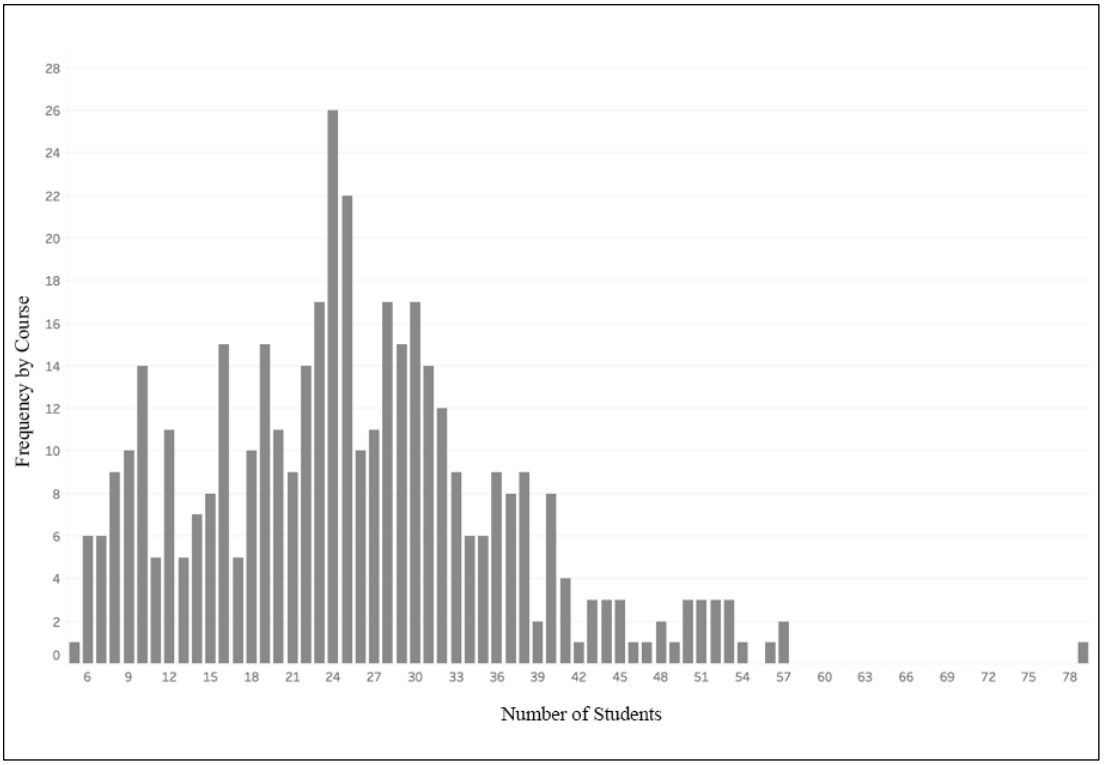

Figure 4.2 Frequency of Number of Students per Course

Number of Discussion Boards

The number of discussion boards is a variable used to describe the number of active discussions in a course. As described in Chapter 2, a discussion board has two parts, a discussion topic or question usually posed by the instructor and posts (also called replies) to the topic or another post. In order to better understand how instructors and students interact in discussion boards, it was important to analyze the number of discussions in a course. Figure 4.3 shows the total number of discussions boards in each course. The total number of discussion boards in a course ranged from 0 to 140. There were 23 courses with no discussions. These courses were removed from further analysis since these courses did not use discussions boards. Therefore, 392 courses were included in the analysis.

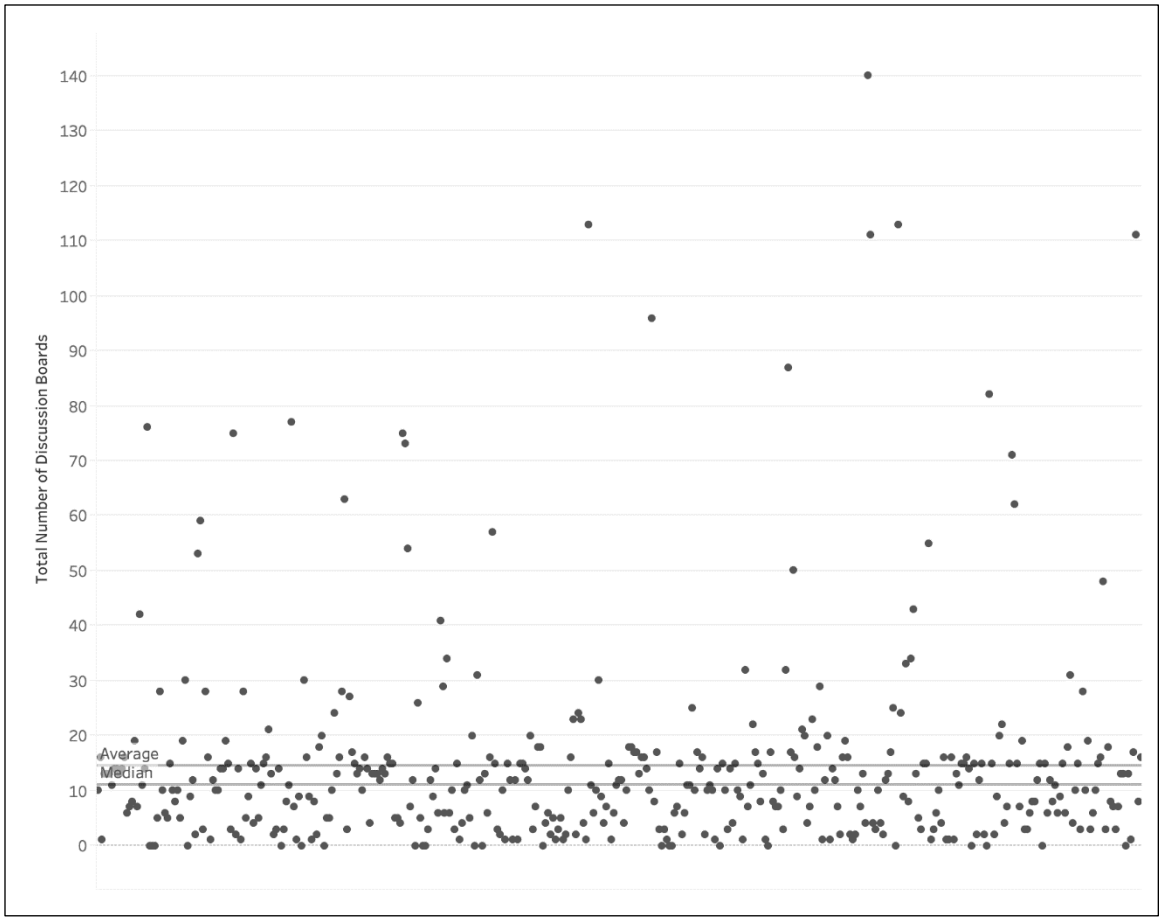

Figure 4.3 Distribution of the Total Number of Discussion Boards per Course

Upon further investigation, there were several courses identified as outliers. However, looking more closely at the data, these outliers actually had a significant amount of interaction through discussion activity. For example, the course with 140 discussions had 1207 total posts and a class size of 36. Since the average class size for the population was 25 (M = 25.43) and the average number of posts per course was 503 (M = 503.21) it was reasonable to assume that the instructors for these courses used different discussion board strategies to address the larger class size. Table 4.4 shows the courses with the highest discussions and number of total posts. All five courses with the highest number of discussions also had a large class size. In addition, all five courses were from

the business school. Four of the courses were upper division undergraduate courses and one was a graduate course.

Table 4.4 Courses with the Highest Number of Discussion Boards

Research ID	Course Level	# of Students	# of Discussions	Total Posts	Total # of Student Posts	Total # of Instructor Posts
307	Grad	36	140	1207	1066	141
196	Upper Division Undergrad	51	113	971	846	125
319	Upper Division Undergrad	50	113	607	482	125
308	Upper Division Undergrad	50	111	1200	1089	111
413	Upper Division Undergrad	52	111	787	686	101

Total Posts

The total posts refer to the total number of posts per course to any discussion board in the course. A post is a reply to the discussion topic or another post. A post can be made by the instructor or a student. This number is used to describe the amount of interaction in a course because a post in a discussion board is similar to a face-to-face discussion where students and instructors exchange ideas through taking turns speaking. Figure 4.4 illustrates the total number of posts per course by an instructor or student (N=392, M = 503.21, SD = 447.147). The minimum number of posts was two and the maximum number of posts was 2,468.

