April 2022

Relationships among the Community of Inquiry, Achievement Emotions, and Academic Achievement in Asynchronous Online Learning in Higher Education

David H. Tai
University of South Florida

Relationships among the Community of Inquiry, Achievement Emotions, and Academic Achievement in Asynchronous Online Learning in Higher Education

by

David H. Tai

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in Curriculum and Instruction
with a concentration in Instructional Technology
Department of Educational and Psychological Studies
College of Education
University of South Florida

Major Professor: Sanghoon Park, Ph.D.
Robert Dedrick, Ph.D.
Darlene DeMarie, Ph.D.
James Hatten, Ph.D.

Date of Approval:
December 7th, 2021

Keywords: Activity Emotions, Cogmotion Theory of Learning, Cognitive Presence, PLS-SEM

DEDICATION

I dedicate this dissertation to the youngest and one of the best community college presidents in American history, Dr. Carl Kuttler Jr., who devoted his entire life to education. Dr. Kuttler created opportunities for many who otherwise would have no chance to fulfill their potential. I'm one of those lucky ones blessed by Dr. Kuttler's generous and compassionate helping hands. I met Dr. Kuttler in May of 1991 when he visited my college in China, Baoji Teachers' College (now called Baoji University of Arts and Sciences), along with 18 other American community college presidents. I was a young faculty member in the English department and served as the interpreter for the presidents' meetings. When all the presidents went sightseeing, Dr. Kuttler decided to work and took a four-hour car ride to visit my college and discussed establishing a sister-college relationship. As a result, I became the first visiting scholar at St. Petersburg Junior College on Friday, Sept 13th, 1991. After I came to the U.S., Dr. Kuttler took me in and guided me as if I were one of his own family members. He further helped me go to graduate school, which opened all the possibilities in my life. Thank you, Dr. Kuttler, for believing in me and opening doors for me. More importantly, thank you for over 30 years of generosity. You are a man of your word. You do what you say. You have been my inspiration. I've never seen anyone who works as hard as you do. Without you helping me come over to America, my life would have been entirely different, and this dissertation from USF would have been implausible. Thank you for being the linchpin in my life at the critical stage of my life and for changing many people's lives like mine through your hard work in the American educational system.

ACKNOWLEDGEMENTS

I would not have been able to complete my dissertation without the never-ending and indefatigable help from my committee members, mentors, and family. I'm lucky to have had two dissertation committees. Dr. Ann Barron from my first dissertation committee was the most influential professor in my life. Being a graduate assistant for Dr. Barron and learning how to program the web in 1994 opened a whole new world for me. Your devotion to your students, dedication to research, and publication productivity are impeccable qualities for me to model.

My final dissertation committee members were Dr. Sanghoon Park, Dr. James Hatten, Dr. Robert Dedrick, and Dr. Darlene DeMarie. Thank you, Dr. Park, for giving me a second chance by working with the USF graduate school to readmit me after a 15-year hiatus. Pointing me to use PLS-SEM for my dissertation statistical analysis was a turning moment and led us to a breakthrough finding: emotion is the rudder of learning. Dr. Hatten, thank you for allowing me to teach the Digital Identity class you created. Without this class and many students participating in my research, there won't be sufficient data to validate my theory. Dr. Dedrick, thank you for finding time in your early mornings to coach me on statistical analysis and on how to write scholarly. Without the thoughtful questions you asked, I wouldn't have changed my theoretical model to uncover the central role activity emotions played in asynchronous online learning. Finally, thank you, Dr. DeMarie; your Cognitive Issues class launched me into the cognition and emotion literature, enabling me to propose the Cogmotion Theory of Learning. More importantly, your philosophy class cemented me into the post-positivism philosophical paradigm and affirmed my determination to be a learning scientist.

IBM and my IBM mentors, such as Ed Timmons, Gordon Fuller, Ted Hoff, and Diane Gherson, have played a long-lasting role in the making of my dissertation. Thank you, Ed, for hiring me into IBM and for all the tuition paid to USF. The years when we were creating the e-learning revolution, especially the asynchronous learning paradigm shift at IBM, became the foundation of my dissertation. Your trust, kindness, and continued nudge calling me "Dr. Tai" built my urge to finish the Ph.D. I started in 1994. I will never forget your motto, "it's later than you think," and continue to complete my bucket list and leave no regrets behind. Gordon and Ted, thank you for sending me to China and enabling me to create IBM's first 3D virtual learning game. Ted, thank you for rotating me to India, a country that left me with the best memories. Diane, thank you for so many years of mentoring. Your high-impact thinking approach enabled me to achieve a breakthrough in creating the Cogmotion Theory of Learning.

Last but not least, I want to thank my lifelong partner and wife, Jane Tai, my son, Jonathan Tai, and daughter Elisabeth Tai for all their never-ending support, love, and prayers. Thank you, Jane, for taking care of everything at home so that I can focus on my studies. Your patience, endurance, and love are unparallel, and I'm ever indebted to you. Jonathan, I still remember your adorable dissertation prayers when you were only three. I learned that prayers do work even though timing might not be in our control. Finally, Elisabeth, your hard work, from launching your small business during COVID to bringing your puppy, Xiangfei, home, showed me anything is possible if I put my heart into it.

A seemingly impossible dissertation became possible at last. Thank you all, including many I missed to enumerate here, for helping me make the impossible possible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This research aimed to investigate how achievement emotions predict, mediate, and affect academic achievement in online learning. Online learning has been proliferating, but little is known about how emotion mediates cognition in the Community of Inquiry framework. Recent progress in cognitive neuroscience provided the theoretical foundation for researchers to investigate emotion's role in online learning, especially academic achievement. The researcher of this study adopted a quantitative non-experimental research design to investigate how achievement emotions mediated, predicted, and affected academic achievement in the Community of Inquiry framework. The Partial Least Square Structure Equation Modeling (PLS-SEM) method was adopted for statistical analysis. The participants were 110 undergraduate university students enrolled in an online course called Digital Identity in the Spring and Summer semesters of 2021 in a large public university. The researcher of this study discovered activity emotions singularly and significantly mediated teaching presence and cognitive presence to predict and affect academic achievement. This research was the first to pinpoint the criticality of activity emotions to academic achievement in online learning. Although four limitations existed in this research, the findings of this research extended the Control Value Theory of Achievement Emotions into the Community of Inquiry framework. A new learning theory called the Cogmotion Theory of Learning was proposed for the asynchronous online learning environment. Thus, this research and the Cogmotion Theory of Learning can enable future researchers to specify new design principles based on the criticality of activity emotions for learners to realize better achievement and higher performance.

Chapter One: Introduction

What role does emotion play in online learning? More importantly, does emotion mediate, moderate, or predict academic achievement? These questions do not have clear answers in the online learning research literature, even though neuroscientists have validated emotion's inextricable role in decision-making, cognition, and learning (Barrett, 2020; Damasio, 1999, 2005; Dirkex, 2001; Immordino-Yang & Damasio, 2007; Linnenbrink-Garcia & Pekrun, 2011; Tyng et al., 2017). Recent progress in cognitive neuroscience provided the theoretical foundation for researchers to investigate emotion's role in online learning, especially academic achievement. The Control-Value Theory of Achievement Emotions (Pekrun, 2006) is one of the most prominent applied theories of emotion undergirded in cognitive science. This theory had validated the predictive relationship between achievement emotions and academic achievement in the traditional classroom learning environment, but not in online learning yet (Daniels & Stupnisky, 2012). In the online learning environment, the Community of Inquiry framework (Garrison et al., 1999, 2010; Garrison & Arbaugh, 2007) is the most widely used framework for online learning research, design, and delivery (Castellanos-Reyes, 2020), but how this framework impacts academic achievement concerning achievement emotions has not been studied (Annand, 2019; Lawson, 2019).

This research aimed to explore the relationship among the Community of Inquiry, achievement emotions, and academic achievement in asynchronous online learning in higher education. Chapter one seeks to establish the rationale of this study and expound on the research questions and hypotheses. The sections of this chapter include: 1) Context of the Study, 2)

Problem Statement, 3) Research Questions, 4) Conceptual Framework and Hypotheses, 5) Significance of the Study, 6) Definitions of Terms, and 7) Summary.

Context of the Study

The context of this study underpins upon 1) the advancement of neuroscientific research on emotion, 2) the Control-Value Theory of Achievement Emotions, 3) the rapid growth of online learning, and the Community of Inquiry framework.

The Advancement of Research in Emotion

Emotion is an integral part of human existence (Barrett, 2017b; Benozzo, 2011; Durant, 1943). Philosophers and scientists have studied emotion as long as civilization existed. Contrary to the common understanding that Plato (428/427-348/347 BC) might have emphasized reason over emotion, he maintained desire, emotion, and knowledge were the three fundamental drivers of human behavior (Durant, 1943). Plato listed three elements to describe human behaviors, but two were emotion related. After Plato established his school, he tested each of his students and tailored their learning based on whether they were lovers of wisdom, lovers of honor, or lovers of gain. For those who loved wisdom, he trained them to be politicians; lovers of honor, soldiers; lovers of gain, businessmen. Plato's educational method established the importance of emotion for education and training as long as western civilization existed.

On the other hand, Plato did not study human emotions further to provide categories of emotions. It was Rene Descartes (1596-1650), a French philosopher, in answering a request from Princess Elisabeth of Bohemia whose love life caused her to question the nature of happiness, passions, and ethics wrote the first book on emotion in 1643: "The Passions of the Soul" (Descartes & Voss, 1989). In this book, Descartes concluded six emotions in human beings: wonder, love, hatred, desire, joy, and sadness. He further postulated that all other human

emotions were derivations from these six emotions. Although Descartes believed that human emotions underlined human behaviors, he asserted that people should control their emotions rather than be controlled by them (Durant, 1943). Descartes was the first philosopher who defined the six basic human emotions. He was also the first who set the stage for rationalists to discard the importance of emotion in human activities (Kuhn & Hacking, 2012). As rationalism continued to elevate the importance of reason over emotion in the 18th century, a Scottish Enlightenment philosopher, historian, and economist, Humes (1711-1776), argued against rationalists. He posited that humans derived knowledge from empirical experience, not merely from the "I think; therefore, I am" paradigm of rational thinking (Damasio, 2005; MacNabb, 1951). As a result, he proclaimed that emotion, not reason governed human behaviors (MacNabb, 1951). Furthermore, he maintained that reason should be the slave of emotion, not the other way around (MacNabb, 1951).

Although Humes attempted to emphasize emotion's importance above reason, he did not conduct empirical studies to validate his proclamation. It was Darwin (1809-1882) who established the foundation to study emotion scientifically. He used the empirical observational method to study how animals and humans expressed their emotions first. Then he published his third evolution-theory-based book: "The Expression of the Emotions in Man and Animals" (Darwin, 1872) in 1872. This book set the foundation for the science of emotion and enabled more scientists to study emotion in the future (Barrett, 2017b). Similar to Descartes, Darwin concluded six basic human emotions. However, unlike Descartes, he concluded the following six basic emotions that became the basis of all modern-day emotion-related research: happiness, sadness, fear, anger, surprise, and disgust (Barrett, 2017b; Ekman, 1992; Ekman & Cordaro, 2011).

After Darwin established the six basic human emotions, the 20th century arrived, and behaviorism dominated the social and psychological research fields, causing researchers to ignore Darwin's and previous philosophers' emphasis on emotion's importance, but only fixated on observable behavioral changes during empirical studies (Lukenchuk, 2013). Thus, by the time cognitive psychology emerged, researchers either forgot or ignored Darwin's research on emotion. Fortunately, one researcher, Paul Ekman (1934-), stumbled upon the emotion research field and started his facial expression research in the 1960s based on Darwin's six basic emotions (Barrett et al., 2016). Through experimental studies around the world, Ekman validated Darwin's six basic emotions and established the linkage between these six emotions with six universal facial expressions (Ekman, 2006).

As Ekman's facial expression research matured into the 1990s, cognitive neuroscience made significant discoveries. Damasio (1994), one of the most prominent cognitive neuroscientists found that the human emotional process guided and biased human behaviors, particularly in decision-making (Adolphs et al., 1994). He used gambling tasks and experimentally established the somatic marker hypothesis. Somatic markers are emotions exhibited as bodily and physiological feelings and changes. For example, anxiety is an emotion that embodies rapid heartbeats. Disgust is another emotion that could induce nausea. These somatic markers are significant and vital as they become indicative, pivotal moments for humans to shift their decisions (Bechara et al., 2005). These somatic markers strongly influence decision-making, especially in complex and uncertain situations such as gambling (Bechara et al., 2005; Damasio, 2005), and were validated to be linked in the ventromedial prefrontal cortex and the amygdala neural system (Bechara et al., 2005; Damasio, 1999, 2005). Damasio (1994) found that patients whose frontal lobe was damaged could not make rational decisions even though their

working memory, attention, language, and logical thinking were intact, proving the importance of emotion in cognition and decision-making. Disappointedly, educational researchers have made little progress in applying the cognitive neuroscience findings, especially emotion's inextricable relationship with cognition and learning in educational research (Anderman & Corno, 2016; Linnenbrink-Garcia & Pekrun, 2014).

With Damasio's (1994) breakthrough in establishing emotion's pivotal role in cognition and decision-making, 21st-century neuroscientists such as Barrett (2017a, 2020) discovered that emotions were subjectively constructed cognitive predictions and active mental simulations, not simply reactive physiological responses and reactions. This unprecedented discovery has revolutionized the emotion research field and is likely to accelerate neuroscientific findings in education. One of the challenges in emotion-related research was the difficulty of measuring and capturing people's emotions. Barrett's (2014) groundbreaking finding was due to her methodological shift to constructionism; therefore enabled her to empirically validate that emotions were not simply physiological reactions but cognitive simulations and constructions. Emotions are merely predictions and mental simulations of what might happen subsequently based on one's judgment on the current situation and past experiences. Barrett (2017a) maintained that emotions are not limited to six, but multitude as humans construct complex and intricate emotions depending on their situations. This finding is revolutionary because Barrett (2013) invalidated Darwin's six basic emotions theory, the foundation of all emotion-related research in the past 200 years.

In summary, Barrett's (2017a, 2020) revolutionary findings shifted the emotion research paradigm to constructionism and established the Theory of Constructed Emotion, replacing Darwin's theory of six basic human and animal emotions. Her discovery solved one of the most

significant issues in emotion-related research, the difficulty of tracking and measuring people's emotions. Now that emotion is defined as constructed, a mental cognitive process, educational researchers could enable students to construct emotions conducive to learning without being confined to the six basic emotions theory. The Theory of Constructed Emotions could create a paradigm shift to accelerate emotion-related research for better cognition, learning, and academic achievement. Unfortunately, the researcher of this study did not find any research that applied the Theory of Constructed Emotions in the online learning setting. It is time for educational researchers to use these new cognitive neuroscientific advancements in emotion in the learning context. Thus, the advances of neuroscientific research in emotion underline the current study. The researcher's goal is to accelerate the application of the Theory of Constructed Emotion in the learning design and technology field.

Control-Value Theory of Achievement Emotions

Not many theories of emotion exist in the educational research field. However, the Control-Value Theory of Achievement Emotions (Pekrun, 2000) is the only one with roots in cognitive science and neuroscience. Pekrun (2000) rooted the Control-Value Theory of Achievement Emotions in the Attribution Theory of Motivation and Emotions (Weiner, 1986) and the Circumplex Model of Emotion (Russell & Barrett, 1999; 1980).