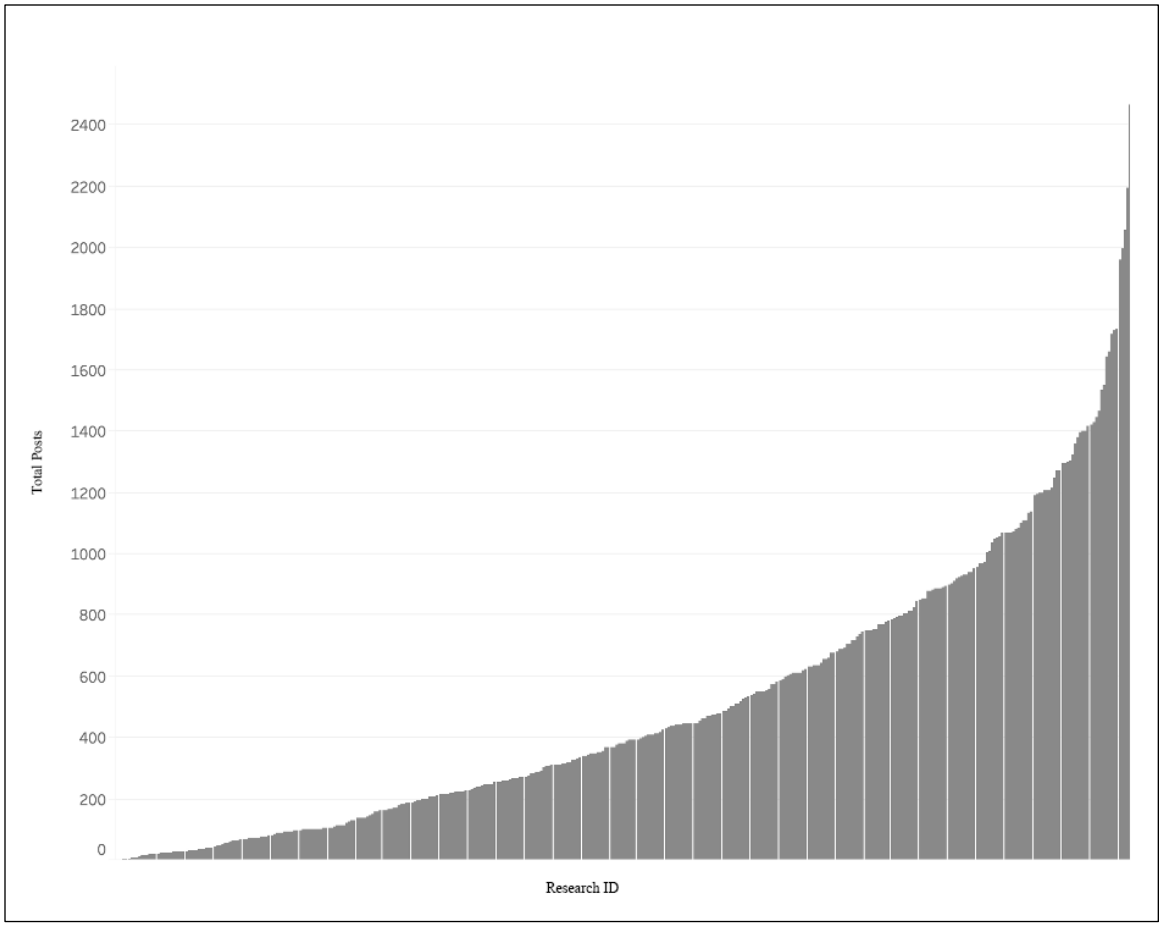

Figure 4.4 Total Posts Per Course

Research Question 1: Instructor Interaction

Research question one asked, "How do instructors interact in asynchronous discussions in online courses?" This research question is significant because it provides baseline data for CU Denver regarding frequency of discussion board posts and rate of interaction for instructors in online courses. It is not possible to determine whether the instructor or students created the initial discussion board in the data set. However, regardless of who created the discussion, interaction occurs through a series of posts, or replies between the instructor and students. Descriptive statistics were analyzed for the number of posts by the instructor. The results are shown in Table 4.5. The number of

posts by an instructor ranged from 0 to 347, with the average instructor posting 32.90 times throughout a course.

Table 4.5 Descriptive Statistics of Instructor Posts

Variable			Statistic	Standard Error
Number of Posts	Mean		32.90	2.350
	95% Confidence Interval for Mean	Lower Bound	28.28	
		Upper Bound	37.52	
	5% Trimmed Mean		26.63	
	Median		17.00	
	Variance		2164.682	
	Std. Deviation		46.526	
	Skewness		2.961	.123
	Kurtosis		12.892	.246

Note. N = 392.

Figure 4.5 shows the frequency and distribution of total number of posts by instructors. An instructor post would be in response to either the initial discussion board or a student in the course. When assessing the distribution, 250 courses (63.7% of all courses) had the instructor post less than the mean of 32 times during the semester. Of those 250 courses, 28.8% of the courses had no instructor posts at all. This did not include the 23 courses which had no discussions. The remaining 142 courses (36.2% of all courses) had the instructor post more than the mean of 32 times during the semester.

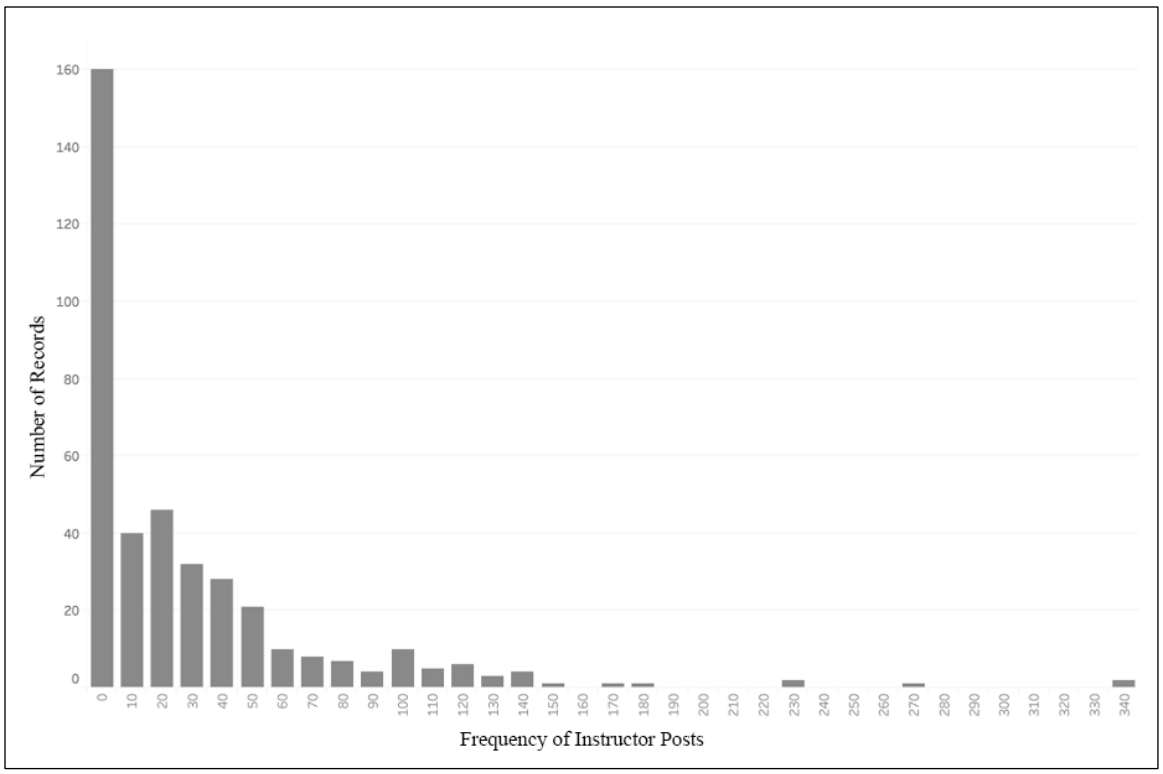

Figure 4.5 Number of Courses by Instructor Post Frequency

It is important to note that the total number of posts an instructor makes in an online course provides only a glimpse into their interactions in a course. While it is helpful to know if an instructor is posting below the average number of posts for the institution, the number does not take into account situational factors, such as class size. For instance, the effect of 32 posts by an instructor is more impactful with a course with 25 students versus a course with 75 students. Thus, researchers and practitioners alike need a way to better understand how active instructors are in a course. One method was created by Bliss and Lawrence (2009a). In this method, instructor participation is a multi-factor discussion board metric which allows for comparison between classes with different enrollment sizes. Instructor participation takes into account the problem of just measuring the number of instructor posts, by taking the number of instructor posts per enrolled student in the course. The calculation of instructor participation is total number

of instructor posts divided by the number of students in the course. This means that in a course with five students and an instructor who posted 80 times during the semester would have an average interaction rate of 16 posts per student. While a course with 25 students and an instructor who posted 80 times during the semester would have an average interaction rate of 3.2 posts per student.

Instructor interaction rate was calculated for each course in the study and descriptive statistics are shown in Table 4.6. Instructor interaction ranged from 0 to 18.9 with a mean of 1.49 and a standard deviation of 2.33. These results indicate a varied approach to discussion boards.

Table 4.6 Descriptive Statistics of Instructor Interaction Rate

Variable			Statistic	Standard Error
Instructor Interaction Rate	Mean		1.49	.11791
	95% Confidence Interval for Mean	Lower Bound	1.26	
		Upper Bound	1.72	
	5% Trimmed Mean		1.11	
	Median		.74	
	Variance		5.45	
	Std. Deviation		2.33	
	Minimum		.00	
	Maximum		18.90	
	Skewness		3.41	.123
	Kurtosis		16.11	.246

Note. N = 392.

A closer look at the distribution (see Figure 4.6) shows that although the majority of courses in the study had an average instructor interaction rate of less than one post per student, there was a large spread with some instructors having an interaction rate of over ten posts per student. This spread could indicate varied approaches by the instructors. For instance, some instructors may post less frequently in discussions, but have other methods of communication, like email or synchronous communications, such as video chat. The wide variety of tools available within and outside the learning management system means that interaction is not limited to discussion boards only. Based on this research, instructors post an average of 1.49 times a semester for every student in their class. However, due to a variety of strategies and tools being used, more research would be needed to understand how instructors interact in their online courses.

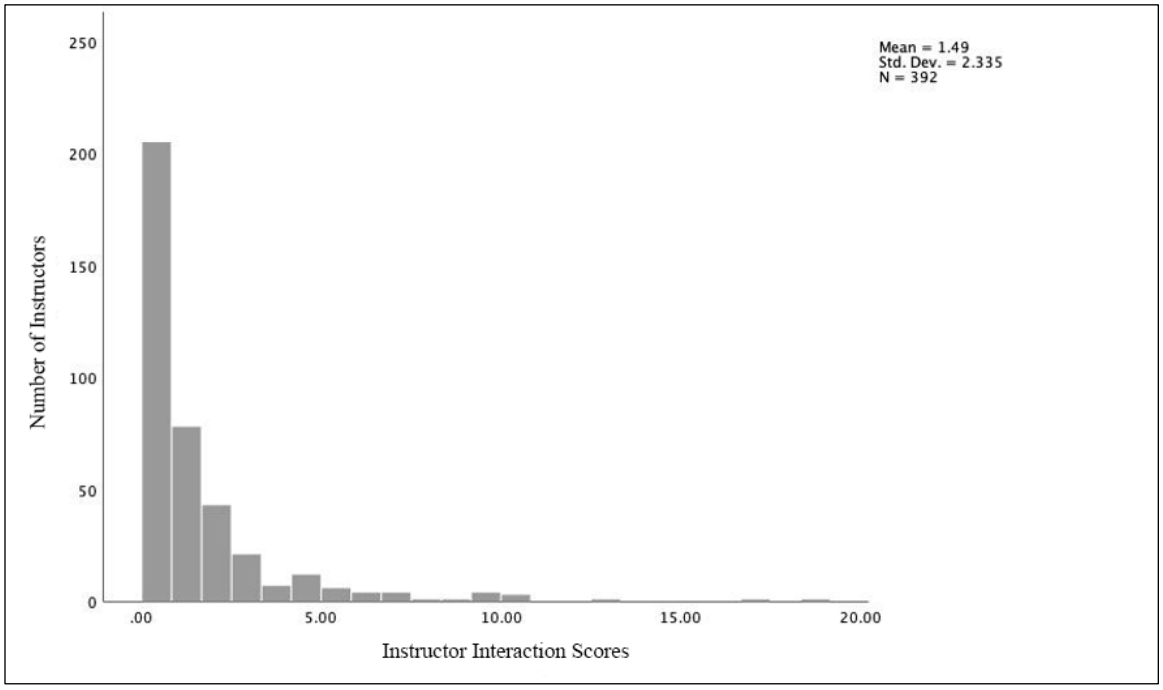

Figure 4.6 Distribution of Instructor Interaction Rate Scores

Research Question 2: Student Interaction

Research question two was "How do students interact in asynchronous discussions in online courses?" This question is significant because it provides baseline data about student use of discussion boards in online courses at CU Denver. In an online course, discussion boards serve as a primary opportunity for person-to-person interaction (Lieberman, 2019). When a student posts to a discussion board, makes a reply to a discussion board or another person's post, it is meant to simulate a conversation in a face-to-face classroom. Descriptive statistics were used to analyze the number of posts by students. The results are shown in Table 4.7. The total number of student posts per course ranged from 0 to 2438 (N = 392, M = 470.31, SD = 432.833).

Table 4.7 Descriptive Statistics of Student Posts

Variable			Statistic	Standard Error
Number of Posts	Mean		470.31	21.861
	95% Confidence Interval for Mean	Lower Bound	427.33	
		Upper Bound	513.29	
	5% Trimmed Mean		432.53	
	Median		342.50	
	Variance		187344.032	
	Std. Deviation		432.833	
	Skewness		1.276	.123
	Kurtosis		1.724	.246

Note. N = 392.

When assessing the shape of the distribution (see Figure 4.7), almost half of the courses in the study had over 350 student posts (N = 194) throughout the semester. 48

courses (12.2%) had less than 50 student posts. Only one course had no student posts, but this course only had one active discussion which the instructor posted twice. Based on the data queried for this study, there was no way to determine the purpose of this discussion board in the course.

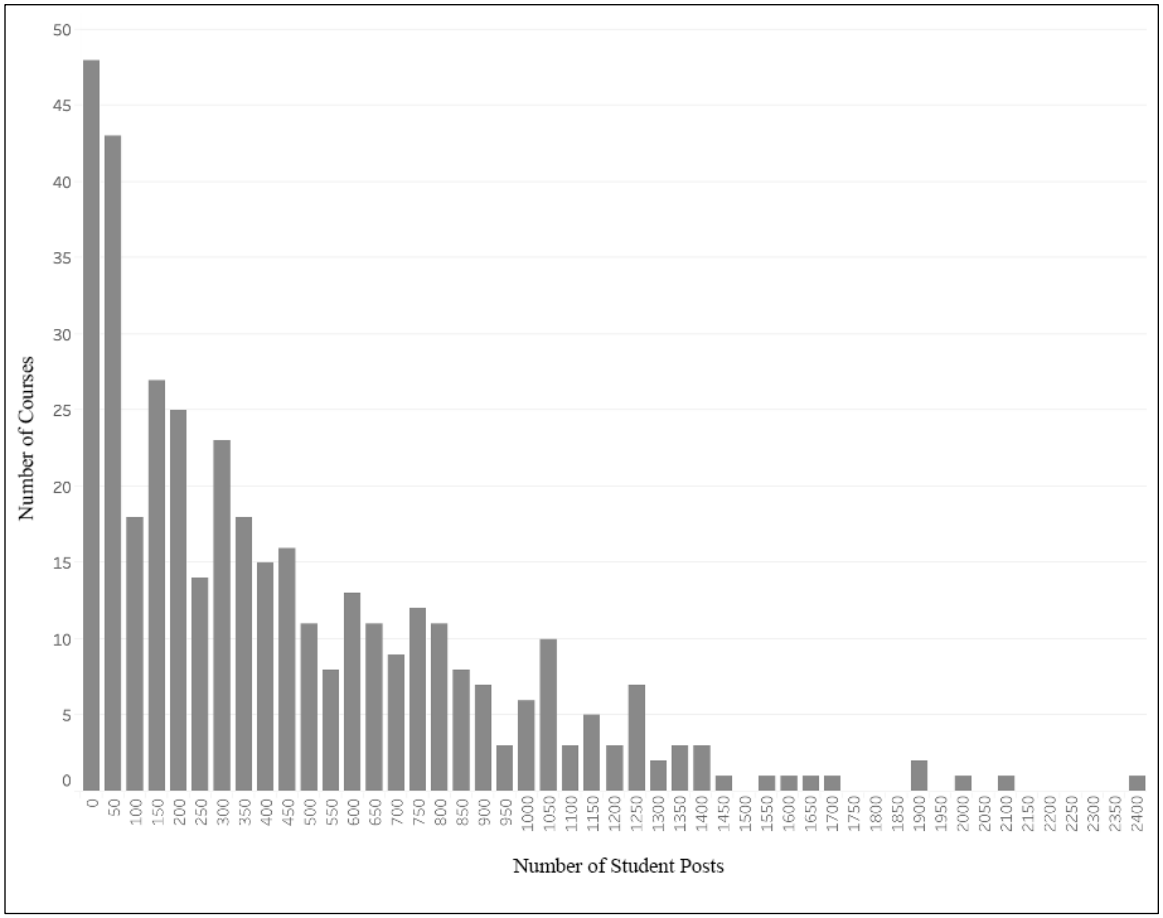

Figure 4.7 Number of Courses by Student Post Frequency

Due to the fact that each course has a variable number of students, it is difficult to determine from total posts alone whether a course has a lot of student or not. Therefore, it was important to look at the average number of posts per student, in addition to total numbers. An analysis of the data revealed that the average number of total posts per student was 19.9 per student per course (N = 392, M = 19.918, SD = 18.062). This means

that on average, a student posted in discussions approximately 19 times per semester (see Table 4.8). Given that the semester is 15 weeks, plus final weeks, this averages out to each student posting a little more than once a week.