Pekrun first created the Expectancy-Value Theory of Anxiety in 1992. As he expanded his research into other academic emotions, he found achievement emotions correlated with academic successes. For this reason, he revised his Expectancy-Value Theory of Anxiety to Control-Value Theory of Achievement Emotions (Pekrun, 2000, 2006). This theory is an integrated framework that describes the antecedents and effects of emotions experienced by

learners. Achievement emotions are composed of two types of emotions: activity emotions and outcome emotions.

Activity emotion is a sub-construct of the achievement emotion construct. Activity emotions relate to the ongoing achievement-related activities such as studying, completing an assignment, interacting with classmates, and preparing for a test. Activity emotions include enjoyment, boredom, and anger (Pekrun, 2006).

Outcome emotion is another sub-construct of the achievement emotions, which includes two categories of emotions: prospective emotions and retrospective emotions. Prospective emotions are emotions in anticipation of learning activities and have hope, anxiety, hopelessness. Retrospective emotions are emotions engendered by the outcomes of learning activities such as test scores and include emotions such as pride, relief, and shame.

Suppose learners are engaged in a conducive learning environment. In that case, their positive achievement emotions are activated, exhibiting the activity emotion such as enjoyment and outcome emotions such as joy, hope, pride, and gratitude. On the other hand, if the learning contents are too easy, learners' positive emotions could be deactivated, causing learners to show relaxation for the activity emotion and contentment or relief for outcome emotions. On the other hand, if learners are not happy with the learning environment, they activate their negative emotions to show anger and frustration as activity emotions, and anxiety, shame, or anger as outcome emotions. Similarly, learners activate boredom in the activity emotion category or sadness, disappointment, and hopelessness in the outcome emotion category. The emotion activation and deactivation process described in the Control-Value Theory is similar to the construction process in the Theory of Constructed Emotion. Students construct or activate their positive emotions based on the successes in their past learning experiences.

Similarly, students construct or activate their negative emotions based on their past learning experiences, even if the new learning contents might be comparatively more manageable than their past learning experiences. This cognitive process of emotion activation and deactivation dovetails with the latest neuroscientific findings explained by the Theory of Constructed Emotions. Thus, it provides a solid theoretical foundation to contextualize the current research.

Online Learning and the Community of Inquiry

Enrollment in higher education has been declining, but online learning enrollment has been increasing rapidly. When the mobile internet started to accelerate in 2010, undergraduate and graduate degrees enrollment went down 32% (Educationdata.org, 2021). In 2010, there were 29.5 million students (Educationdata.org, 2021) studying for undergraduate and graduate degrees. In 2021, there were only 19.81 million (Statista, 2021) students enrolled, which was a 32% drop in higher education enrollments.

At the same time, online enrollment has been increasing rapidly. In the same period when higher education enrollment decreased 32% from 2008 to 2018, online registration increased by 151% (Employment Department, 2021). By 2026, the projected increase of online enrollment is another 29.1%, with an additional 2.6 million new students joining the rapidly growing online learning platform (Employment Department, 2021). Online learning became the de facto option during the COVID-19 pandemic. There is a potential that online enrollment might accelerate now that every student has experienced some level of online learning during the COVID-19 shutdown (Bozkurt et al., 2020; Dhawan, 2020).

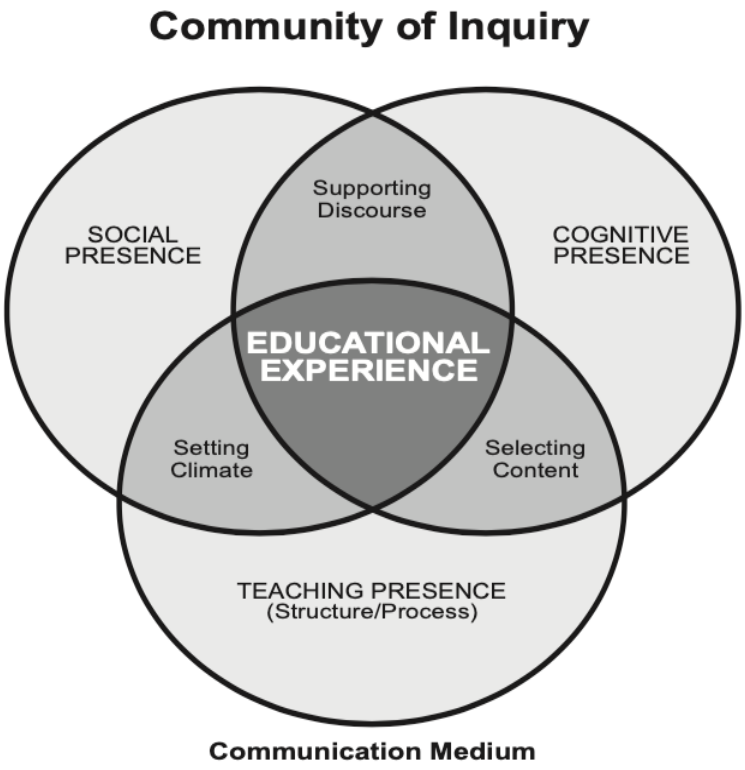
On the other hand, studies have revealed that emotion-related issues such as lack of bonding, social-emotional interactions, and engagement were inhibitors of online learning

(Bozkurt et al., 2020). Without understanding the role emotion plays in online learning, particularly its relation to academic achievement, an inherent risk exists in the quality of learning outcomes for billions of online learners. This rapid growth in online learning requires a better understanding of how emotion impacts learning, creating the urgency and criticality of the current study.

Figure 1

The Community of Inquiry Framework

From "Critical inquiry in a text-based environment: computer conferencing in higher education" by R. D. Garrison, T. Anderson, and W. Archer, *The Internet and Higher Education*, 2, p. 88. Copyright 1999 by Elsevier Science Inc. Reprinted with permission.



The Community of Inquiry (Garrison & Arbaugh, 2007a) is the most prominent online learning framework. Garrison and Arbaugh (1999) created this framework 20 years ago when

computer-mediated communication rapidly expanded to the online learning arena precipitating the need for a new online learning model. This framework was based on Dewey's social constructivism theory and was a distance transaction model enabling teachers and students to traverse distance through learning management systems to build learning communities for inquiry (Garrison et al., 1999; Garrison & Arbaugh, 2007). The Community of Inquiry framework has three key components: teaching presence, social presence, and cognitive presence. See Figure 1.

Teaching presence is the planning, organization, and delivery process of instruction and learning. The activities include directing instructions, managing students' learning processes, and building understanding. Successful teaching presence indicates defining learning goals, initiating discussion topics, sharing personal meaning, and focusing on discussions (Garrison et al., 1999).

Social presence is the online collaborative learning experience through interactions with instructor(s) and classmates. From a student's perspective, social presence means projecting themselves socially and emotionally as real people in online communication. Activities in social presence include emotional expression, open communication, and group cohesion. Indicators of social presence are emotional exhibition, risk-free expression, and active collaboration (Garrison et al., 1999; Garrison & Arbaugh, 2007a). The first indicator of social presence is the emotional expression activities, indicating emotion plays an essential role in the Community of Inquiry.

Cognitive presence depicts how learners use critical thinking to construct knowledge through discourse and reflection in an online computer-mediated asynchronous learning environment. Students start their cognitive presence through a triggering event asked by their instructor. Then they start an exploratory learning process and complete the cycle of cognitive presence by integrating their exploration into a resolution. An example would be completing an

assignment given by the instructor, participating in a discussion thread, producing a prototype, or writing a paper. Cognitive presence indicators include information exchange, connecting ideas, and applying the newly learned knowledge into practice. Sense of puzzlement, a knowledge emotion between surprise and confusion, was particularly pointed out by Garrison et al. (1999), indicating the Community of Inquiry framework acknowledges the role of emotion in online learning.

After 20 years of research and practices, researchers and practitioners of the Community of Inquiry called for the need to address emotion-building as a pedagogical tool within this framework (Campbell, 2006; Cleveland-Innes & Campbell, 2012; Lawson, 2019; Mardi, 2020; Stenbom et al., 2016; Williams, 2017). The first time researchers investigated the role of emotion in the Community of Inquiry framework context was in 2006, when Campbell (2006), in her master's thesis, proposed the emotional presence construct to study emotion in online learning. Unfortunately, the researcher did not publish her research result as the study's sample size was small. Still, six years later, Cleveland-Innes and Campbell (2012) increased their research sample size to 217 online learners and published a seminal paper titled "Emotional Presence, Learning, and the Online Learning Environment" (Cleveland-Innes & Campbell, 2012). In this study, the scholars used Confirmatory Factor Analysis and validated the existence and pervasiveness of emotions in online learning. Year to date, researchers published multiple studies using the emotional presence construct and definition created by Cleveland-Innes and Campbell (2012). Still, no research investigated the mediation or moderation relationships between the achievement emotions and academic achievement variables in the Community of Inquiry framework. These studies attempted to modify the Community of Inquiry framework by adding the emotional presence construct as a fourth presence. However, they did not provide sufficient

empirical evidence on whether emotion mediated, moderated, or predicted learning outcomes such as academic achievement. Researchers did not establish correlational or predictive relationships between emotional presence and academic achievement in the context of the Community of Inquiry.

In summary, three factors converged to provide compelling reasons to conduct the current study. First, research in cognitive neuroscience established emotion's inextricable role with cognition and learning. Second, the Control-Value Theory of Achievement Emotions concluded that achievement emotions predict academic achievement. Third, online learning is rapidly growing, but the most prominent framework, the Community of Inquiry, lacks empirical studies on the relationship between achievement emotions and academic achievement. Based on these contexts, the researcher of this study explored the relationships among the Community of Inquiry, achievement emotions, and academic achievement.

Problem Statement

Three critical issues exist in the Community of Inquiry research. First, researchers have not agreed upon the inextricable role emotion plays in the online learning process despite multiple researchers proposing to add emotional presence as a fourth component (Campbell, 2006; Cleveland-Innes & Campbell, 2012; Mardi, 2020; Williams, 2017). Second, researchers have focused on studying the inter-relationships between teaching presence, cognitive presence, and social presence, but not on the most crucial factor of learning: academic achievement (Annand, 2019; Castellanos-Reyes, 2020; Garrison & Arbaugh, 2007). Third, qualitative research methods dominated studies in the Community of Inquiry. More quantitative studies are needed to transform the qualitative textual analysis research method to quantitative studies on how emotion mediates, moderates, or predicts academic achievement. For example, the Control-

Value Theory of Achievement Emotions has empirically validated the predictive relationship between achievement emotions and academic achievement in the traditional classroom environment (Pekrun et al., 2002, 2017). However, the researcher did not find any research that espoused such findings in the context of the Community Inquiry. Finally, no research has investigated the relationships among the Community of Inquiry, achievement emotions, and academic achievement. These three areas of issues form the basis of this study.

Lack of Academic Achievement Research

Researchers of the Community of Inquiry framework have focused on establishing the internal relationship between teaching presence, cognitive presence, and social presence. Year to date, researchers have concluded the following. First, teaching presence is the most crucial factor in the Community of Inquiry as it significantly predicts both cognitive and social presence (Castellanos-Reyes, 2020; Garrison & Arbaugh, 2007). Second, from a learning engagement point of view, teaching presence significantly predicts cognitive presence, while social presence only influences cognitive presence (Fiock, 2020; Garrison et al., 2010). Third, cognitive presence predicts training effectiveness (Garrison et al., 2010; Garrison & Arbaugh, 2007). External to these three presences, researchers used engagement, self-efficacy, and satisfaction variables to study the relationship between teaching, cognitive, and social presences. Finally, researchers (Garrison et al., 2010; Garrison & Arbaugh, 2007) theorized that higher perceived teaching, cognitive, and social presence might mean high course scores. However, the researcher did not find any research investigating the relationship between the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) and academic achievement.

Lack of Emotion's Impact Research on Academic Achievement

Cleveland-Innes and Campbell's (2012) seminal research on emotional presence substantiated widespread emotions in the online learning process. However, they did not investigate the relationship between emotion (i.e., emotional presence) and the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) or academic achievement. They found 23 different types of emotional expressions. For example, at the beginning of an online learning course, students experienced joy, enthusiasm, and excitement because of the flexibility of online learning. When students fulfill the course requirements, they experience pride and contentment. Participating in the online communication process, students felt the emotions such as surprise and excitement or alienation or connectedness depending on different expectations and interaction results. When students encounter unknowns, they feel fear and anxiety. When meeting deadlines and multiple roles, students experienced stress and guilt.

Because of its definition, the emotional presence research did not approach academic achievement as a potential dependent variable. The following is the definition defined by Cleveland-Innes and Campbell (2012):

> "Emotional presence is the outward expression of emotion, affect, and feeling by individuals and among individuals in a community of inquiry, as they relate to and interact with the learning technology, course content, students, and the instructor" (Cleveland-Innes & Campbell, 2012, p. 218).

This definition focused on emotion as an outward expression; therefore, it missed the role emotion serves to inextricably impact memory, cognitive resource allocation, learning strategies, and academic achievement empirically established by researchers in the Control-Value Theory of Achievement Emotions (Pekrun, 2006). Furthermore, because of the incomplete definition of

emotional presence, researchers who conducted subsequent emotion-related studies using Cleveland-Innes and Campbell's (2012) emotional presence definition did not establish the relationship between emotion and academic achievement.

Lack of Quantitative Research

In a thirty-year review of cognition and emotion research, Rothermund and Koole (2018) called for a movement to shift qualitative research to data-intensive quantitative research. Similarly, researchers (Annand, 2019; Garrison et al., 2010; Garrison & Arbaugh, 2007) in the Community of Inquiry also called to shift the traditional textual analysis qualitative research to more rigorous quantitative research. However, quantitative research is even more scarce in emotion-related research using the emotional presence construct. The researcher found twelve studies using the emotional presence construct to study emotion in the Community of Inquiry. Fifty-eight percent used qualitative research methods (Krish et al., 2012; le Roux & Nagel, 2018; Majeski et al., 2018; Mardi, 2020; Pool et al., 2017; Stenbom et al., 2016; Williams, 2017). Only 42% used quantitative research methods (Cleveland-Innes et al., 2013; Cleveland-Innes & Campbell, 2012; Kang et al., 2014; Kucuk & Richardson, 2019; Lawson, 2019). The lack of quantitative research, especially causal and predictive relationship studies, caused the paucity of emotion-related design principles in the Community of Inquiry.

Purpose Statement

This research aimed to explore the relationship among the Community of Inquiry, achievement emotions, and academic achievement in the asynchronous online learning context in higher education. This study deployed a quantitative non-experimental research design using the Partial Least Square Structural Equation Modeling (PLS-SEM) statistical analysis method. The Control-Value Theory of Achievement Emotions posited that achievement emotions predicted

academic achievement in the traditional classroom-based learning environment, but it was unclear whether the same relationship would persist in the Community of Inquiry framework. Furthermore, no researcher explored how teaching presence, cognitive presence, and social presence related to achievement emotions (i.e., activity emotions and outcome emotions) and whether these achievement emotions subsequently predicted academic achievement in the Community of Inquiry framework.