Table 4.8 Descriptive Statistics of Average Posts per Student

Variable			Statistic	Standard Error
Average Posts per Student	Mean		19.918	.9123
	95% Confidence Interval for Mean	Lower Bound	18.124	
		Upper Bound	21.711	
	5% Trimmed Mean		18.290	
	Median		15.452	
	Variance		326.259	
	Std. Deviation		18.062	
	Skewness		1.501	.123
	Kurtosis		4.107	.246

Note. N = 392.

When assessing the shape of the distribution (see Figure 4.8), 25% of courses had an average of less than 5 posts per student (N = 98). Based on these results, it would appear that students who post more than 20 times per semester have an above average number of posts. This information could be used by instructors or administrators looking to identify students who may need additional support or encouragement in order to fulfil the requirement of regular interaction. In this case, an instructor may identify students who have posted only a few times during the first two weeks of the semester. Then, the instructor could reach out to those students regarding the expectation of regular interaction.

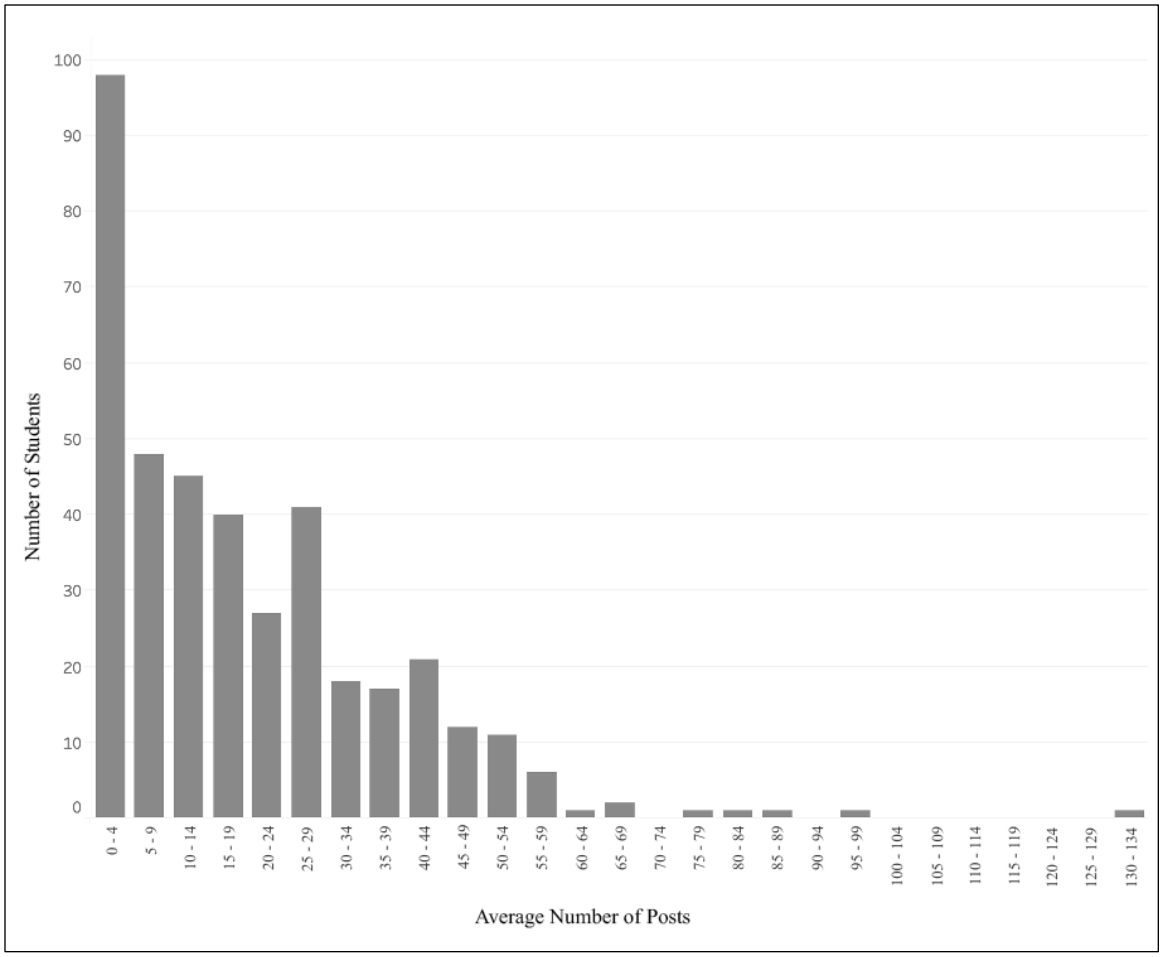

Figure 4.8 Average Number of Posts per Student by Course

Research Question 3: Weekly Interaction

Research question three was "How do students and instructors interact each week in asynchronous discussions in online courses?" This research question is significant because the results provide baseline data for discussion board activity in online classes at CU Denver. This data could be used to identify courses early in the semester who have low levels of discussion board interaction. An instructor or administrator may wish to identify students or instructors who have low levels of interaction in an effort to promote regular learner-instructor interaction. In order to answer research question number three, weekly totals of discussion posts were calculated. For each week, the number of student

posts and instructor posts were reported for each of the courses in the study. The courses in the data set were offered over fall or spring semester; the courses were assumed to have followed the university's traditional 15 week schedule, plus finals week. All courses are expected to take part in finals week, either by giving an exam or fulfilling two contact hours of instruction. Table 4.9 shows the weekly totals of posts for all courses in the study as well as the totals for instructors and for students. Additionally, average number of posts per course was calculated along with the percentage of overall posts for each week.

Based on the data set, the most interaction happened in the course discussion boards during the first two weeks of a semester. This was true for both students and instructors. After that, there was a steady decrease in the number of discussion board posts. The least amount of interaction in the course discussion boards happened during finals week and spring or winter break (depending on the semester). Although, it is worth pointing out that the last few weeks of the semester have about a third of the interaction as the first week.

Table 4.9 Weekly Total Discussion Board Posts

Week	Total Number of Posts	Total Instructor Posts	Total Student Posts	Average Posts per Course	Percentage of Overall Posts
1	25269	3043	22226	64.46	12.6%
2	18599	1728	16871	47.44	9.3%
3	14852	1120	13732	37.88	7.4%
4	14196	856	13340	36.21	7.1%
5	13048	768	12280	33.28	6.5%
6	12310	655	11655	31.40	6.2%
7	13223	690	12531	33.73	6.6%
8	11129	657	10472	28.39	5.6%
9	11559	667	10892	29.48	5.8%
10	11369	464	10905	29.00	5.7%
11	10557	562	9995	26.93	5.3%
12	10392	441	9951	26.51	5.2%
13	9744	491	9253	24.85	4.9%
14	9707	515	9192	24.76	4.9%
15	9242	552	8690	23.57	4.6%
Finals Week	2361	171	2220	6.02	1.2%
Spring/Winer Break	2399	143	2256	6.11	1.2%

Note. N = 392

As discussed previously, class size can influence raw numbers such as number of student posts and number of instructor posts. Therefore, using the average class size of the courses in the study (m = 25.43), average instructor interaction rate and average posts per student were calculated each week. These numbers provide a baseline measure which

could be used to identify courses with low interaction rates. Since this data could be particularly helpful during the first few weeks of the semester to encourage participation from students and ensure that instructors are practicing regular interaction, Table 4.10 shows the average instructor interaction rate and average posts per student for the first four weeks of the semester. After that, average interaction drops off.

Table 4.10 Average Interactions for Instructors and Students by Week

Week	Average Instructor Interaction Rate	Average Posts per Student
1	.3	2.2
2	.17	1.7
3	.11	1.4
4	.08	1.3

Based on the average instructor interaction rate and average posts for student, instructors at CU Denver should attempt to post an average of once per every three students in their class and a student should post at least twice. During week two, an instructor should post an average of once per every seven students in their class and a student should post at least once. Using the average instructor interaction rate and average posts per students, these numbers will help assist instructors on setting target numbers which they can use to help ensure they are maintaining regular interaction with their students.

The two semesters used in the study showed similar results for interaction. Term 1 had 207 courses and term 2 had 185 courses. Figure 4.9 shows the total posts by term. As shown in Figure 4.9, posts for both students and instructors decrease from the first week of the semester to the last week. This decrease in posts may indicate a reduction in

interaction throughout the semester. However, additional research would need to be done to determine if interaction was occurring in different ways at different points in the semester.

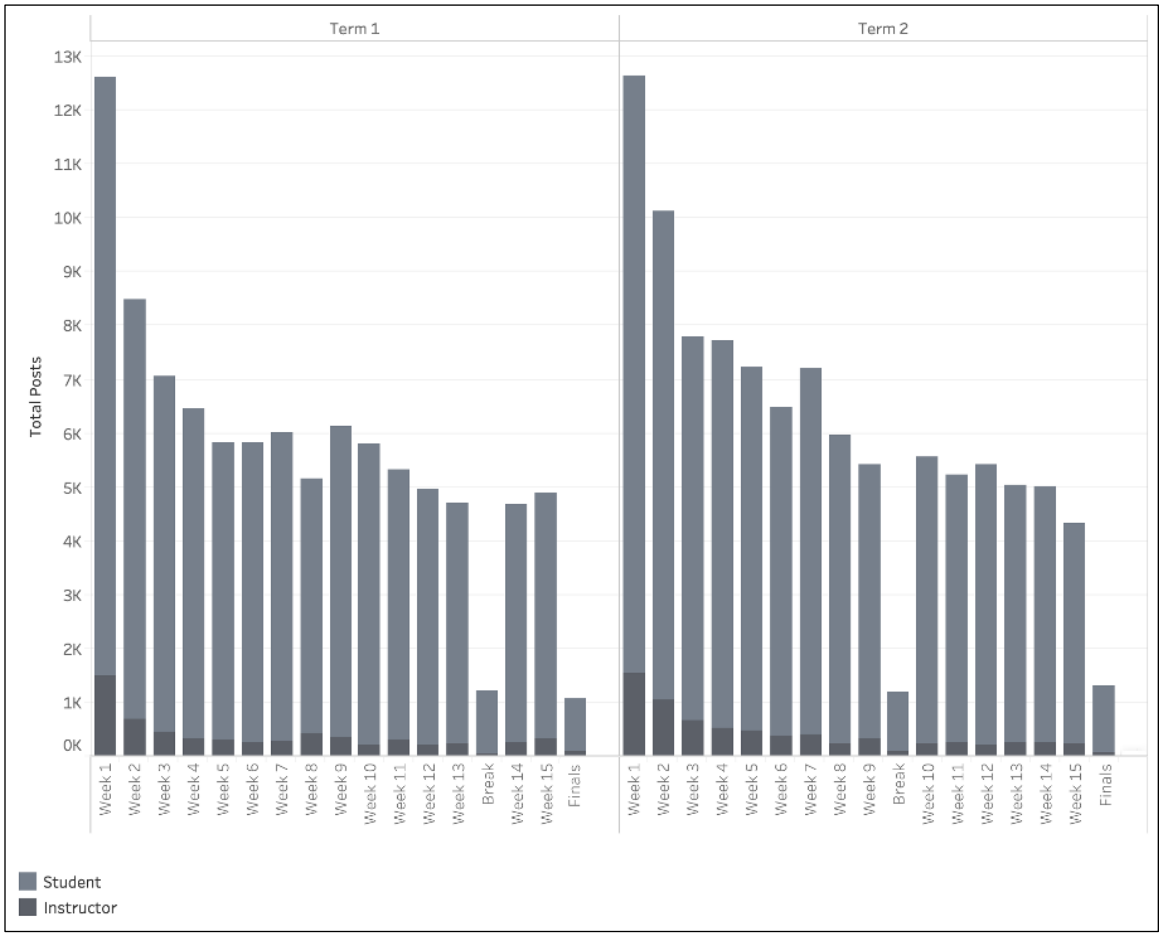

Figure 4.9 Total Discussion Posts Based on Enrollment Type

Research Question 4: Correlation Testing

Research question four was, "Is there a relationship between asynchronous discussion interaction measures and student satisfaction?" This research question focuses on whether there is a correlation between total posts (i.e., interaction) in a course and student satisfaction. This research question is significant because it is important to understand if total posts in a course is related to student satisfaction. If a correlation was

found, course design and delivery methods could be modified to increase student satisfaction. Table 4.11 provides the descriptive statistics for the two variables. For the variable, total posts, from the 392 courses with discussions, the total number of posts ranged from two to 2468 posts, with a mean of 503.21 and a standard deviation of 447.147. For the variable, student satisfaction, from the 392 courses with discussions, student satisfaction ranged from 2.625 to 6.0 with a scale from zero to six. The mean was 4.96 and the standard deviation was .499.

Table 4.11 Descriptive Statistics for Key Variables

Variable			Statistic	Standard Error
Total Posts	Mean		503.21	22.584
	95% Confidence Interval for Mean	Lower Bound	458.81	
		Upper Bound	547.61	
	5% Trimmed Mean		464.69	
	Median		381.00	
	Variance		199940.549	
	Std. Deviation		447.147	
	Skewness		1.240	.123
	Kurtosis		1.519	.246
Student Satisfaction Score	Mean		4.96	.025
	95% Confidence Interval for Mean	Lower Bound	4.91	
		Upper Bound	5.01	
	5% Trimmed Mean		4.99	
	Median		5.01	
	Variance		.249	
	Std. Deviation		.499	
	Skewness		-1.009	.123
	Kurtosis		2.011	.246

Note. N = 392

In order to determine the appropriate statistical technique, a test of normality was used to assess the distribution of the scores (Pallant, 2013). Results of the Kolmogorov-Smirnov and Shapiro Wilk provided the Sig. value of .000 for both total posts and student satisfaction, suggesting violation of the assumption of normality. An inspection of the

normal probability plots (see Figure 4.10) confirmed a non-normal distribution for both variables.

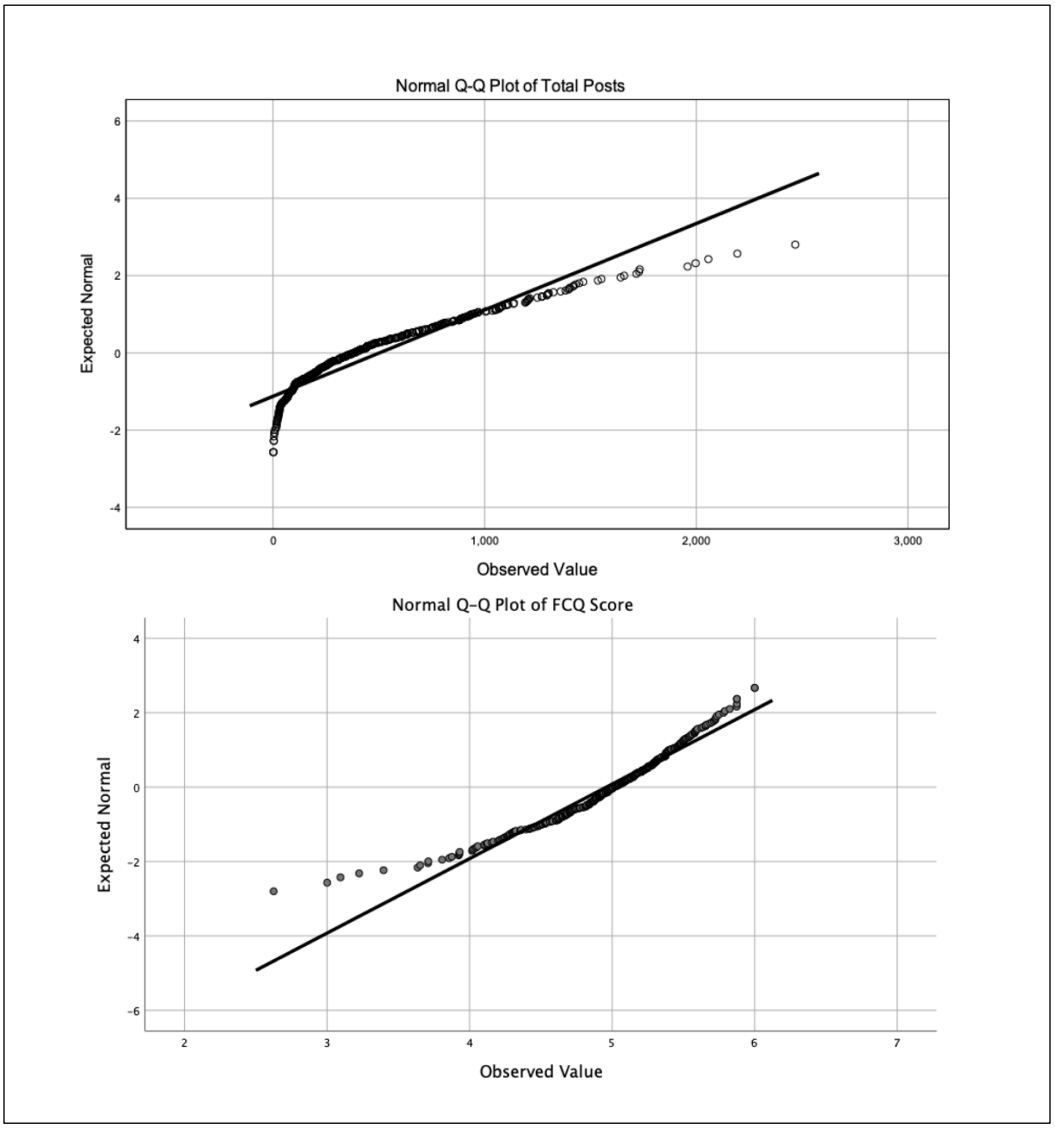

Figure 4.10 Normal Probability Plots for Variables, Total Posts and Student Satisfaction Score