This study introduced the latest advancement of cognitive neuroscience into the Community of Inquiry research to update the incompleteness of the emotional presence definition. Cognitive neuroscientists found that emotion and cognition were inextricable (Damasio, 1999; Immordino-Yang, 2015). Emotion affects cognitive resource allocation, learning strategies, and self-regulation (Barrett et al., 2016a; Camacho-Morles et al., 2021; Linnenbrink-Garcia & Pekrun, 2014; Pekrun et al., 2002). The Control-Value Theory of Achievement Emotions was based on cognitive psychology and aligned with cognitive neuroscience's study of emotion.

The study also introduced the achievement emotion construct as an alternative definition to the emotional presence construct into the Community of Inquiry research field. Using the achievement emotion construct should enable more researchers to investigate how emotions impact different aspects of online learning experiences, especially academic achievements, and provide guidelines to improve the rapidly growing online learning environment.

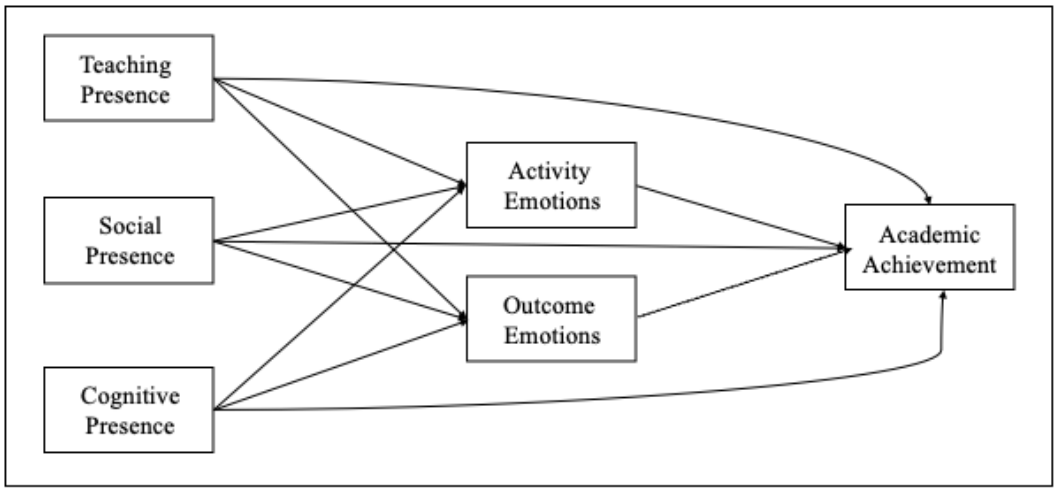
Conceptual Framework

The Control-Value Theory of Achievement Emotions theorized that antecedent events such as listening to a lecture, conducting learning activities, interacting with classmates, and completing assignments cause achievement emotions (Pekrun, 2006). Achievement emotions

included activity emotions engendered while participating in learning activities and outcome emotions while anticipating or completing learning activities (Pekrun et al., 2017). The researcher hypothesized that the antecedents to cause achievement emotions in the Community of Inquiry would be teaching presence, cognitive presence, and social presence. Since achievement emotions were already empirically validated to predict academic achievement in the traditional classroom environment (Huang, 2011; Pekrun et al., 2017), The researcher also hypothesized that achievement emotions would similarly predict academic achievement in the Community of Inquiry. Figure 2 depicts the hypothesized research model of this study.

Figure 2

Hypothesized Research Model



Research Questions

This research aimed to explore the relationship among the Community of Inquiry, achievement emotions, and academic achievement in asynchronous online learning in higher education. The researcher formulated the following research questions based on the conceptual framework and research problem statement.

1. What is the relationship between asynchronous online students' perception of the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) and their achievement emotions (i.e., activity emotions and outcome emotions)?
2. What is the relationship between asynchronous online students' perception of the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) and their academic achievement?
3. What is the relationship between asynchronous online students' perception of their achievement emotions (i.e., activity emotions and outcome emotions) and academic achievement?
4. How do students' achievement emotions (i.e., activity emotions and outcome emotions) mediate the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) to impact their academic achievement in asynchronous online learning in higher education?

Hypotheses

Hypotheses are tentative explanations or predictions for a correlational study (Cohen et al., 2011). Based on the conceptual framework of this study and the research questions, the researcher formulated the following hypotheses.

H1. Teaching presence (TP) has a significant positive effect on activity emotions (AE).

H2. Teaching presence (TP) has a significant positive effect on outcome emotions (OE).

H3. Teaching presence (TP) has a significant positive effect on academic achievement (AA).

H4. Social presence (SP) has a significant positive effect on activity emotions (AE).

H5. Social presence (SP) has a significant positive effect on outcome emotions (OE).

H6. Social presence (SP) has a significant positive effect on academic achievement (AA).

H7. Cognitive presence (CP) has a significant positive effect on activity emotions (AE).

H8. Cognitive presence (CP) has a significant positive effect on outcome emotions (OE).

H9. Cognitive presence (CP) has a significant positive effect on academic achievement (AA).

H10. Activity emotions (AE) have significant positive effects on academic achievement (AA).

H11. Outcome emotions (OE) have significant positive effects on academic achievement (AA).

H12. Activity emotions significantly meditate teaching presence to impact academic achievement.

H13. Outcome emotions significantly meditate teaching presence to impact academic achievement.

H14. Activity emotions significantly meditate social presence to impact academic achievement.

H15. Outcome emotions significantly meditate social presence to impact academic achievement.

H16. Activity emotions significantly meditate cognitive presence to impact academic achievement.

H17. Outcome emotions significantly meditate cognitive presence to impact academic achievement.

Significance of the Study

The current study is significant in three aspects. First, it answered the call to shift the Community of Inquiry research from internal relationship studies toward learning-outcome related research (Annand, 2019; Garrison et al., 2010; Garrison & Arbaugh, 2007). Second, the current study was the first to use the achievement emotion construct to explore the relationships among the Community of Inquiry, achievement emotions, and academic achievement. Establishing the mediational relationship between the Community of Inquiry and achievement emotions could establish a foundation for future researchers to shift studying what emotions exist in online learning to designing emotions for better learning outcomes. Third, using the PLS-SEM statistical analysis method answered the call to shift the Community of Inquiry research method from qualitative, descriptive, and textual analyses to quantitative studies (Annand, 2019; Garrison & Arbaugh, 2007).

Definition of Terms

Terms used in this study are based on the Control-Value Theory of Achievement Emotions (Pekrun, 2006) and the Community of Inquiry framework (Garrison & Arbaugh, 2007a). The following terms are defined in alphabetical order.

Academic Achievement. Lindholm-Leary and Borsato (2005) defined academic achievement as 1) communication (oral, reading, writing), 2) thinking, and 3) subject-area skills that enable a student's success in school and society. The academic achievement score from the online Digital Identity course was used to assess academic achievement for this research. Specifically, 1) ***communication skills*** were assessed through writing tweets and participating in discussion forums weekly. 2) ***Thinking skills*** were assessed through weekly quizzes and digital artifact creations. An example of a digital artifact was the creation of a digital infographic that analyzed

the pros and cons of digital anonymity. 3) ***The subject-area skills*** were assessed by capstone website creation and social media campaign projects for a non-for-profit organization.

Academic Emotions. Pekrun, Goetz, and Titz (2012) defined the academic emotion construct through a synthesis of learning-related emotions research from 1974 to 2000 and five qualitative studies (Pekrun et al., 2002). They defined academic emotions as emotions experienced by students in educational settings related to taking classes, conducting learning activities, and completing tests.

Achievement Emotions. Based on Chou (2021) and Pekrun et al. (2017), achievement emotions affected learning outcomes. These emotions dovetail through appropriate learning strategies, self-regulation, motivation adjustment, and academic achievement.

Activity Emotions. The activity emotion construct is a sub-construct of the achievement emotion construct. Activity emotions are related to the ongoing achievement-related activities such as studying, completing an assignment, interacting with classmates, and preparing for a test. Activity emotions included sentiments such as enjoyment, boredom, and anger (Pekrun, 2006).

Asynchronous Online Learning. Asynchronous online learning is an instructional modality in which teachers and learners interact in different locations and times. The key feature is that teachers and learners do not communicate in real-time. Typically, teachers pre-design the learning contents as readings, videos, discussion forums, and various assignments. Students conduct their learning weekly. They choose their best time to study the learning materials, interact with their teachers and classmates, and complete the required assignments or tests within a timeframe by the teachers (usually weekly). Asynchronous learning provides the benefit and freedom for students to learn at any time and location and is becoming a popular learning mode.

Cogmotion Theory. The Cogmotion Theory (Figure 9) is a learning theory that posits emotion as the rudder of learning and postulates that deep learning takes place at the intersection of cognition, emotion, and achievement through a recursive interaction process. In this theory, the learning environment is designed to activate a learner's emotional (i.e., hypothalamus and amygdala) and cognitive (i.e., frontal cortex, hippocampus, and striatum) neurological processes, converging into cogmotion to realize learning and achievement. This is a new learning theory to guide the advancement of the asynchronous online learning field, but researchers should use experimental designs to validate and extend this theory to other learning environments.

Cognitive Presence. Cognitive presence is a construct in the Community of Inquiry framework. Cognitive presence depicts how learners use critical thinking to construct knowledge through discourse and reflection in an online computer-mediated asynchronous learning environment. First, students' cognitive presence is triggered by teaching presence. Then students move onto the exploratory learning process and finally complete the cycle of cognitive presence by integrating their exploration into a resolution (Garrison et al., 2001).

Community of Inquiry (CoI). The Community of Inquiry (Garrison et al., 1999) is the most prominent framework in designing and delivering online learning in distance education (Richardson et al., 2017; Stenbom, 2018). This framework was based on Dewey's social constructivism theory and was a distance transaction model enabling teachers and students to traverse distance through learning management systems to build learning communities for inquiry (Garrison et al., 1999; Garrison & Arbaugh, 2007). Three key components represented the instruction, learning, and interaction process in the Community of Inquiry framework: teaching presence, cognitive presence, and social presence.

Control-Value Theory of Achievement Emotions. The Control-Value Theory of Achievement Emotions is an integrated framework that describes the antecedents and effects of emotions experienced by learners. Achievement emotions are generated based on two factors: 1) how learners perceive the control of the learning environment, and 2) how they assess the value of the learning activities. If a learner's perceived control and value assessment are relatively high, positive achievement emotions are activated; otherwise, they activate their negative achievement emotions. These achievement emotions determine how learners feel and regulate their learning strategy, self-regulation, and motivation adjustment (Pekrun, 2006).

Emotion. Emotion is an umbrella term to describe the physiological, cognitive, and neurological changes in one's emotional, motivational, behavioral, cognitive, and expressive attributes (Tyng et al., 2017)

Emotion in Learning. The researcher of the current study defined emotion in learning as a recursive active physiological, cognitive, and neurobehavioral interaction between emotion and cognition to make meaning of the environment by appraising a situation, attributing values, and regulating one's behaviors.

Emotional Presence. Emotional presence was a construct coined by Cleveland-Innes and Campbell (2012) to study how the Community of Inquiry framework manifested learning emotions. Emotional presence was defined as "the outward expression of emotion, affect, and feeling by individuals and among individuals in a community of inquiry, as they related to and interacted with the learning technology, course content, students, and the instructor" (Cleveland-Innes & Campbell, 2012, p. 283).

Outcome Emotions. The outcome emotion construct is the second sub-construct of the achievement emotion construct, which includes two categories of emotions: prospective

emotions and retrospective emotions. Prospective emotions are emotions in anticipation of learning activities and have hope, anxiety, hopelessness. Retrospective emotions result from learning activities such as test scores and include pride, relief, and shame.

PLS-SEM. PLS-SEM is a structural equation modeling method that enables the estimation of complex causal-effect relationship path models. This method overcomes the dichotomy between explanation and prediction. It allows researchers to estimate complex models with many constructs, latent variables, and structure paths without imposing distributional assumptions on the data (Hair et al., 2019). The Swedish econometrician Herman O. A. Wold developed this method in 1982. This method is gaining rapid popularity in the research community for structural equation modeling research because of its easy-to-use software, SmartPLS.

Social Presence. Social presence is the online collaborative learning experience through interactions with instructor(s) and classmates. Activities in social presence include emotional expression, open communication, and group cohesion. Indicators of social presence are emotional exhibition, risk-free expression, and active collaboration (Swan et al., 2009).

Teaching Presence. Teaching presence is the planning, organization, and delivery process of instruction and learning in the Community of Inquiry. The activities include directing instructions, managing students' learning processes, and building understanding. Successful teaching presence is manifested through defining learning goals, initiating discussion topics, sharing personal meaning, and focusing on discussions (Garrison et al., 2001).

Summary

In summary, the inextricable relationship between emotion and cognition based on neuroscience provided the foundation for the current study. The Control-Value Theory of Achievement Emotions is the theory undergird the current study as it postulates that antecedents

such as teaching, social, and cognitive presences engender achievement emotions that impact students' academic achievement. Researchers in the Community of Inquiry have not acknowledged the importance of emotion in the online learning process. Furthermore, the researcher found that no researcher has explored the relationship among the Community of Inquiry, achievement emotions, and academic achievement. Based on these contexts, the researcher of this study explored the relationship among the Community of Inquiry, achievement emotions, and academic achievement in asynchronous online learning in higher education. This study was the first to introduce the achievement emotion construct into the Community of Inquiry research field. It was also the first to investigate whether the Community of Inquiry generated achievement emotions and whether it affected students' academic. This study could transform the current emotion identification research trend to emotional design resulting in the improvement of learning outcomes for billions of learners in the rapidly growing online learning field.

Chapter Two: Review of the Literature

Fifteen years after researchers proposed emotional presence as the fourth presence in the Community of Inquiry, the emotional presence construct is still not elevated to the same level of importance to teaching presence, social presence, and cognitive presence (Campbell, 2006; Cleveland-Innes et al., 2019; Mardi, 2020). On the other hand, cognitive neuroscientists have validated that emotion played an inextricable role in cognition and learning (Balaž et al., 2021; Immordino-Yang, 2015; Loderer et al., 2018; Pekrun et al., 2017; Stephan et al., 2019). The Control-Value Theory of Achievement Emotions, rooted in cognitive science, validated that achievement emotions were essential in learning and predicted academic achievements in the traditional classroom environment. Although the Community of Inquiry is one of the most widely used online learning frameworks for online learning, no researcher has applied the Control-Value Theory of Achievement Emotions to study the relationship among the Community of Inquiry, achievement emotions, and academic achievement.

To close this research gap and define the role emotion plays in the Community of Inquiry framework, the researcher of the current study applied a quantitative non-experimental research design to investigate the relationship among the Community of Inquiry, achievement emotions, and academic achievement. The researcher established a hypothesized conceptual research model, as illustrated in Figure 2. In this model, the researcher postulated that the Community of Inquiry affected achievement emotions, and the achievement emotions, in turn, affected academic achievement. This study was the first to apply the Control-Value Theory of Achievement Emotions in the context of the Community of Inquiry to investigate the role

emotion plays in online learning. Answers to the research questions in this study contribute to the understanding of how the Community of Inquiry affected achievement emotions and how achievement emotions, in turn, affected academic achievement.