Several attempts were made to normalize the data. This included removing outliers and transforming the variables. Since student satisfaction was already a new variable introduced by averaging the scores from eight questions from the end-of-course evaluation, it felt excessive to transform that variable. In addition, there is "considerable

controversy" concerning transforming variables (Pallent, 2013, p. 96). When removing outliers, results from correlation testing produced similar results as when not removing outliers. Therefore, a non-parametric technique was selected. Although often described as "less sensitive" to parametric tests, non-parametric tests are useful in cases where the assumption required for parametric tests are not met (Pallent, 2013, p. 221). Therefore, a Spearman's Rho correlation was selected to measure the relationship between the two variables. Figure 4.10 is a scatterplot of the relationship between the two variables, student satisfaction score and total post. A Spearman's rank-order correlation (see Table 4.12) was run to assess the relationship between student satisfaction score and total posts in a course. 392 courses were used in the analysis. Preliminary analysis showed the relationship to be non-monotonic, as assessed by visual inspection of a scatterplot (see Figure 4.11). There was no statistically significant correlation between student satisfaction scores and total posts, $r_s = -.060$, $p = .240$.

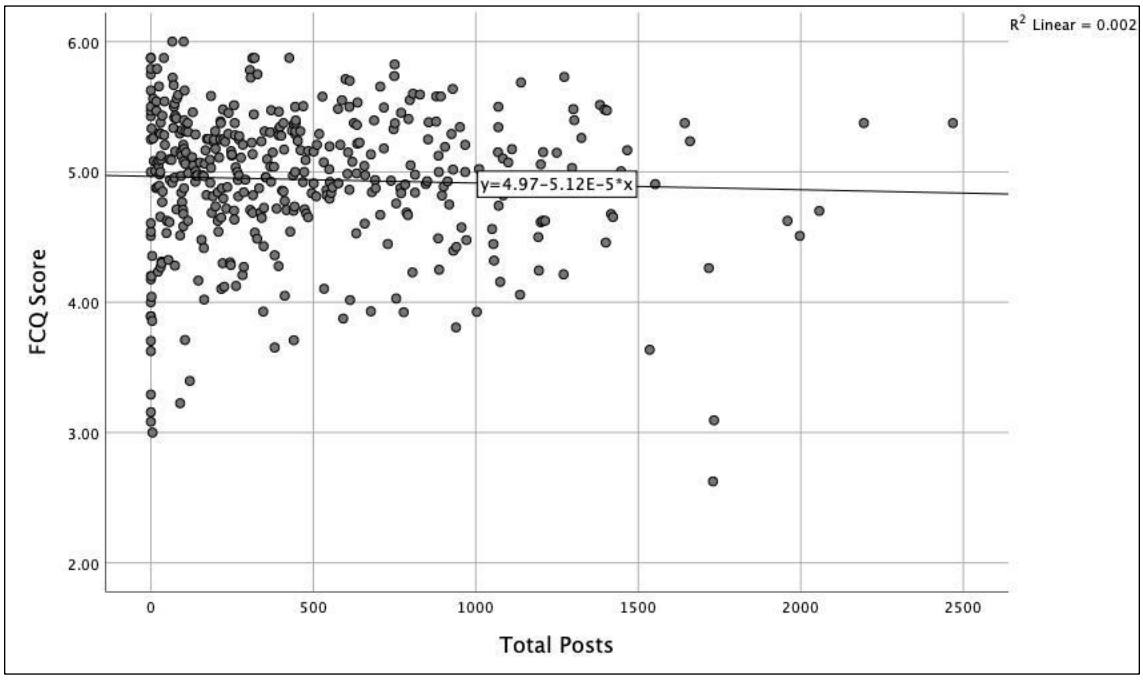

Figure 4.11 Scatterplot of Student Satisfaction Scores and Total Posts

Table 4.12 Results from the Spearman's Rho Correlation

Variable			Total Posts	Student Satisfaction
Spearman's rho	Total Posts	Correlation Coefficient	1.000	-.060
		Sig. (2-tailed)		.240
	Student Satisfaction Score	Correlation Coefficient	-.060	
		Sig. (2-tailed)	.240	

Note. N = 392.

Chapter Summary

The purpose of this study was to explore the frequency of interaction between instructors and students in discussion boards in online courses at the University of Colorado Denver. The study population consisted of 415 online courses. For the study, 82% of the instructors were non tenure-tracked and less than 20% of the instructors were tenure-track. 27.71% (N = 115) of the courses were lower level undergraduate courses, 38.07% (N = 158) of the courses were upper level undergraduate courses, and 34.22% (N = 142) were graduate level courses. The average number of students in a class was 25 and the average number of posts per course was 503. Results from the study found that the average number of posts by an instructor was 32.9. The average instructor interaction was 1.49 instructor posts per student. 23% (N = 72) of courses had no instructor posts. Student posts averaged 470 per course and the average posts per student was 19.9. Based on the discussion board activity, the most discussion interaction occurred during the first two weeks of the semester and steadily decreased in the number of discussion posts each week. In determining if a relationship existed between total posts and student satisfaction

scores, a Spearman's rho correlation was selected. There was no statistically significant correlation between student satisfaction scores and total posts, $r_s = -.060$, $p = .240$.

CHAPTER FIVE: DISCUSSION

Federal guidelines as well as common quality assurance frameworks emphasize the importance of regular and substantial interactions between student and instructor in online courses. Thus, the purpose of this study was to explore the frequency of interaction between instructors and students in discussion boards in online courses at the University of Colorado Denver. LMS data from 415 online courses was combined with end-of-course evaluation data to answer the following research questions:

1. How do instructors interact in asynchronous discussions in online courses?
2. How do students interact in asynchronous discussions in online courses?
3. How do students and instructors interact each week in asynchronous discussions in online courses?
4. Is there a relationship between asynchronous discussion interaction measures and student satisfaction?

In the following chapter, I will summarize and discuss the research findings, then highlight the implications for research and practice, address the limitations of the study, and conclude by identifying areas of future research. The discussion takes into consideration previous research and literature on interaction and asynchronous discussion boards.

Summary of Findings

Findings from this study are intended to provide insight into how instructors and students interact in online discussion boards at CU Denver. This research is not designed

to generalize how instructors and students interact in all online courses at CU Denver or generalize how instructors and students interact in online discussion boards at other institutions. The exploratory nature of this research was meant to provide baseline data that can help instructors, department chairs, and administrators at CU Denver better understand how instructors and students interact in online courses.

Research Question 1

Research question 1 explored how instructors interact in asynchronous discussion boards in online courses. Research suggests that instructors should play an active role in online discussions and research indicates that regular interaction between students and instructors encourages discussion and improves learner satisfaction (Darabi et al., 2013; Moller, 1998; Nandi et al., 2012). Results from this study showed that instructor interaction varies greatly from course to course. In some courses, instructors did not post at all in discussions, while in other courses, instructors posted over 200 times. On average, an instructor posted 33 times during the semester.

In addition, instructor interaction rate was calculated for each course. The calculation was determined by taking the total number of instructor posts and dividing it by the number of students in the course. This means that in a course with five students and an instructor who posted 80 times during the semester would have an average interaction rate of 16 posts per student. While a course with 25 students and an instructor who posted 80 times during the semester would have an average interaction rate of 3.2 posts per student. Instructor interaction ranged from 0 to 18.9 with a mean of 1.49 and a standard deviation of 2.33. Since there was a wide range of instructor interaction, it is

possible that instructors took a varied approach to discussion boards or perhaps instructors used other tools, beyond the discussion boards, for facilitating interaction.

Although there is no magic number for the number of posts an instructor makes in a course, research indicates and regulation requires, that regular interaction from the instructor has an impact on student perceived learning, student satisfaction, and student engagement (Hrastinski, 2008; Jung et al., 2002; Swan, 2004; U.S. Department of Education, 2014). Online discussions create opportunities for collaborative, knowledge sharing, and social interaction (Fleming, 2008; Rovai, 2002; Thompson, 2006). Specifically, when it comes to instructor interaction, Ringler et al. (2015) found that "there is a positive relationship between the number of instructor posts and the number of posts per student" (p. 23). Meaning that the more often instructors participated, the more discussion occurred. The thought is that more discussion means greater learning and a stronger sense of community. However, depending on teaching style of the instructor, the instructor may post more or less often (Quitadamo & Brown, 2001). Meaning if an instructor posted infrequently, perhaps they were writing (or recording) longer posts of higher quality or choosing to summarize discussions at the end of the week (Rovai, 2007). Or perhaps an instructor found that when posting too frequently, students shut down or merely waited for the instructor to respond instead of responding to a fellow student's post and therefore believed that posting less frequently actually simulated student-student discussion (Mazzolini & Maddison, 2003). The variety of strategies and facilitation strategies makes it difficult to judge the quality of the course just on the number of posts by an instructor.

In addition to instructor posts, the number of discussion boards also varied greatly from course to course. In some courses there were no discussion boards, while in other courses over 100 discussion boards existed. The average number of discussion boards in a course was 14 and the median was 11. The design of the course and the beliefs of the instructor likely influenced how many discussions were in the course. According to Covelli (2017), there are a number of techniques that can be applied to the course or by the instructor to encourage effective discussions. Research suggests that facilitating discussions may not come naturally to instructors and therefore, instructors should engage in professional development on facilitating effective discussions (Covelli, 2017). For example, learning how to incorporate audio and video into discussions can add texture and personality to discussions (Covelli, 2017). Additionally, the course design may offer opportunities small group or whole class discussions which can assist in building community within the course (Covelli, 2017).

The University of Colorado Denver has a faculty-driven development and delivery model, meaning that courses are designed and taught by instructors with little or no assistance from an instructional designer. This was common practice during the early years of online learning in an effort to increase production of online courses (Oblinger & Hawkins, 2006). Faculty were provided release time or a stipend in exchange for developing and delivering online courses (Oblinger & Hawkins, 2006). In fact, in 2010, Lowenthal and Thomas described their “web camp” strategy which was implemented at the University of Colorado Denver. Web camp was a week-long workshop designed to help faculty develop new fully online courses (Lowenthal & Thomas, 2010). Led by instructional designers and academic technologists, the web camp strategy encouraged

faculty buy-in and increased faculty's comfort level with online education. However, this decentralized approach to course design also means that some instructors may receive no training or limited support. This leads to wildly different approaches to course design and specifically to the design and facilitation of online discussions. More recently, CU Denver implemented the Online Skills Mastery (OSM) training program (Johnson, Adams Becker, Estrada, & Freeman, 2015). The 10-week course prepares online instructors to teach online. The training program provides real-world experience by having instructors take the professional development online. In addition, they receive mentoring and support from a seasoned online instructor. Although over 150 instructors have completed the training, it is not required for every instructor.

Research Question 2

Research suggests there are many factors that influence student contribution in online discussions (Hew et al., 2010; Xie et al., 2006). Results from this study found that the frequency of student posts varied from zero to over two thousand in a course during the semester with a mean of 470 posts per course. Due to differences in class size, the average number of posts per student was calculated by dividing the total number of student posts by number of students in the class. The average posts per student was 19 times per semester or just barely more than once per week. One of the challenges with this measure is that it assumes that every student participated in the discussions (Bliss & Lawrence, 2009a).

Similar to instructor postings, the total number of student posts only tells part of the story. Other factors, such as instructor expectations, the design of the discussion, and extrinsic motivation can have an effect on the number of posts or level of engagement of

students in online discussions (Rovai, 2007). These factors are reflected in popular online learning standards. For example, Chickering and Gamson's (1989) seven principles of good teaching includes communicating high expectations. Specifically related to discussions, Rovai (2007) suggests clearly communicating with the students what the requirements are for active participation in discussions; a discussion rubric can assist in setting those expectations (Rovai, 2007). Popular online learning standards include the design of learning activities as an important component in effective online courses. Discussion boards are learning activities that require thoughtful preparation. Maddix (2012) argues that discussion questions should be open-ended and encourage critical and creative thinking. Maddix (2012) also recommended prompting students to defend their stance or relate their responses to personal experience. Related to design, the size of the discussion board can also affect participation. For example, Reonieri (2006) found that 10-15 students was the ideal size for an effective online discussion. Fewer than 10 students resulted in too few perspectives and more than 15 began to feel overwhelming (Reonieri, 2006). In addition, Bliss and Lawrence (2009b) found that students participated more frequently in small group discussions than in whole class discussions. Finally, extrinsic motivation can affect discussion participation. All the popular online learning standards include assessment. Best practices for discussion boards recommend evaluating and grading discussion board interactions in online classes (Maddix, 2012; Rovai, 2007). The use of rubrics can assist not only in the grading process, but also provide expectations for participation (Ringler et al., 2015).

Since this research focused on using basic LMS data, number of postings, it is unclear if other factors as described in the research had an effect on total postings by

students. Additional research, including looking at the quality of student posts would provide a more complete view of how students interact in discussions and what factors most influence student participation in discussions. In addition, a follow up to this study could look at courses with high interaction in an effort to discover what may be different about those courses, the facilitation strategies, or the students.

Research Question 3

Research question 3 looked at weekly interaction between students and instructors in online discussion boards. This is because it is one thing to understand how instructors and students interact across an entire semester once a semester is over, but it is another thing to better understand how these interactions occur each week. Total posts, average posts per course, and the percentage of overall posts was calculated for each week. Results from the study found that the most interaction occurred during the first two weeks of the semester. After the first week, interaction dropped nearly every week for both instructors and students. During week two, interaction dropped 25% and then during week three interaction dropped 20%. After the first three weeks, on average, interaction dropped about 4% each week. The lowest number of interactions occurred during semester break and finals week.

Best practices for online learning often recommend an “introductory discussion” or “water cooler” where students and the instructor can introduce themselves and become acquainted with others in the online class (Gunawardena & Zittle, 1997; Rovai, 2007). These introductory discussions are meant to spark a sense of community (Gunawardena & Zittle, 1997). However, similar to other studies (Pham, Thalathoti, & Dakich, 2014), interactions in this data set dropped over the course of the semester. Pham et al. (2014)

found after a high level of engagement at the beginning of the course, momentum faded as the semester continued. Research, though, has highlighted the importance for online instructors to create motivation throughout the semester in order to increase student engagement in discussions (Rovai, 2007). This means that without extrinsic motivation, even the most motivated student may have a hard time staying engaged in an online course. One strategy identified by researchers to increase extrinsic motivation is to assign a grade for discussion participation ranging from 10 to 35% of the overall course grade (Rovai, 2007). Rovai (2007) points out that students should be clear on what and how their being graded. Some instructors use discussion board rubrics, to assist students in self assessing their participation and provide clear expectations, while others simply require a minimum number of posts each week. Other strategies for maintaining motivation and increasing interaction throughout the semester include making sure the discussion activities are directly tied to the course objectives, use small group discussions to encourage participation from students who may be reluctant to post in larger discussions, and provide tutorials or detailed instructions for those who may not be familiar with discussion board technology (Suler, 2004). Finally, many researchers believe that the instructor should actively participate in discussions, but without taking over or responding too quickly (Bliss & Lawrence, 2009a).

Research Question 4

Research suggests that learner-instructor interaction plays an important role in student satisfaction, therefore, research question 4 looked at the possible relationship between asynchronous discussion interaction measures and student satisfaction scores. A Spearman's rank-order correlation was used to assess the relationship between student

satisfaction score and total posts in a course. 392 courses with discussions were used in the analysis. Results showed that there was no statistically significant correlation between student satisfaction and total discussion board posts in a course. Although there is a large body of research which suggests that classroom participation and engagement is positively associated with student satisfaction, results of this study found no association (Hrastinski, 2008; Jung et al., 2002; Sher, 2009; Swan, 2004).

However, there are a number of possible explanations for the result of no correlation between total posts and student satisfaction scores. First, there could have been an issue with the dataset. There were limited resources available for validation and interpretation of the data and therefore, there could be errors unknown to the researcher. In addition, the exploratory nature of this study lends itself to exploring outliers more deeply in future research. As Teasley (2019) points out, volume of data alone does not prove validity or provide the ability to generalize across entire populations. The data from this research is subject to errors in analysis or interpretation.

Another possible explanation is that discussions are not correlated to student satisfaction. Richardson and Swan (2003) found that students with a high perception of social presence also felt they learned more and were more satisfied with the instructor. It is generally well accepted that regular and substantive interaction between the instructor and students is a critical part of a quality online course (Battalio, 2007; Richardson & Swan, 2003). However, discussions are not the only place interaction can occur. Huang and Hsiao (2012) identified seven different communication tools which facilitated online interaction between learners and instructors. Those tools included email, discussion boards, announcements, blogs, streaming audio/video, chat, and web-conferencing

(Huang & Hsiao, 2012). It could be that a variety of communication tools are being used in online courses and in order to fully understand the effects of interactions on student satisfaction additional research would need to be done.