To support the research goal of this study, the researcher conducted a literature review on two levels of variables involved in this research. The first level were variables such as the Community of Inquiry, achievement emotions, and academic achievement. The second level included latent variables such as the teaching presence, social presence, cognitive presence, activity emotions, and outcome emotions. To ensure this research was rooted in a sound theory, the researcher first reviewed the paradigms of emotion research. Then, the researcher examined the literature in the Control-Value Theory of Achievement Emotions, the Community of Inquiry, and academic achievement.

Paradigms of Emotion Research

A research paradigm is a set of philosophical assumptions on the ontology, epistemology axiology, and methodology in a particular research field (Cohen et al., 2011; Kivunja & Kuyini, 2017; Lukenchuk, 2013). The literature review of emotion research in the different paradigms grounded this study in sound theories to ensure consistency in the ontological, epistemological, and methodological approaches. The researcher uncovered three paradigms of emotion research during the literature review process. They are physiological theories, cognitive theories, and neurological theories (Scherer & Ekman, 2014). These three paradigms have different views on how the knowledge of emotion was conceived; therefore, leading to divergent definitions of emotion and research methods. Furthermore, eight theories of emotion emerged in these three paradigms.

Physiological Theories of Emotion

The physiological theories of emotion have the most extended history. Four theories belong to this paradigm. The first one is ***Darwin's Evolutionary Theory of Emotion*** (Darwin, 1872). The essence of this theory is in its evolutionary nature. Based on Darwin's theory, emotion played an adaptive role and responded to stimuli in the environment to improve the chances of survival and success (Darwin, 1872).

The second is the ***James-Lange Theory of Emotion*** (Titchener, 1914). Proposed by William James (1842-1910) and Carl Lange (1834-1900), this theory extended Darwin's evolutionary theory of emotion. Further, it postulated that people's emotions depended on how they interpreted their bodily reactions to stimuli in the environment. For example, if someone saw a bear at night, their body might tremble; therefore, they would interpret trembling as the fear emotion. The fear emotion resulted from the physical reaction of trembling, not because the fear emotion produced trembling.

The third theory, the ***Cannon-Bard Theory of Emotion*** (Dror, 2014), disagreed with the James-Lange theory. First, they argued that people could experience certain emotions without feeling the actual emotions. For example, if someone's heart was beating fast, it could be caused by running, not necessarily by fear. Moreover, they argued that if people were in danger, they would feel the fear emotion before trembling (Dror, 2014). Third, they maintained that people feel emotions and experience physiological reactions simultaneously.

The fourth is the ***Facial-Feedback Theory of Emotion*** (Buck, 1980). This theory states that facial expressions foretell people's emotions; therefore, changes in emotions and facial muscles are the same. Vice versa, changing facial expressions could cause emotional changes.

For example, people who force themselves to smile pleasantly at a party could have a better time than those who frown or have neutral facial expressions.

Although rooted in the science of physiology, the above four emotion theories acutely formed a "chicken and egg" debate: do emotions occur in the body first or in the brain first, or simultaneously? Nevertheless, these theorists illuminated an important question: how do we know we have emotions? This question led to the development of the cognitive theories of emotion.

Cognitive Theories of Emotion

There are two theories in the cognitive theories of the emotion paradigm. The first one is the ***Schachter-Singer Theory*** (Dror, 2017). As a two-factor theory of emotions, this theory postulates that when physiological arousal occurs, an individual must identify the reasons for arousal cognitively to experience and label the emotion accordingly. For example, the physiological reaction of a racing heart and sweating palms could be cognitively interpreted as the anxiety emotion if one takes an important exam but could be interpreted as love if one is on a first date.

The second theory is the ***Cognitive Appraisal Theory*** (Smith & Lazarus, 1993). It is also called the ***Lazarus Theory of Emotion*** because of its original creator, Richard Lazarus (1922-2002). This theory posits that humans experience physiological responses and emotions simultaneously. For example, if one sees a bear in the woods, one would feel the emotion of fear and cognitively decide to react to the flight or fight behavior.

The cognitive theories of emotion rationalized that emotion is a cognitive process, not entirely a physiological phenomenon, leading cognitive neuroscientists to use advanced

neuroimaging technologies to investigate the relationship between physiological and neurological reactions in the body and the brain.

Neurological Theories of Emotion

Two neurological theories of emotion stood out in neuroscience. Both revolutionized the field. The first is Damasio's ***Theory of Emotion, Feeling, and Core Consciousness*** (Bosse et al., 2008). This theory originated from the Somatic Marker Hypothesis, which indicated that human emotional processes guide cognition, behavior, and decision-making (Adolphs et al., 1994; Bechara et al., 2005, 2005; Damasio, 1999). For example, Damasio invented a gambling game known as the Iowa Gambling Task or IGT (Bechara et al., 2005) to test how people learn and make decisions. Multiple replicable experiments revealed that people with malfunctioned emotion-related neurons could not rectify their mistakes but kept making the same mistakes even though they knew the devastating consequences logically during the Iowa Gambling Task experiments (Bechara et al., 2005). One example Damasio used to illustrate this phenomenon was his patient, Elliot, a well-known lawyer, but his emotional part of the brain was damaged in surgery. He could still calculate, reason, and recite facts, as well as any high IQ individual, but he could not make any sensible decisions nor take pleasure in anything. These experiments and cases, such as Elliot, enabled Damasio to validate his somatic marker hypothesis and generated the Theory of Emotion, Feeling, and Core Consciousness. This theory postulated that emotion guided cognition and was one's consciousness, serving as a guidepost for anything humans do (Damasio, 1999). In essence, Damasio broke the artificial wall philosophers and scientists established between the mind and the body or cognition and emotion. That was why he wrote a book titled "Descartes' Error: Emotion, Reason, and the Human Brain." This book rectified the dominant Cartesian dualism (i.e., the separation of body and mind) and united cognition and

emotion into one through the Theory of Emotion, Feeling, and Core Consciousness (Damasio, 1999).

Damasio's Theory of Emotion, Feeling, and Core Consciousness won him the highest status in the neuroscience field and became one of the most cited scholars. His breakthrough on emotion's effect in cognition prepared and enabled Lisa Barrett (Barrett, 2016) to create a paradigm shift in emotion science by creating the Theory of Constructed Emotions (Barrett, 2016). First, this theory postulates that emotions are not necessarily only localized in brain regions such as the amygdala, thalamus, and prefrontal cortex. Second, neuroimaging scans revealed that these brain regions serve to produce emotions, cognition, and memory; therefore, further validating Damasio's conclusion of the inseparable relationship between cognition and emotion.

Secondly, while conducting these neuroimaging scans, Barrett (2013, 2017a) found that different parts of the brain and body would light up and construct emotions irrelevant to the stimuli but very relevant to their own experiences and anticipations. Barrett (2013) concluded from these experiments that people used their brains' computational capability to compare the stimuli they experience with their existing experiences to construct emotions predictively. This finding was a breakthrough in emotion science. For decades, the entire world has settled on Darwin's physiological emotion reaction claims that emotions are mere reactions to the world. Barrett (2013) found that humans create emotions through physiological responses and construct emotions through their predictive computational thinking mechanisms. Thirdly, Barrett attempted to replicate Ekman's emotion expression recognition research in the same ethnic groups Ekman conducted his experiments but found Ekman's research design was flawed as he trained his participants on what different facial expressions meant before he completed his

experiments (Barrett, 2017a). As a result, Barrett (2017a) could not replicate Ekman's experiments without training participants on the various facial expressions. On the contrary, she found that different cultures defined and construed emotions differently; therefore, her third finding was that emotions are cultural and language bound (Barrett, 2017a).

Putting all these experiments together, the researcher of this study concluded that if Damasio collapsed two artificial walls: cognition and emotion, Barrett collapsed four walls: emotion, cognition, culture, and language. Barrett's revolutionary findings could mean that the paradigmatic shift she created in cognitive neuroscience might find ways into the educational research arena to create similar paradigm shifts resulting in different learning constructs, processes, models, frameworks, and theories.

Emotion-Related Definitions and Constructs

The review of different paradigms of emotion research painted a picture that the study of emotion has progressed rapidly in the last 30 years. Although Cartesians and behaviorists separated our minds and bodies and had the entire western world focused on studying rational behaviors, neuroscience rectified emotion back onto the same stage with cognition (Barrett, 2016; Damasio, 2005). The three paradigms of emotion research (physiological, cognitive, and neurological) showed significant progress and revealed three paradigmatic shifts of emotion science research. The three paradigms of emotion will be used as the theoretical foundation to underpin this research. To further build the foundation of this research, the following paragraphs clarify the definition of emotion and emotion-related constructs.

Each of the three paradigms of emotion theory has its definition of emotion.

The physiological theory of emotion defines emotion as a bodily reaction to an object or stimuli in the environment expressed and manifested by facial expressions or bodily changes (Darwin, 1872; Dror, 2014; Titchener, 1914).

The cognitive theory of emotion defines emotion as a cognitive process to exhibit a mental interpretation of external stimuli in the body manifested as physiological changes and behavior decisions such as fight or flight (Dror, 2017; Smith & Lazarus, 1993).

On the other hand, the neurological theory of emotion, represented by contemporary neuroscientists such as Barrett (2016), defines emotion as a recursive construction process between the environmental events and the somatovisceral, kinesthetic, proprioceptive, and neurochemical fluctuation, resulting in predictive changes in feelings, facial movements, vocal acoustics, autonomic nervous system changes, and actions

Other terms such as mood, affect, core affect, feeling, and emotional episode are also used in the emotion research literature (Plass et al., 2014; Tyng et al., 2017). They also must be defined to finalize the definition of emotion.

Mood. Compared to emotion, moods have a longer duration. Similar to emotion, moods also have positive and negative states. When people are not engaged in any activities and are not surrounded by many external stimuli, people's physiology and being are in a mood state.

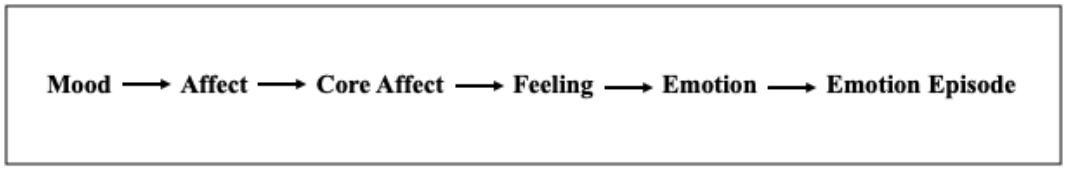
Affect. Affects are bodily states linked to bodily homeostasis. Affects serve two functions. The first one is to sense one's bodily internal states such as hunger, thirst, temperature, and energy. When any of these loses its homeostasis, signals are sent to the central nervous system for actions. The second function serves as the first line of receptors of external stimuli such as visual, auditory, taste, touch, and smell. Affects are subjective experiences, and this construct was used in the early days of emotion-related research.

Core Affect. Today constructs such as affect and affective neuroscience are still used in research even though researchers such as Barrett (2016) and Russell (2003) have created a new construct called core affect to replace the term affect. In essence, affects and core affect are the beginning stages of to-be-interrupted homeostasis, resulting in feelings based on different environmental stimuli.

Feeling. Suppose affects and core affects are physiological states. In that case, feelings are mental experiences that have a valence state of good or bad involving changes in one's viscera such as heart, lungs, and gut to maintain one's bodily homeostasis (Bosse et al., 2008; Plass & Kaplan, 2016; Tyng et al., 2017). For feelings to happen, a neural remapping of different body features must go through the central nervous system to reconstruct itself to stay in a homeostasis state (Tyng et al., 2017). In this phase, the cognitive appraisal process and the anterior insular cortex play a vital role in constructing emotions (Barrett, 2016). Once a meaning is constructed through the feeling process, an emotion or multiple emotions kick in, causing changes in one's motivations and actions.

Figure 3

Emotion Related Constructs from Mood to Emotional Episode



Emotional Episode. Sometimes an emotional episode describes how individuals recursively construct their reactions and actions (Gross, 2014). As illustrated in Figure 3, these emotion-related constructs, if linked together, would be similar to a tidal wave. If external stimuli are not strong, people typically stay at the mood and affect stage. However, suppose there

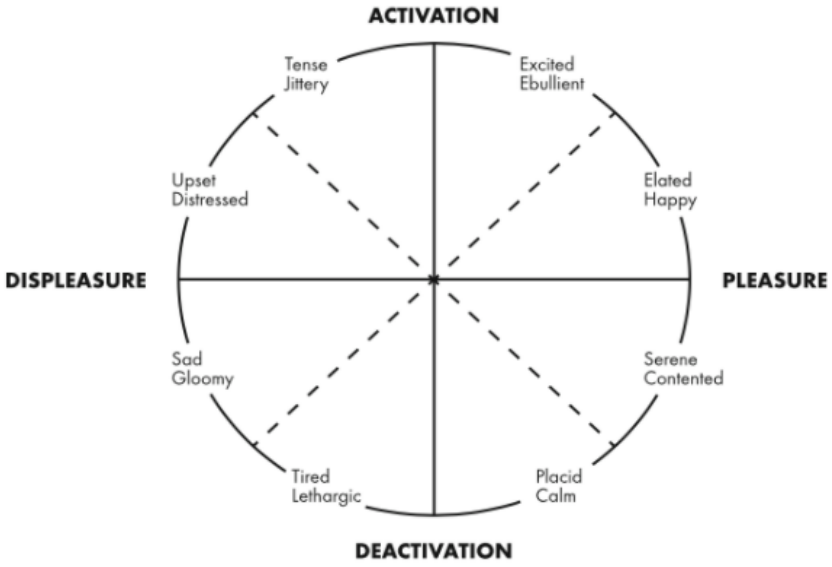
are unanticipated or dissonant stimuli. In that case, an emotional wave will start and change to a tidal wave depending on how individuals construct the situation and their emotions.

Today, most of the literature has adopted ***emotion as an umbrella term to describe the physiological, cognitive, and neurological changes in one's emotional, motivational, behavioral, cognitive, and expressive attributes once triggered by external stimuli*** (Tyng et al., 2017).

Figure 4

Russell's Dimensional Model of Emotions

From "Core affect and the psychological construction of emotion" by J. A. Russell, *Psychological Review*, 110, p. 148. Copyright 2003 by American Psychological Association. Reprinted with permission.



Every emotional change involves three dimensions: valence (i.e., pleasure or displeasure), arousal (i.e., activation or deactivation), and intensity (i.e., strong or mild) (Russell, 2003). See Figure 4. Most of today's educational application of emotion science is based on this model. For the current study, the researcher defined ***emotion in learning as a recursive active physiological, cognitive, and neurobehavioral interaction between emotion and cognition with***

a goal to make meaning of the environment by appraising a situation, attributing values, and regulating one's behaviors.

Summary

In summary, the researcher reviewed three paradigms, eight theories of emotion, and six constructs. The three paradigms of theories of emotion are physiological, cognitive, and neurological. The eight emotion theories are: 1) Darwin's Evolutionary Theory of Emotion, 2) James-Lange Theory of Emotion, 3) Cannon-Bard Theory of Emotion, 4) Facial Feedback Theory of Emotion, 5) Schachter-Singer Theory, 6) Cognitive Appraisal Theory, 7) Theory of Emotion, Feeling, and Core Consciousness, and 8) Theory of Constructed Emotion. The six emotion-related constructs or terminologies are mood, affect, core affect, feeling, emotion, and emotion episode. The current study adopts the neurocognitive view of emotion; therefore, defining emotion as an active cognitive process to construct emotion by appraising a situation, attributing values, and regulating one's behaviors.

Control-Value Theory of Achievement Emotions

The literature review on the emotion research paradigms, theories, and constructs established a macro-level foundation for this research. Next, the researcher reviewed the applied theories of emotion in education to build a theoretical foundation. Finally, this review answered why the Control-Value Theory of Achievement Emotions was the appropriate underlying theory to be used to explore the relationship among the Community of Inquiry, achievement emotions, and academic achievement.

Only two applied theories of emotion in the education research field exist in the literature. One is the Control-Value Theory of Achievement Emotions (Pekrun, 2000, 2006). Another is the Cognitive-Affective Theory of Learning with Media (Moreno, 2010). The

Cognitive-Affective Theory of Learning with Media is an extended multimedia learning theory that postulates that learners' states and traits impact multimedia learning. This theory has no subscription to a particular theory of emotion and applies only to individual-based multimedia learning. The current research investigates how emotion impacts learning in a community-based online learning environment, not individual-based self-guided learning. For the above three reasons, the Cognitive-Affective Theory of Learning with Media is not appropriate for the current research.

On the other hand, the Control-Value Theory of Achievement Emotions (Pekrun, 2000) was rooted in the cognitive paradigm of emotion research and has accumulated 20 years of research results in the traditional classroom environment. The issue is that researchers have not applied this well-founded theory in the Community of Inquiry framework. Pekrun (2000) produced the Control-Value Theory of Achievement Emotions from the educational psychology perspective. He theorized that student-instructor, student-content, and student-student interactions caused achievement emotions first, then postulated how achievement emotions impacted academic achievements. Based on the goal of the current study, the Control-Value Theory of Achievement Emotions served as an appropriate theoretical foundation for the researcher to explore the relationships among the Community of Inquiry, achievement emotions, and academic achievement.

Integration of Antecedents and Effects of Emotion

The Control-Value Theory of Achievement Emotions is an integrated framework that describes the antecedents and effects of emotions experienced by learners. For example, suppose learners are engaged in a good learning environment. In that case, their positive achievement emotions are activated, exhibiting the activity emotion of enjoyment and one or more outcome

emotions such as joy, hope, pride, and gratitude. On the other hand, if the learning contents are too easy, learners' positive emotions could be deactivated, showing relaxation for the activity emotion and contentment or relief for outcome emotions. On the other hand, if learners are not happy with the learning environment, they can activate their negative emotions to show anger and frustration as activity emotions, and anxiety, shame, or anger as outcome emotions. Similarly, learners can activate their negative emotions as boredom for the activity emotion or sadness, disappointment, or hopelessness as outcome emotions.

Achievement Emotions

The achievement emotion construct is a critical component in the Control-Value Theory of Achievement Emotions. Before Pekrun (2002) defined the achievement emotion, he first studied academic emotions. After synthesizing learning-related emotions research from 1974-2000 and conducting five qualitative studies, Pekrun, Goetz, and Titz (2002) defined academic emotions as emotions experienced by students in academic settings related to taking classes, conducting learning activities, and completing tests. In general, Pekrun et al. (2002) found that academic emotions are significantly related to students' motivation, cognitive resources allocation, learning strategies utilization, self-regulation, and academic achievement.

While academic emotions pertain to all emotions students engender during the educational learning process, the achievement emotion construct explicitly describes the outcome and activity based emotions; therefore, achievement emotions are competence specific (Pekrun, 2009). The Achievement Emotion Questionnaire (Pekrun et al., 2011) measure these emotions. This questionnaire consists of nine emotions: enjoyment, boredom, anger, hope, anxiety, hopelessness, pride, relief, and shame. In the past, researchers used achievement emotions only to study learning outcomes. In 2011, Pekrun linked the achievement emotion

construct with the Achievement Goal Theory (Maehr & Zusho, 2009). As a result, Pekrun (2000) defined two additional sub-constructs to study both the learning outcomes and the antecedents of achievement emotions. The two sub-constructs of the achievement emotions are the activity emotions and outcome emotions

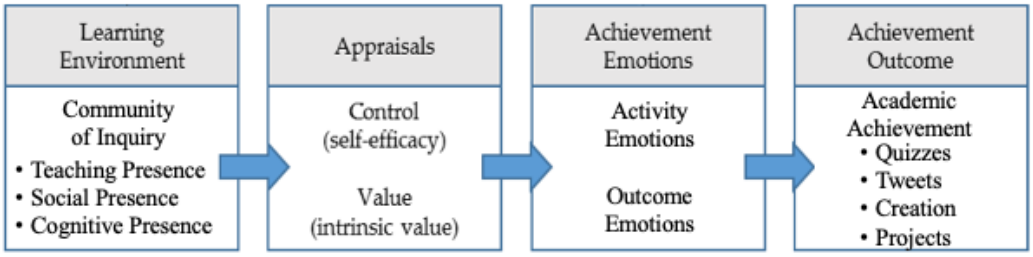
Activity emotions relate to ongoing achievement-based activities such as attending classes, studying learning content, completing assignments, and taking tests. Activity emotions include enjoyment, boredom, and anger emotions. Multiple psychological subsystems such as affective, cognitive, motivational, expressive, and physiological processes generate these emotions (Pekrun, 2006; Shuman & Scherer, 2014). Two dimensions activate these positive and negative activity emotions. The first one is whether students feel they have control over the learning situations. The second is whether students perceive positive values of the learning. If the control-value perception is high, positive activity emotions such as enjoyment are aroused. On the other hand, negative activity emotions such as boredom and anger are aroused if the control-value perception is negative or low. See Figure 5 on how activity emotions are activated or deactivated.

Positive activity emotions play a critical role in the learning process. They regulate on-task attention, moderate intrinsic motivation, allocate cognitive resources, and sustain learning efforts (Camacho-Morles et al., 2021; Loderer et al., 2018; Pekrun et al., 2017). Camacho-Morles et al. (2021) conducted a meta-analysis on activity emotions and found that enjoyment as a positive activity emotion increased academic performance (f=.27), but negative activity emotions such as anger (f =-.35) and boredom (f =-.25) decreased academic performance.

Figure 5

Control-Value Theory of Achievement Emotions

From "The control-value theory of achievement emotions: assumptions, corollaries, and implications for educational research and practice" by R. Pekrun, *Educational Psychology Review*, 18, p. 328. Copyright 2006 by Springer Nature. Adapted and reprinted with permission.



Although Pekrun (2000, 2006, 2009) published empirical evidence on how achievement emotions positively impacted academic achievements, recent studies reported non-significance (Trevors et al., 2016), neutral, or even negative relationships when researchers used activity emotion to investigate the relationship with academic achievement (Camacho-Morles et al., 2021). Camacho-Morles et al. (2021) asserted that the unidirectional positive or negative predictive relationship between the activity emotions and academic achievement was unclear. Furthermore, she called for researchers to conduct additional studies. The current research focusing on analyzing the predictive relationship between activity emotions and outcome emotions with academic achievement in the Community of Inquiry framework satisfies the call for such research.

Unlike activity emotions, outcome emotions do not relate to the learning tasks or process. On the other hand, they include two different emotions related to the learning outcomes: prospective outcome emotions and retrospective outcome emotions. For example, students often anticipate the outcome of tests. If they feel they can control the tests, they can generate positive

outcome emotions such as anticipatory joy. However, if they do not possess the control feeling over the tests, negative outcome emotions such as anxiety and hopelessness are experienced.

Similarly, students often retrospectively reflect on the success or failure of tests once they get their test results. If they feel they had control over the tests by studying hard, they could feel positive outcome emotions such as pride, gratitude, or joy. On the other hand, they could feel negative outcome emotions such as shame, disappointment, sadness, or even anger.

Outcome emotions, especially prospective emotions, precede activity emotions; therefore, it is critical to ensure students adequately manage their outcome emotions. Suppose negative outcome emotions are perceived, students will likely lose interest before starting their classes. In the learning process, outcome emotions direct attention, crystalize goals, moderate self-regulation, and regulate motivation (Camacho-Morles et al., 2021; Pekrun, 2006). Jarrell et al. (2017) conducted an experimental study, grouped medical students into three outcome emotion profile groups, and used *k*-means to analyze their performances. The researchers found a clear relationship between outcome emotion profiles with performances. The positive outcome emotion group performed the highest; the negative outcome emotion group performed the lowest; the middle outcome emotion group's performance fell in the middle.

Contradictions also exist in the literature regarding the impact of outcome emotions on performance. Kirwan (2018) conducted another study with 155 undergraduate medical students but in the nursing field. The researcher used the Achievement Emotions Questionnaire to measure achievement emotions but used a nursing standard test to measure academic achievement. Surprisingly, researchers did not find any statistical significance between outcome emotions and academic achievement. Furthermore, the researcher found few studies studying the relationship between the sub-construct of outcome emotion and academic achievement. Kirwan's

research was the only study to contradict the predictive correlation between outcome emotions and academic achievement. Could this be due to the use of a difficult nationwide standard nursing test or the participants as undergraduate students from a small private college? Kirwan (2018) did not explain why other than stating the Achievement Emotions Questionnaire instrument was found statistically valid and reliable. Since the researcher could not find many studies investigating the outcome emotion construct, the current research needed to use the outcome emotion construct as one of the variables for predictive analysis with the academic achievement construct. Perhaps outcome emotions and activity emotions could have different coefficients with academic achievements; therefore, having a different predictive relationship with academic achievement? This unclarity added another reason for conducting the current study, which was aimed to investigate whether the activity emotion and outcome emotion constructs predicted academic achievement differently.

Researchers used the achievement emotion construct extensively in educational research, particularly in classroom-based learning environments. Pekrun et al. (2009) conducted a study with 213 students and found that achievement emotions predicted performance attainment, mediated achievement goals, and moderated performance outcomes. Researchers found that enjoyment increased students' interests, improved intrinsic motivation, focused attention on task execution, and maintained cognitive resources, enhancing academic achievement.

Based on the assumption that achievement emotions mediate academic achievement through motivation (Parker et al., 2018; Pekrun, 2006, 2019), Parker et al. (2021) designed a study involving 327 participants to investigate how motivation profiles impacted achievement. The scholars first identified three motivation profiles through the Latent Profile Analysis method through co-occurring appraisals and emotions: 1) high control-enjoyment, 2) low control-

boredom, and 3) low value-boredom profiles. Then, participants took six tests over a two-semester period. The research results revealed that the high control-enjoyment students outperformed the low control-boredom and low value-boredom students on all tests. It means that highly motivated students subjectively exerted control over their learning; therefore, they generated the enjoyment achievement emotion, resulting in better academic achievement.

Regarding how achievement emotions could enable students to maintain focused attention and cognitive resources, Putwain et al. (2020) used academic buoyancy (i.e., resiliency in focusing attention and maintaining cognitive resources despite academic difficulties) to investigate the relationship between emotions and academic achievement. The scholars collected data from 1,242 primary school students through four waves within an entire school year. Through an SEM analysis, they found test performance was the highest when academic buoyancy was high. Another latent-interaction SEM revealed academic buoyancy mediated anxiety and test performance. Focusing attention on the tasks at hand and maintaining cognitive resources to combat complex learning tasks enabled students to lower anxiety and, in turn, improved test performance. It means students could reduce their negative achievement emotions such as anxiety if they would learn how to regulate their emotions by focusing on the tasks at hand and allocating cognitive resources to learning instead of worrying.

Two meta-analysis studies were found to synthesize the relationship between achievement emotions and academic achievement. The first one was by Huang (2011). She found 30,003 participants had participated in achievement emotion-related studies. She discovered that different achievement goals are associated with achievement emotions—for example, mastery goals correlated with positive achievement goals. Students who set mastery goals tend to focus their attention on studying without worrying about how others would

perceive them (Huang, 2011; Pekrun et al., 2009). Camacho-Morles et al. (2021) conducted the second meta-analysis. In this meta-analysis, the researchers analyzed 68 studies with sample sizes as large as 31,868. The researchers detailed their analysis of each activity emotions: enjoyment, anger, frustration, and boredom. The result unequivocally validated that positive achievement emotions increase academic performance, but negative achievement emotions decrease academic performance.

Although it is clear achievement emotions predict academic achievement, the researcher found that none of the studies was conducted in the Community of Inquiry framework. Thus, it made this study not only necessary but also urgent.

The Community of Inquiry

Four theories and frameworks exist in the distance and online learning literature, and the Community of Inquiry Framework is the most prominent one (Garrison et al., 1999; Stenbom, 2018; Swan et al., 2009). First, the Theory of Transactional Distance (Moore, 1993) was produced in the 1970s to serve the traditional distance education needs in solving the physical and psychological distance between instructors and learners. Second, Connectivism was defined by George Siemens in 2004 in his blog as a learning theory for the Internet age (Siemens, 2017). Siemens posited that connections were more critical than merely memorizing facts; therefore, creating connections with people and lessons on the Internet should be the learners' focus. Although connectivism is popular, it cannot be considered a formal online learning theory for academic research as it was never published in a peer-reviewed journal. The third theory, Online Collaborative Learning (OCL) (Harasim, 2007), is a macro-theory to reshape formal, non-formal, and informal learning through collaboration and knowledge building. However, it is too generic and lacks specificity. More importantly, none of these three theories addresses emotion

as a learning process in their models. On the other hand, the Community of Inquiry framework research community has created the emotional presence construct to address emotion as an essential variable in the online learning environment.

Emotional Presence and Achievement Emotions

Emotional presence is not a distinctive presence in the Community of Inquiry framework. For theoretical parsimony purposes, the Community of Inquiry framework only denotes three presences: teaching, social, and cognitive presences. Cleveland-Innes and Campbell (2012) coined the emotional presence construct to study how the Community of Inquiry framework manifested learning emotion. They defined emotional presence as "the outward expression of emotion, affect, and feeling by individuals and among individuals in a community of inquiry, as they relate to and interact with the learning technology, course content, students, and the instructor" (Cleveland-Innes & Campbell, 2012, p. 283). On the other hand, achievement emotions are defined as emotions that affect learning outcomes. These emotions are exhibited through behaviors such as appropriate learning strategies, self-regulation, motivation adjustment, and academic achievement (Chou, 2021; Pekrun et al., 2017). As contrasted in Table 1, the emotional presence and the Control-Value Theory of Achievement Emotions are drastically different in almost every angle.

First, emotional presence is not rooted in a theory of emotion. On the other hand, the achievement emotion construct is rooted in the Cognitive Appraisal Theory (Smith & Lazarus, 1993) and the Attribution Theory of Motivation and Emotions (Weiner, 1986). Second, the emotional presence construct is focused on emotional expression, while the achievement emotions focus on learning outcomes. Third, 23 emotions were identified in the emotional presence construct, while only nine were identified in the achievement emotions construct.