Finally, it is worth considering that courses with high number of discussion interactions are of higher quality, but no correlation was found because this study measured student satisfaction, not quality. Boysen et al. (2014) lament that although student evaluations are often used as a direct measure of teaching quality, it is difficult to make accurate judgement about instructors based on the results of student evaluations. Additionally, there is "eternal debate" about the validity and interpretation of student evaluations (Boysen et al., 2014, p. 641). Additionally, this research used a calculated score, which was an average of all the end-of-course evaluation questions. It is possible that looking just at a single measure, such as instructor overall, would serve as a better measure.

Implications for Research and Practice

The U.S. Department of Education has identified regular and substantive interaction between the instructor and students as a standard and required practice for online education to be considered for federal funding (U.S. Department of Education, 2014). Best practices and quality standards for online education also acknowledge the importance of interaction (Lowenthal & Davison-Shivers, 2019; Richardson & Swan, 2003; Swan, 2004). In fact, Spiros Protopsaltis, former deputy assistant secretary of education in the Obama administration, said that "interaction between a student and an instructor is an integral part of the education process" (Toppo, 2018). And although there are an increasing number of ways to facilitate this interaction, asynchronous discussion

boards are still the most popular (Lieberman, 2019). Therefore, this study sought to explore the frequency of interaction between instructors and students in discussion boards in online courses at the University of Colorado Denver.

The first major finding was that numbers alone do not tell the entire story. Although LMS data has become more readily available and accessible for analysis, the differences in course design and course facilitation made it difficult to generalize across all courses. Courses in this study had wildly different practices when it came to discussions. For example, in some courses, no discussions were present while other courses had over 100 discussions. Due to the decentralized development model for online courses, the differences in the number of discussions is unexplained. However, perhaps courses with many discussions break students into discussion groups or even pairs. Meaning that for every discussion, there are duplicates of that discussion to allow groups or pairs to respond to one another, as opposed to the entire class. Although there are other ways of accomplishing this in the LMS, depending on the training of the instructor they may be unaware. Additionally, there may be pedagogical reasons for making group discussions available to other groups in the course. Without a deeper analysis of course design and course facilitation, the numbers from the LMS data only tell a part of the story. Therefore, it would be suggested that if department chairs or administrators wanted to use discussion board activity to inform evaluation, they do so along with other data points.

Another major finding in this data set was that the total posts in a course was not correlated to student satisfaction. Even though there were no findings in this study additional research would need to be conducted to confirm these results in other contexts.

Therefore, it would be logical to continue to follow best practices which include making efforts to participate regularly in discussions, setting expectations, and assigning grades for participation in discussions. These best practices are aligned with research related to increasing social presence among students (Garrison et al., 2000; Gunawardena & Zittle, 1997).

In addition, this research makes use of LMS data, which historically has been difficult to obtain. With a growing interest in using student data to improve teaching and learning, this research serves as an example of how advances in technology and reduced data storage costs has allowed institutions to take advantage of the tremendous amount of data available in the LMS (Viberg, Hatakka, Baleter, & Mavroudi, 2018). However, this research also brings up a number of concerns about "if" Canvas data should be used. Viberg et al. (2018) suggests that concerns of data privacy, security and informed consent of learning data should be considered as institutions scale research efforts using learning data. Although data from this study was anonymized and exploratory in nature, it brings up questions about how institutions should ensure ethical practices as future research is conducted. The ethical considerations of using learning management data is a much larger discussion, but it felt worth mentioning as a consideration for institutions looking to utilize LMS data for their own research.

Specifically, at CU Denver, the results from this study could be used to inform department chairs and administrators of the general practices of discussion board use at CU Denver. Using this information, department chairs or administrators could target courses with low number of discussions or instructors and students with fewer than average number of discussion posts during the first few weeks of class. By catching low

levels of interaction early, support and guidance can be provided to instructors or students in order to increase interaction throughout the semester. These results could also be used by instructional designers at CU Denver in order to guide recommendations for future training and support. As mentioned previously, CU Denver provides extensive training opportunities for instructors. This research could be helpful to share with instructors as a baseline of minimum interaction that should be occurring in their online classes.

Limitations of the Study

The generalization of this research to a larger audience is limited due to the size and scope of the study. The courses, instructors, and students in this study come from a single university with a common LMS, Canvas. The actual teaching methods used in each class varied, as there is no standardized production of courses at CU Denver. Additionally, this research took a campus wide view of discussion interactions. It did not consider situational variables, (e.g., class size, subject matter, faculty experience). Additionally, the researcher did not have access to other datasets, such as course grades or retention rates, which would be worthwhile beyond student satisfaction. Finally, due to the exploratory nature of this study, additional research would need to be completed in order to more fully understand how students and instructors are interacting in online courses.

Another limitation is the data set used for this study. The data set consisted of numeric totals of discussion activity by instructors and students. The quantity of posts is only one metric. Bliss and Lawrence (2009b) describe additional metrics to measure interaction in discussion boards, such as quality of posts and the extent of threading. Quality of posts would require transcript analysis, while the extent of threading would

need to examine the structure of the discussion boards. However, these additional metrics would require significant resources, so it was of value to explore how numeric data could be used. Additionally, it is important to disclose that Canvas data is not perfect and is subject to misinterpretation. However, best effort attempts were made to validate the data prior to the research. Like most research, there is a chance of misinterpretation or error, particularly when using large data sets.

The data for this study is just a small subset of data available from Canvas Data. The researcher was provided numeric data which could be used to answer the research questions in the study. However, due to the anonymous nature of the data, there are many unknowns. For instance, courses with multiple instructors had to be removed from the analysis because there was no way to identify which instructor was participating in the discussion. Additionally, discussion board data was limited to the number of discussions. Since no metadata was included, such as the creation date or the creator of the discussion, it was not possible to determine whether the instructor or students created the initial discussion board from the data set. Using purely numeric data improved the anonymity of the dataset but simplified the data which limited the final analysis.

Future Research

There are many future directions for additional research. Specifically, as it related to this research, this study only looked at the quantity of posts by instructors and students. Future research could expand to include the quality of posts, length of posts, as well as the extent of threading. Bliss and Lawrence (2009a) recommend using multi-factor metrics to provide a more complete view of how interactions occur in online discussion boards. Additionally, with an array of best practices for discussion boards, it would be

valuable to explore if the use of best practices, like providing clear guidelines for discussions or grading discussions, has any effect on the quantity of posts. Although not touched on in this research, the impact of faculty training on the quantity of interactions may provide guidance or direction for faculty development organizations. With access to Canvas data, there are many possibilities to explore.

Specifically, at CU Denver, future research would involve expanding the exploratory nature of the study for additional campus wide interpretation. In order to continue the exploration, CU Denver could attempt to test correlations with different measures of interaction. Since this study used an average score from end-of-course evaluations to represent student satisfaction, it would be worth looking at individual questions to see if a correlation exists. It would also be worth looking at other semesters to determine if similar results were found regarding discussion board activity. Alternatively, a similar study could be conducted using specific data for a school or college or a subset of the campus population, such as lecturers or tenure-track faculty. Additional research would be based on the campus or specific unit needs.

Discussion boards are just one tool for interacting in online courses. The single metric is not adequate for measuring or ensuring that online courses meet the "regular and substantive" interaction requirement set by the U.S. Department of Education. Future research could look more diversely at the toolset used for communication in online courses in an effort to establish metrics which could be used to measure interaction.

Conclusion

The findings of this study explores and builds upon current research and theory related to the importance of interaction between students and instructors in online

courses. Results found that discussion board activity of students and instructors varied greatly depending on the course. There was no relationship between the number of discussion board interactions and student satisfaction, as tested in this study. The result of this study contributes research and practice for online education by extending the research related to asynchronous discussion boards. In addition, this research serves as a proof of concept for additional research which uses data available from the LMS to continue the work of improving online education. Future research includes expanding exploring quantity verses quality or expanding to examine how other communication tools are being used for online teaching.

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APPENDIX

Faculty Course Questionnaire (FCQ) Questions

1. Estimate the average number of hours per week you have spent on this course for all course-related work including attending classes, labs, recitations, readings, reviewing notes, writing papers, etc.	1-3	4-6	7-9	10-12	13-15	16+

For the items below, the scale is **Lowest = 1 to 6 = Highest.**

	Lowest					**Highest**
2. Rate your personal interest in this material before you enrolled.	1	2	3	4	5	6
3. Rate the instructor's effectiveness in encouraging interest in this subject.	1	2	3	4	5	6
4. Rate the instructor's availability for course-related assistance such as email, office hours, individual appointments, phone contact, etc.	1	2	3	4	5	6
5. Rate the intellectual challenge of this course.	1	2	3	4	5	6
6. Rate how much you have learned in this course.	1	2	3	4	5	6
7. Rate the course overall.	1	2	3	4	5	6
8. Rate the instructor overall.	1	2	3	4	5	6
9. Rate this instructor's respect for and professional treatment of all students regardless of race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, or veteran status.	1	2	3	4	5	6

Publicly available: https://www.colorado.edu/fcq/