Table 1

Comparison of Emotional Presence and Achievement Emotions

	Emotional Presence	Achievement Emotions
Theoretical Foundation	• Not rooted in any paradigm, but seemed to relate to the physiological paradigm • Not based on any identifiable theory, but it seems to relate to a social theory.	• Rooted in the cognitive paradigm of theories of emotion. • Based on the Cognitive Appraisal Theory and the Attribution Theory of Motivation and Emotions.
Focus	• Focused on the expression of emotion, affect, and feeling.	• Focused on learning outcomes
Identified Emotions	• Identified 23 emotional expressions: joy, delight, enjoyment, happiness, enthusiasm, excitement, hope, pride, contentment, surprise, alienation, connectedness, disappointment, fear, anxiety, stress, guilt, irony/sarcasm, and unhappiness. • Not validated by an emotion model. Mixed emotion with affect and feeling.	• Identified nine emotions: enjoyment, boredom, anger, hope, anxiety, hopelessness, pride, relief, and shame. • Validated by the Emotion Circumplex Model

Fourth, the Emotion Circumplex Model (Russell, 1980) validated the nine emotions in the achievement emotions, but Cleveland-Innes and Campbell (2012) did not validate the 23

emotions in the emotional presence construct. Because of these differences, the emotional presence construct cannot be used to study how achievement emotions relate to the Community of Inquiry and academic achievement.

Teaching Presence and Achievement Emotions

No studies were found to study the relationship between teaching presence and achievement emotions, but some studies implicated the importance of teaching presence and student emotions. For example, teaching presence was identified to have a significant link with the level of regard and empathy when Swan et al. (2020) studied Carl Rogers' person-centered education approach with the Community of Inquiry framework. It found that a teacher's attention to students' emotions was critical in fostering better learning outcomes. This finding was validated in another study by Nyanjom and Naylor (2020). They found teachers often regulated their emotions and demonstrated empathy, concern, and friendliness while suppressing their emotions during online text-based interpersonal communications. This way, the teachers who participated in the study ensured students' active engagement in learning without any emotional discouragement. Thus, although no studies specifically investigated the relationship between teaching presence and achievement emotions, these studies indicated that teaching presence could engender achievement emotions. The current study was aimed to provide empirical evidence on how strong teaching presence would relate to achievement emotions; therefore, closing a literature gap in the Community of Inquiry and the achievement emotions' research fields.

Social Presence and Achievement Emotions

Emotion is supposed to be subsumed by social presence in the Community of Inquiry (Garrison et al., 2010). The definition of social presence is the projection of learners socially and

emotionally as real people in an online learning environment. Activities in social presence include emotional expression, open communication, and group cohesion. Indicators of social presence are emotional exhibition, risk-free expression, and active collaboration (Garrison et al., 1999; Garrison & Arbaugh, 2007b; Swan et al., 2009). Researchers produced contradictory empirical evidence. Molinillo et al. (2018) investigate the relationship between social presence, interactions, and active collaborative learning using PLS-SEM with 416 students in two universities. They found that emotional engagement mediated social presence. They also found that emotional engagement mediated teacher-student interactions, which in turn influenced students' active learning process. This finding indicated that emotion played a crucial role in social presence and learning outcomes.

On the contrary, the above empirical evidence was invalided by another study with the same rigor of research design. Kucuk and Richardson (2019) deployed SEM to study engagement in the Community Inquiry Framework with 123 students. They (2019) found social presence did not create emotional presence. Instead, they found teaching presence, cognitive presence, and cognitive engagement created an emotional presence. This finding contradicted the social presence definition in the Community of Inquiry Framework (Garrison et al., 1999) and the research result by Molinillo et al. (2018).

Both studies used SEM with a large sample size but created contradictory results. This might have been caused by the definition of the emotional presence construct, which focused on emotional expression, not engagement and learning; therefore, emotion was empirically proved to be related to the social presence in one study but not in another. Additional studies must be conducted with a sound definition of emotion rooted in a sound theory to uncover the relationship emotion has with social presence. The current study fulfills this requirement by

using the definition of achievement emotions, rooted in the Control-Value Theory of Achievement Emotions.

Cognitive Presence and Achievement Emotions

Students achieve their cognitive presence through active cognitive engagement during their learning process. The Community of Inquiry Questionnaire had questions that related to learning emotions. For example, the word "interest" in the first question of the cognitive presence section, "problem posed increased my interest in course issues," is an epistemic emotion. The word "curiosity" in the second question, "course activities piqued my curiosity," describes a knowledge emotion. The third word, "motivated" in "I felt motivated to explore content-related questions," is a behavioral tendency caused by the enjoyment achievement emotion. Kucuk and Richardson (2019) found that emotional presence was not generated by social presence but by cognitive presence.

Furthermore, Kang et al. (2014) deployed three studies to investigate which presences (i.e., cognitive presence, social presence, and emotional presence) predicted achievement and satisfaction. In all three studies, they found that cognitive presence predicted learner satisfaction. Learner satisfaction derives from the enjoyment achievement emotion in the Control-Value Theory of Achievement Emotions; therefore, supporting the hypothesis that cognitive presence relates to achievement emotions and engenders achievement emotions. The question to be investigated in this study is how strong cognitive presence relates to achievement emotions compared to teaching presence and social presence.

Research Hypotheses

The review of the research variables provided theoretical foundations and empirical evidence for each of the research hypotheses.

H1. The first hypothesis of this study posited that teaching presence had a significant positive effect on activity emotions. In the literature review, research results by Swan et al. (2020) and Nyanjom and Naylor (2020) enabled the researcher of this study to theorize the predictive relationship between teaching presence and activity emotions.

Teaching presence was identified to have a significant link with the level of regard and empathy when Swan et al. (2020) studied Carl Rogers' person-centered education approach with the Community of Inquiry framework. The result of this research revealed that a teacher's attention toward students' emotions was critical in fostering better activity emotions. This finding was validated in another study by Nyanjom and Naylor (2020). They found teachers often regulated their emotions and demonstrated empathy, concern, and friendliness while suppressing their emotions during online text-based interpersonal communications. This research concluded that those teachers who participated in the study took the effort to foster positive activity emotions to enable students for better engagement.

Although no studies specifically investigated the relationship between teaching presence and activity emotions, these studies indicated that teaching presence could engender activity emotions. The current study was aimed to provide empirical evidence with correlational coefficients on how strong teaching presence would relate and affect activity emotions.

H2. The second hypothesis of this study theorized that teaching presence had a significant positive effect on outcome emotions. No studies were found to specify the relationship between teaching presence and outcome emotions. Most of the emotion-related studies were still in the early stages of emotion identification. Researchers had not gone to granular emotion levels such as the outcome emotions to conduct studies on the relationship between teaching presence and outcome emotions in the Community of Inquiry framework.

Since outcome emotion was the second component of the achievement emotion construct, studies by Swan et al. (2020) and Nyanjom and Naylor (2020) applied this hypothesis. Swan et al. (2020) found that teachers' regards and empathy for students could help students feel hopeful about studying. They studied Carl Rogers' person-centered education approach with the Community of Inquiry framework. They found teaching presence was identified to have a significant link with the level of regard and empathy. This research result implied that a teacher's attention to students' emotions could foster a students' outcome emotions. Teachers could conciliate students' anxiety, enable students to feel hope, and transform negative emotions into positive ones. This finding was validated in another study by Nyanjom and Naylor (2020). They found teachers often regulate their emotions and demonstrate empathy, concern, and friendliness. Frequently, teachers attended to students' outcome emotions purposefully to ensure learning engagement without any emotional discouragement. These research results allowed the researcher to hypothesize that teaching presence had a significant effect on outcome emotions.

H3. The third hypothesis of this study postulated that teaching presence had a significant positive effect on academic achievement. Researchers of the Community of Inquiry framework have focused on establishing the internal relationship between teaching presence, cognitive presence, and social presence. Year to date, researchers have found that teaching presence is the most crucial factor in the Community of Inquiry. Teaching presence significantly predicts cognitive and social presence (Castellanos-Reyes, 2020; Garrison & Arbaugh, 2007), but no research was found to have investigated the relationship between teaching presence and academic achievement.

H4. The fourth hypothesis of this study postulated that social presence has a significant positive effect on activity emotions. Social presence is defined as emotional expression, open

communication, and group cohesion. Based on this definition, social presence should theoretically relate to activity emotions. The significance of social presence on activity emotions was what this study investigated. Molinillo et al. (2018) investigated the relationship between social presence, interactions, and active collaborative learning using PLS-SEM with 416 students in two universities. They found that emotional engagement mediated social presence. They also found that teacher-student interactions positively influenced students' learning activities. They concluded that social presence played a vital role in activity emotions. If students and teachers were socially engaged, students could generate activity emotions such as enjoyment, but another research contradicted this finding.

Kucuk and Richardson (2019) deployed SEM to study engagement in the Community Inquiry Framework context with 123 students. They found that social presence did not create emotional presence. Instead, they found that teaching presence, cognitive presence, and cognitive engagement created an emotional presence. This finding contradicted the social presence definition in the Community of Inquiry Framework (Garrison et al., 1999) and the research conducted by Molinillo et al. (2018). Both studies used SEM with a large sample size but created contradictory results. The contradiction might have been caused by the definition of the emotional presence construct, which focused on emotional expression, not engagement and learning. As a result, emotion was empirically proved to relate to the social presence in one study but not in another. These contradictory findings must be rectified with additional studies. The current study hypothesized that social presence significantly affected activity emotions. This hypothesis was based on the definition of social presence and the Control-Value Theory of Achievement Emotions. Although contradiction existed in the literature on social presence's

relationship with activity emotions, the current study provided empirical evidence to clarify whether and how social presence affected activity emotions.

H5. The fifth hypothesis assumes that social presence has a significant positive effect on outcome emotions. Based on the definition of social presence, emotion is supposed to be subsumed by the social presence (Garrison et al., 2010). The definition of social presence is the projection of learners socially and emotionally as real people in an online learning environment. Social presence includes emotional expression, open communication, and group cohesion. Indicators of social presence are emotional exhibition, risk-free expression, and active collaboration (Garrison et al., 1999; Garrison & Arbaugh, 2007b; Swan et al., 2009). How does social presence relate to outcome emotions? Contradictory findings exist in research. For example, Kucuk and Richardson (2019) found that social presence did not create emotional presence, but Molinillo et al. (2018) found that emotional engagement mediated social presence. The contradiction might be due to the definition of the emotional presence construct, which focuses on emotional expression, not engagement and learning. Based on the Control-Value Theory of Achievement Emotions, outcome emotions are generated by antecedents such as social interactions; therefore, the researcher of this study hypothesized that social presence had a significant effect on outcome emotions.

H6. The sixth hypothesis attenuated that social presence had a significant positive effect on academic achievement. Researchers of the Community of Inquiry framework have focused on establishing the internal relationship between teaching presence, cognitive presence, and social presence. Year to date, researchers found that social presence only influenced cognitive presence (Fiock, 2020; Garrison et al., 2010). No research was found to investigate the relationship between social presence and academic achievement.

H7. The seventh hypothesis of this study suggested that cognitive presence had a significant positive effect on activity emotions. In the literature review, the researcher of this study analyzed the Community of Inquiry Questionnaire and found that activity emotions such as interest and curiosity were caused by cognitive presence. For example, the word "interest" in the first question, "problem posed increased my interest in course issues," is an epistemic emotion. The word "curiosity" in the second question, "course activities piqued my curiosity," describes a knowledge emotion. The third word, "motivated" in "I felt motivated to explore content-related questions," is a behavioral tendency caused by the enjoyment activity emotion after a learner appraised a learning activity to be controllable and valuable.

Furthermore, studies by Kang et al. (2014) found that cognitive presence generated satisfaction. Kang et al. (2014) deployed three studies to investigate which presences (i.e., cognitive presence, social presence, and emotional presence) predicted achievement and satisfaction. In all three studies, they found cognitive presence predicted learner satisfaction. Study 1 was conducted in a blended learning environment. The researchers found that cognitive presence predicted both satisfaction and achievement, while emotional presence only predicted satisfaction. Study 2 was based on problem-solving in an online learning environment. The researchers found that cognitive presence predicted satisfaction and achievement, but emotional presence had no relation. Finally, study 3 was on collaborative online learning. The researchers found that cognitive presence and emotional presence predicted satisfaction but not achievements.

In these three studies, cognitive presence predicted satisfaction consistently but not emotional presence. Learner satisfaction derives from the enjoyment activity emotion. Therefore, it means that cognitive presence generates activity emotions. The strength between cognitive

presence and activity emotions compared to teaching presence and social presence was one of the research goals for this study.

H8. The eighth hypothesis of this study posited that cognitive presence had a significant positive effect on outcome emotions. Although no studies investigated the relationship between cognitive presence and outcome emotions in the Community of Inquiry, Kang et al. (2014) found that cognitive presence predicted learner satisfaction. In three studies, Kang et al. (2014) investigated how cognitive presence and emotional presence predicted satisfaction and achievement. Emotional presence was found to predict satisfaction in blended learning and collaborative learning.

On the other hand, cognitive presence predicted satisfaction in blended learning, collaborative learning, and problem-based learning. Based on the Control-Value Theory of Achievement Emotions, learner satisfaction could produce outcome emotions such as joy, pride, and gratitude if students perceived the learning activities as controllable and valuable. On the other hand, if students did not perceive control and value of the learning activities, negative outcome emotions such as anger and shame could be produced, negatively impacting the learning experience and outcome. Based on the above, the researcher of the current study hypothesized that cognitive presence had a significant positive effect on outcome emotions.

H9. The ninth hypothesis posited that cognitive presence had a significant positive effect on academic achievement. Researchers of the Community of Inquiry framework have focused on establishing the internal relationship between teaching presence, cognitive presence, and social presence. Year to date, researchers have found that teaching presence significantly predicted cognitive presence, while social presence only influenced cognitive presence (Fiock, 2020; Garrison et al., 2010). Researchers also found that cognitive presence predicted training

effectiveness (Garrison et al., 2010; Garrison & Arbaugh, 2007). Therefore, it was theorized that higher perceived teaching presence, cognitive presence, and social presence might mean high course scores. However, no specific research was found to investigate the relationship between cognitive presence and academic achievement.

H10. The tenth hypothesis theorized that activity emotions had a significant positive effect on academic achievement. In the literature review, multiple studies showed that positive activity emotions such as enjoyment positively increased academic performance. On the other hand, negative activity emotions such as anger, frustration, and boredom decreased academic performance (Camacho-Morles et al., 2021; Parker et al., 2018, 2021; Pekrun, 2006, 2019). Unfortunately, these studies were not conducted in the context of the Community of Inquiry.

In a study with a large sample size of 213 students, Pekrun et al. (2009) found that achievement emotions predicted performance attainment and mediated achievement goals and performance outcomes. It was found that enjoyment increased students' interests, improved intrinsic motivation, focused learner attention on task execution, and maintained cognitive resources, enhancing academic achievement. These research results supported the inextricable relationship between emotion and cognition by cognitive neuroscientists. Activity emotions such as enjoyment mediated attention focus, motivation levels, and cognitive resource allocation. As a result, activity emotions exerted a direct effect on learning outcomes

Another research with a large sample size indicated activity emotions impacted academic achievement too. Based on the assumption that achievement emotions mediated academic achievement through motivation (Parker et al., 2018; Pekrun, 2006, 2019), Parker et al. (2021) designed a study involving 327 participants. This research expanded over two semesters to investigate how motivation profiles impacted achievement. Using the Latent Profile Analysis

method, the scholars first identified three motivation profiles through co-occurring appraisals and emotions: 1) high control-enjoyment, 2) low control-boredom, and 3) low value-boredom profiles. Next, participants took six tests over a two-semester period. The research results revealed that the high control-enjoyment students outperformed the low control-boredom and low value-boredom students on all tests. Thus, it implied that highly motivated students subjectively exerted control over their learning; therefore, they generated the enjoyment activity emotion, resulting in better academic achievement.

Furthermore, a meta-analysis conducted by Camacho-Morles et al. (2021) revealed that activity emotions significantly impacted academic achievement. In this meta-analysis, the researchers analyzed 68 studies with sample sizes as large as 31,868. The researchers detailed their analysis of each of the activity emotions: enjoyment, anger, frustration, and boredom. The result validated that positive activity emotions increased academic performance, but negative activity emotions decreased academic performance.

Abundant studies have indicated that activity emotions affect academic achievement, but most of these studies were conducted in the traditional classroom-based learning environment. No study was found to investigate the relationship between activity emotions and academic achievement in the Community of Inquiry framework. Hypothesizing that activity emotions had significant effects was both based on theory and empirical evidence. However, this hypothesis still needs to be tested through the current study in asynchronous online learning in a higher education setting.

H11. The eleventh hypothesis postulated that outcome emotions had significant positive effects on academic achievement. Ample research investigated how outcome emotions impacted academic achievement in the traditional classroom-based learning environment. A meta-analysis

study was found to synthesize the relationship between achievement emotions and academic achievement.

Huang (2011) found that 30,003 participants had participated in achievement emotion related studies. She discovered that different achievement goals were associated with achievement emotions. Achievement goals were associated with outcome emotions as goal-setting enabled students to prospect future outcomes cognitively and emotionally. This kind of prospection of future learning outcomes could generate outcome emotions such as joy, pride, or gratitude if students felt in control of the learning situation and believed in the value of the learning activities. For example, Huang (2011) found that mastery goals correlated with positive achievement goals. Students who set mastery goals tend to focus their attention on studying without worrying about how others would perceive them (Huang, 2011; Pekrun et al., 2009). These research results enabled the researcher of the current study to hypothesize that outcome emotions significantly affected academic achievement. However, most of these studies were conducted in the traditional classroom environment. No research was found to investigate the relationship between outcome emotions and academic achievement in the context of the Community of Inquiry, so the current study was designed to explore and test the proposed hypothesis.

H12 to H17. The 12th to 17th hypotheses stated that activity emotions and outcome emotions mediated teaching, social, and cognitive presences to impact academic achievement. However, no mediation studies were found to investigate the mediation relationship between the variables in the Community of Inquiry (i.e., teaching presence, social presence, and cognitive presence) and achievement emotions (i.e., activity emotions and outcome emotions). Studies using the Control Value Theory of Achievement Emotions concluded that teaching presence,

social presence, and cognitive presence could act as antecedents to cause activity emotions and outcome emotions (Pekrun, 2011, Maehr & Zusho, 2009). Still, there was no investigation on whether activity emotions and outcome emotions would mediate their antecedents.

In summary, all the hypotheses were proposed based on both theory and empirical evidence. Past research indicated that both activity emotions and outcome emotions impacted academic achievement. However, there are still contradictions on how teaching presence, social presence, and cognitive presence relate to activity emotions and outcome emotions. Furthermore, it was unclear how achievement emotions were generated in the context of the Community of Inquiry and how they, in turn, related to academic achievement. The result of the current study based on the 17 proposed hypotheses provided empirical evidence to these unanswered questions.

Summary

The purpose of this research was to explore the relationship among the Community of Inquiry, achievement emotions, and academic achievement in asynchronous online learning in higher education. A literature review on the variables involved in this research was conducted to support this research goal. The first level of the review was the composite variables such as the Community of Inquiry and achievement emotions. The second level of the review included the teaching presence, social presence, cognitive presence, activity emotions, outcome emotions, and academic achievement.

Besides reviewing the literature to produce the hypotheses of this study, the paradigms of emotion research were examined at the beginning of Chapter Two to ensure the current research was rooted in a sound theory. The review of the emotion theories enabled the researcher to set the foundation of the present study on the neurocognitive-based emotion theory. The researcher

concluded that the Control-Value Theory of Achievement Emotions was a well-founded theory rooted in the Cognitive Appraisal Theory (Smith & Lazarus, 1993) and the Attribution Theory of Motivation and Emotions (Weiner, 1986). Using the Control-Value Theory of Achievement Emotions as the theoretical base for this research added value to elucidate the current unclear and contradictory findings on emotion in the Community of Inquiry framework.

In conclusion, this study was the first to use the Control-Value Theory of Achievement Emotions to explore the relationship among the Community of Inquiry, achievement emotions, and academic achievement in the asynchronous online learning context in a higher education setting. The research results closed gaps in the extant literature on the role emotion played in the Community of Inquiry and expanded the Control-Value Theory of Achievement Emotions into the widely used Community of Inquiry framework.

Chapter Three: Methodology

This research aimed to explore the relationship among the Community of Inquiry, achievement emotions, and academic achievement in asynchronous online learning in higher education based on the hypothesized research model in Figure 2. A quantitative non-experimental research design using PLS-SEM for statistical analysis was adopted to answer the research questions and test the hypotheses. Seven sections in this chapter are included to explicate the research methodology. They are 1) restatement of the research questions and hypotheses, 2) research design, 3) participants and sample, 4) instrumentation, 5) data collection procedures, 6) ethical standards, and 7) a summary.

Restatement of the Research Questions and Hypotheses

This research aimed to explore the relationship among the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence), achievement emotions (i.e., activity emotions and outcome emotions), and academic achievement in asynchronous online learning in higher education. Based on the Control-Value Theory of Achievement Emotions, a conceptual framework was defined to represent the hypothetical relationship among the Community of Inquiry, achievement emotions, and academic achievement (see Figure 2). In addition, four research questions were examined:

1. What is the relationship between asynchronous online students' perception of the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) and their achievement emotions (i.e., activity emotions and outcome emotions)?

2. What is the relationship between asynchronous online students' perception of the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) and their academic achievement?
3. What is the relationship between asynchronous online students' perception of their achievement emotions (i.e., activity emotions and outcome emotions) and academic achievement?
4. How do students' achievement emotions (i.e., activity emotions and outcome emotions) mediate the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) to impact their academic achievement in asynchronous online learning in higher education?

Based on the above research questions and the conceptual framework of this study, the following research hypotheses were formulated.

H1. Teaching presence (TP) has a significant positive effect on activity emotions (AE).

H2. Teaching presence (TP) has a significant positive effect on outcome emotions (OE).

H3. Teaching presence (TP) has a significant positive effect on academic achievement (AA).

H4. Social presence (SP) has a significant positive effect on activity emotions (AE).

H5. Social presence (SP) has a significant positive effect on outcome emotions (OE).

H6. Social presence (SP) has a significant positive effect on academic achievement (AA).

H7. Cognitive presence (CP) has a significant positive effect on activity emotions (AE).

H8. Cognitive presence (CP) has a significant positive effect on outcome emotions (OE).

H9. Cognitive presence (CP) has a significant positive effect on academic achievement (AA).

H10. Activity emotions (AE) have significant positive effects on academic achievement (AA).

H11. Outcome emotions (OE) have significant positive effects on academic achievement (AA).

H12. Activity emotions significantly meditate teaching presence to impact academic achievement.

H13. Outcome emotions significantly meditate teaching presence to impact academic achievement.

H14. Activity emotions significantly meditate social presence to impact academic achievement.

H15. Outcome emotions significantly meditate social presence to impact academic achievement.

H16. Activity emotions significantly meditate cognitive presence to impact academic achievement.

H17. Outcome emotions significantly meditate cognitive presence to impact academic achievement.

Research Design

The study adopted a quantitative non-experimental research design using PLS-SEM statistical analysis. PLS-SEM was used to explore the relationships among the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence), achievement emotions (i.e., activity emotions and outcome emotions), and academic achievement. Involving multiple

composites, latent, and indicator variables made PLS-SEM a more appropriate research methodology. PLS-SEM is a new methodology that enables researchers to study complex models with many constructs, indicator variables, and structural paths without imposing distributional assumptions on the data (Hair et al., 2019). The traditional Covariance Based Structural Equation Modeling (CB-SEM) method is often used for confirmatory studies to validate or explain a theoretical model, but PLS-SEM can explore causal-predictive relationships while overcoming the dichotomy between explanation and prediction (Hair, 2020; Hair et al., 2019). Despite the advantages of PLS-SEM, criticisms of PLS-SEM exist in the literature. Rouse and Corbitt (2008) started the criticism at a conference. Then Ronkko et al. (2016) published a journal articled and listed their issues with PLS-SEM. The main criticisms were the use of small sample sizes and confusion of terminologies and formulas (e.g., weights vs. optimality) (Rönkkö et al., 2016; Rouse & Corbitt, 2008). These criticisms alerted researchers to know when to use CB-SEM vs. PLS-SEM (Rouse & Corbitt, 2008), but did not hinder the rapid adoption of PLS-SEM in the research field. No other criticisms were found in the last seven years, and no more criticisms were found in the scanned extant literature from Rouse and Corbitt (2008) Ronkko et al. (2016). To ensure the limitations pointed out by Rouse and Corbitt (2008) Ronkko et al. (2016) were considered, the researcher of this study conducted a power analysis to ensure the sample size for this study was adequate. To ensure the statistical analysis through PLS-SEM was reliable, the researcher gained help from his statistical committee member and confirmed the validity and reliability of the statistical analysis outputs using SPSS.

The variables of this study included five composite variables, one outcome variable, and 55 indicator variables. The first three composite variables were the teaching presence, cognitive presence, and social presence in the Community of Inquiry framework. These three presences

(i.e., teaching presence, social presence, and cognitive presence) were antecedents to achievement emotions (Pekrun, 2006). The third and fourth composite variables were the activity emotions and outcome emotions latent variables defined by the achievement emotion construct. These five composite variables were also latent variables. The outcome variable in this research was the academic achievement variable. The five composite variables (i.e., teaching presence, social presence, cognitive presence, activity emotions, and outcome emotions) were reflected in 55 indicator variables through two questionnaires: the Community of Inquiry Questionnaire and the Achievement Emotions Questionnaire. The outcome variable, academic achievement, was the final summative score students achieved from the digital identity class through three academic skill assessments: communication skills, thinking skills, and subject-area skills.

These composite, latent, indicator, and outcome variables were analyzed using PLS-SEM to test the hypotheses of this study. Five phases of analyses were conducted to answer the four research questions of this study. First, the outcome variable, academic achievement, was analyzed to ensure its measurement validity and reliability. Second, descriptive statistical analysis was used to understand the normality of the questionnaire data. Third, inferential statistical analysis was used to determine whether any of the participants' demographic and learning profile variables had any confounding effect on the outcome variable, academic achievement. Fourth, a PLS-SEM measurement model analysis, also called outer model analysis, was conducted to determine the validity and reliability of the five composite variables in this study. Internal reliability, composite reliability, convergent validity, and discriminant validity were analyzed. Fifth, the PLS-SEM structural model analysis, also called the inner model analysis, was conducted to analyze the path coefficients and path strengths among the five composite variables with the outcome variable, academic achievement. The 17 research

hypotheses were determined to be supported or not supported at this stage. As a result of these five phases of analysis, the four research questions of this study were answered. The relationships among the variables in the Community of Inquiry (i.e., teaching presence, social presence, and cognitive presence), the achievement emotions (i.e., activity emotions and outcome emotions), and academic achievement were statistically established. The following sections explicate this study's research method, strengths and weaknesses, threats to validity and reliability, and associated mitigation methods.

Research Method

The research method of this study was a quantitative non-experimental research design. Surveys were used to gather data for the Community of Inquiry and achievement emotion composite variables. Demographic data (i.e., age, gender, and race) and learning profile data (i.e., hours studied, online leering experience, and learning modality preferences) were obtained at the end of the survey. In addition, grades were gathered for the academic achievement outcome variable. The PLS-SEM statistical analysis method was adopted because multiple composite, latent, and indicator variables existed in this study.

Strengths of this Study

The use of the PLS-SEM method increased the strength of this research design. The CB-SEM method is often used for confirmatory studies, but PLS-SEM is often used for exploratory studies and could provide both explanation and prediction through path analyses (Chin et al., 2020; Hair et al., 2017). Thus, PLS-SEM has been established as a distinct method to analyze composite-based path models. Two models were analyzed: the measurement model (i.e., inner model) and the structural model (i.e., outer model). In PLS-SEM, the measurement model uses partial least square regression analysis, but the structural model uses separate ordinary least

squares regression. Thus, algorithms in PLS-SEM analyze the measurement model and structural model separately.

Another strength of this research design was using composite-based path model analysis. The two primary constructs in this research, Community of Inquiry and achievement emotions, comprised five composite variables. These five composite variables were, in turn, measured through 55 indicator variables. For example, the Community of Inquiry framework constituted three composite variables: teaching presence, cognitive presence, and social presence. Moreover, each of the three presences (i.e., teaching presence, social presence, and cognitive presence) was comprised of 9 to 13 indicator variables resulting in 31 indicator variables for the Community of Inquiry construct. The achievement emotion construct consisted of two composite variables: activity emotions and outcome emotions. These two variables were reflected in 24 indicator variables. Although these five composite variables and 55 indicator variables made this research complex, the PLS-SEM method as a preferred approach to test complex conceptual frameworks with many constructs, indicators, and relationships (Hair et al., 2019) strengthened the research design.

Threats to Validity and Reliability

Threats to validity and reliability were analyzed and mitigated. Validity and reliability are critical to any quantitative research. Cohen et al. (2011) maintained that reliability is a precondition of validity, but validity does not ensure research can have reliability; therefore, ensuring validity and reliability at each level of this research was critical.

Theoretical validity, construct validity, and predictive validity were crucial to this research's validity. Any issue in these three validities could cause threats to this study. Therefore, rigorous steps were taken to ensure validity in these three areas.

To ensure theoretical validity, especially in the validity of the conceptual framework represented in Figure 2, the researcher of this study used the Control-Value Theory of Achievement Emotions (Pekrun, 2006) as the theoretical framework of this research. This theory has more than twenty years of research history and was widely accepted as a valid and sound theory to study achievement emotions (Chou, 2021; Huang, 2011).

To ensure construct validity, the researcher of this study adopted the definitions of each construct formally defined by the Community of Inquiry framework (Garrison & Arbaugh, 2007) and the Control-Value Theory of Achievement Emotions (Pekrun, 2006). For example, the definitions of teaching, cognitive, and social presences were adopted from the Community of Inquiry framework without any change. Likewise, the activity emotion and outcome emotion definitions were adopted from the Control-Value Theory of Achievement Emotions without any change. More importantly, two existing data collection instruments validated and used in multiple studies for almost ten years were adopted for this study. The first instrument was the Community of Inquiry Questionnaire (Arbaugh et al., 2008). The second instrument was the Achievement Emotions Questionnaire (Pekrun et al., 2011). For the Community of Inquiry Questionnaire, Stenbom (2018) conducted a literature review and analyzed 103 journal articles from 2008 to 2017. He concluded that the instrument had high validity and reliability. For the Achievement Emotions Questionnaire, Pekrun (2011) used Goodness-of-fit (GFI), the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA) to validate the instrument and found that the Achievement Emotions Questionnaire was reasonable for all scales, good for the vast majority of the scale, and superior when compared to one-factor model analysis.

The predictive validity in this research lies in the hypothesis that the Community of Inquiry affects achievement emotions, and the achievement emotions affect academic achievement. Pekrun (2011) concluded that achievement emotions were caused by antecedents such as teaching, learning, and social activities. Huang (2011) conducted a meta-analysis by analyzing 78 articles with a sample size of 30,003 and found that the achievement emotion's construct was valid and reliable. Although researchers in the Community of Inquiry did not conclude whether teaching presence, cognitive presence, and social presence predicted achievement emotions or academic achievement, the Control-Value Theory of Achievement Emotions provided a theoretical foundation to hypothesize their relationships.

The reliability of this research depended on the sampling, replicability, and objectivity of this study. Therefore, rigorous efforts were put in place to ensure this research's reliability, validity, and replicability.

Most PLS-SEM-based research used the ten-times rule-of-thumb method (i.e., 10 cases per variable) to decide sample size because PLS-SEM can use a small sample size to produce reliable research results. To ensure high reliability, the researcher of this study used G*Power (Y. A. Wang & Rhemtulla, 2021) to determine the sample size instead. The sample size of this study was produced based on relevant statistical power, effect size, and probability. The details can be found in the sample and sampling procedure section.

Since this study was the first to explore the relationship among the Community of Inquiry, achievement emotions, and academic achievement, enabling other researchers to replicate this study was critical. For this reason, the researcher of this study documented the research design and procedures in detail and used existing instruments such as the Community Inquiry Questionnaire and Achievement Emotion Questionnaire. In addition, the data collected

for this study were made readily available for any researcher who would be interested in reanalyzing the data or replicating this study. These steps made this research easily replicable.

Research objectivity is a principle drawn from the positivism research paradigm (Houghton, 2011). This principle calls for researchers to maintain a distance from what they study so that the researcher's personality, beliefs, and values do not inadvertently influence the result of the research, therefore, causing research reliability issues. One weakness of this study was that the researcher taught one of the three courses and was a teaching assistant for one of the other two classes. Although the researcher's course had only 29 students while the other two sections had 157 students, the researcher's involvement in teaching 29 students and acting as a teaching assistant for the other class might threaten the objectivity of this study. This issue was mitigated first by implementing the same course contents, design, assignments, and assessments. The second mitigation strategy was implementing ethical standards and procedures to collect data after all students received their grades to avoid any dishonesty in the data collection process.

Sampling Procedure

Wang and Rhemtulla (2021) emphasized that sample sizes in research must be determined appropriately to accommodate the complexity of a research model and estimation methods. They criticized the commonly used and widely accepted ten-times rule of thumb sampling method in PLS-SEM and called for an *a priori* power analysis to determine sample size. To estimate the sample size for this study, the researcher used the G*Power program (Faul et al., 2009) and conducted an *a priori* power analysis using 11 structural paths. The following sample size was determined based on the F-test parameters and the "Linear multiple regression: Fixed model, R^2 deviation from zero" statistical test parameter in G*Power. To achieve a power of .80 (1-β error probability) and 5% of Type I error probability (α=.05) with a medium effect

size (f^2=0.20), the sample size for this study was determined to be 95. The medium effect size was chosen based on Cohen's recommendation (Cohen, 2003). Cohen (2003) defined .10, .30, and .50 as small, medium, and large effect sizes and recommended using medium effect size for psychological studies. Chuan and Penyelidikan (2006) affirmed Cohen's medium effect size recommendation in another power analysis article. For this research, .20 was chosen based on past research studies using PLS-SEM (ALvi, 2021; Nazari & Far, 2019; Soroya et al., 2020; F. H. Wang, 2019).

Participants and Sample

The total population of the participants of this study was 186 students who enrolled in three sections of the Digital Identity online course in the Spring and Summer semesters of 2021 from a large public university in the central region of Florida. All 186 participants from the three sections of the Digital Identity course were invited to participate in this study. One hundred and fifteen students completed the research questionnaires. The survey completion rate was 62%. Five surveys were invalid as four were duplicates, and one had a straight-line survey completion error (e.g., providing the same response on a series of questions). Thus, the final valid survey was from 110 participants with a valid survey completion rate of 59% (See Table 2).

Table 2

Survey Response Rate

Target Population	Completed Surveys	Completion Rate	Invalid Surveys	Valid Surveys	Valid Completion Rate
186	115	62%	5	110	59%

Sample Size Sufficiency

After deleting the five invalid surveys from the 115 responses, the final valid survey sample size was 110. The predetermined sample size for this study was 95 based on *a priori* power analysis. Therefore, a sample size of 110 exceeded the predetermined sample size and thus, provided an adequate sample size for this research.

Participants' Demographic Information

Of the 110 participants, 67% were female, 29% were male, 3% were non-binary, and 1% preferred not to disclose their gender. The age of the participants was homogenous, with 95% of the participants between the ages of 18 to 25 years. The mean was 21, the median was 20, and the mode was 20. The youngest was 18, but there were only two at that age. Two participants were older than 40. The race and ethnicity of the participants were somewhat diverse, with 67% being White, 16% Black, 11% Asian, Latino 4%, and Hispanic 2%.

Participants' Learning Profiles

The learning profiles of the participants consisted of learning mode preference, online learning experience, and hours studied.

Learning Mode Preference. The participants of this research preferred the traditional face-to-face classroom learning mode the most, the asynchronous online self-paced learning mode the second, and the synchronous online live learning mode the least. Of the 110 participants, 59% preferred the traditional face-to-face classroom learning mode, while 32% preferred the asynchronous self-paced learning mode. Only 8% chose the synchronous online live learning method, while 1% did not disclose their preference.

Online Learning Experience. The participants of this research were experienced in online learning. Every participant had taken at least two prior online courses before. Of the 110

participants, 95% participants had the experience of taking 5 to 37 online courses. Only 5% of the participants took fewer than three online learning courses.

Hours Studied. The study participants spent an average of 8 hours studying for this course per week. The median was 5 hours. The minimum was 0, and the maximum was 30 hours. Two students spent 0 hours studying, and another two spent 30 hours studying. The standard deviation was 7 hours. Overall, 80% of students spent more than 3 hours studying for this course and 20% spent less than 3 hours.

Ethical Standards

This study was approved by the Institutional Review Board (IRB) by the researcher's university (See Appendix A for the Approval Letter). The actual data collection began after the semesters ended and students received their grades. This process ensured each student could answer the questionnaires objectively without worrying about repercussions to their grades.

Participants' anonymity, privacy, and confidentiality were maintained throughout the entire data collection and storage process. As soon as the participants completed the questionnaires, their identifiers such as the university IDs and email handlers were deleted. Any researcher could request the data file for replication purposes. No one could link the final data to any individual student, nor any of the instructors. No hardship for participants could be experienced since the data collection was conducted after they finished their semester and received their grades.

Instrumentation

Three sets of data were collected and analyzed to achieve the research goal. The researcher collected the first set of data through the Community of Inquiry Questionnaire, the

second from the Achievement Emotions Questionnaire, and the third from the course instructors of the Digital Identity online classes.

The Community of Inquiry Questionnaire

The Community of Inquiry Questionnaire (Arbaugh et al., 2008) was created to add a quantitative research dimension to the predominantly textual-analysis-based qualitative research method in the Community of Inquiry research field. Seven scholars from seven universities collaborated to develop the Community of Inquiry Questionnaire. This questionnaire comprised 31 questions divided into three major sections: teaching presence, social presence, and cognitive presence. Each of these sections was further subdivided into their respective sub-sections. Each of the three main sections and their sub-sections is described below. A five-point Likert scale (1=Strongly Disagree, 2=Disagree, 3=Neither Disagree or Agree, 4=Agree, 5=Strongly Agree) was used to gather quantifiable data from participants.

The teaching presence section comprised 13 questions to assess a participant's perception of an online course's design, the instructors' facilitation, and teaching. It had three sub-sections: design and organization, facilitation, and direct instruction. The design and organization sub-section had four questions, facilitation six questions, and direct instruction three questions. The questions for the teaching presence section are below:

Design and Organization

1. The instructor clearly communicated important course topics.
2. The instructor clearly communicated important course goals.
3. The instructor provided clear instructions on how to participate in course learning activities.

4. The instructor clearly communicated important due dates/time frames for learning activities.

Facilitation

1. The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.
2. The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.
3. The instructor helped to keep course participants engaged and participating in productive dialogue.
4. The instructor helped keep the course participants on task in a way that helped me to learn.
5. The instructor encouraged course participants to explore new concepts in this course.
6. Instructor actions reinforced the development of a sense of community among course participants.

Direct Instruction

1. The instructor helped to focus discussion on relevant issues in a way that helped me to learn.
2. The instructor provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives.
3. The instructor provided feedback in a timely fashion.

The social presence section comprised nine questions to assess a participant's perception of their social communication and engagement quality. There were three sub-sections: affective

expression, open communication, and group cohesion. Each subsection had three questions. Below are the nine questions in the social presence section.

Affective expression

1. Getting to know other course participants gave me a sense of belonging in the course.
2. I was able to form distinct impressions of some course participants.
3. Online or web-based communication is an excellent medium for social interaction.

Open communication

1. I felt comfortable conversing through the online medium.
2. I felt comfortable participating in the course discussions.
3. I felt comfortable interacting with other course participants.

Group cohesion

1. I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.
2. I felt that my point of view was acknowledged by other course participants.
3. Online discussions help me to develop a sense of collaboration.

The cognitive presence section was composed of 9 questions to assess a participant's perception of their learning. Each sub-section had three questions. The following are the questions in the cognitive presence section.

Triggering Event

1. Problems posed increased my interest in course issues.
2. Course activities piqued my curiosity.
3. I felt motivated to explore content related questions.

Exploration

1. I utilized a variety of information sources to explore problems posed in this course.
2. Brainstorming and finding relevant information helped me resolve content related questions.
3. Online discussions were valuable in helping me appreciate different perspectives.

Integration

1. Combining new information helped me answer questions raised in course activities.
2. Learning activities helped me construct explanations/solutions.
3. Reflection on course content and discussions helped me understand fundamental concepts in this class.

Resolution

1. I can describe ways to test and apply the knowledge created in this course.
2. I have developed solutions to course problems that can be applied in practice.
3. I can apply the knowledge created in this course to my work or other non-class related activities.

The Community of Inquiry Questionnaire achieved validity and reliability through multiple studies (Arbaugh et al., 2008; Stenbom, 2018; Swan et al., 2008). Arbaugh et al. (2008) united seven scholars from seven major universities to create the questionnaire to ensure validity and reliability. More importantly, data were collected from all seven universities with a sample size of 287. The researchers used the Principal Components Analysis (PCA) method in SPSS to determine its reliability and validity. As a result, they found that the Community of Inquiry Questionnaire had high internal consistency with Cronbach's alpha for teaching presence as .94, social presence as .91, and cognitive presence as .95.

The researcher of the current study analyzed the validity and reliability of the Community of Inquiry and found the Cronbach's alpha for teaching presence as .93, social presence .87, and cognitive presence .92. Cronbach's scores above .70 indicate construct reliability; therefore, reliability for the Community of Inquiry Questionnaire was established in this research.

The Community of Inquiry Questionnaire used a five-point Likert scale (0=Strongly Disagree, 1=Disagree, 2= Neither Disagree nor Agree, 3=Agree, 4=Strongly Agree). The entire instrument was adopted for the current study without any modification other than aligning the Likert scale was changed from 0-4 to 1-5 to be consistent with the Achievement Emotions Questionnaire.

The Achievement Emotions Questionnaire

The Achievement Emotions Questionnaire (Pekrun et al., 2011) was created due to the lack of measurement instruments in assessing how emotions were related to achievement. Pekrun et al. (2011) developed this instrument to close the gap after gaining five years of experience with the Control-Value Theory of Achievement Emotions (Pekrun, 2006). This instrument is the only widely accepted instrument that measures students' perceptions of how their emotions related to achievement (Raccanello et al., 2021; Raccanello & Hall, 2020).

There are 24 questions in the Achievement Emotions Questionnaire to assess three areas of achievement emotions: 1) class-related emotions, 2) learning-related emotions, and 3) test-taking emotions. These three areas of emotions are marked into activity emotions (AE) and outcome emotions (OE) to distinguish whether the achievement emotions are learning activity related or learning outcome related. Since this research focused on studying how the Community of Inquiry related to activity emotions and outcome emotions, each question was marked as AE for activity emotion or OE for outcome emotion. Of the 24 questions, 16 items form the activity

emotion construct (i.e., AE1 to AE16), while eight forms the outcome emotion construct (i.e., AE1 to AE8).

The AE and OE denotations were not included when the questionnaire was distributed to students. The current denotation in the questionnaire was only for research and statistical analysis purposes.

The Achievement Emotions Questionnaire is introduced section by section in the following paragraphs. Then the instrument's validity and reliability are explicated. A five-point Likert scale (1=Strongly Disagree, 2=Disagree, 3=Neither Disagree or Agree, 4=Agree, 5=Strongly Agree) was used to gather quantifiable data from participants.

The class-related questions in the Achievement Emotions Questionnaire measure how students feel about the class they are taking. There are eight questions in the class-related emotions section.

1. Enjoyment I enjoy being in this class (AE1)
2. Hope I am confident when I attend this class (OE1)
3. Pride I am proud of myself (OE2)
4. Anger I am angry (OE3)
5. Anxiety Thinking about this class makes me feel uneasy (OE4)
6. Shame I get embarrassed (AE2)
7. Hopelessness I feel hopeless (OE5)
8. Boredom I get bored (AE3)

The learning-related questions measure how students feel about the learning activities they are engaged in. There are also eight questions in this section.

1. Enjoyment I enjoy acquiring new knowledge (AE4)

2. Hope — I have an optimistic view toward studying (OE6)
3. Pride — I'm proud of my capacity (AE5)
4. Anger — Studying makes me irritated (AE6)
5. Anxiety — I get tense and nervous while studying (AE7)
6. Shame — I feel ashamed that I can't absorb the simplest of details (AE8)
7. Hopelessness — I feel hopeless when I think about studying (OE7)
8. Boredom — The material bores me to death (AE9)

The original questionnaire named this section "Test Emotions." Since the Digital Identify course used both quizzes and assignments to assess student's academic achievements, the researcher of this study renamed this section "Test and Assignment Related Emotions." This section assessed how students felt about the quizzes and assignments in the course. One modification was made to three of the eight questions. The word "test" was replaced with "quiz and assignment" for clarity purposes as both quizzes and assignments were used in the Digital Identity class to assess students' academic achievement. Similar to the previous two sections, there are also eight questions in this section.

1. Enjoyment — For me, the quizzes and assignments were challenging and enjoyable (AE10)
2. Hope — I have great hope that my abilities will be sufficient (OE8)
3. Pride — I'm proud of how well I mastered the quiz and assignment (AE11)
4. Relief — I feel very relieved (AE12)
5. Anger — I am fairly annoyed (AE13)
6. Anxiety — I feel panicky when doing a quiz and assignment (AE14)
7. Shame — I feel ashamed (AE15)

8. Hopelessness I have lost all hope that I have the ability to do well in the class (AE16)

The Achievement Emotions Questionnaire has been validated by multiple studies and is widely accepted as an instrument with high validity and reliability (Bhansali & Sharma, 2020; Bieleke et al., 2020; Davari et al., 2020; Lichtenfeld et al., 2012; Paoloni et al., 2014; Peixoto et al., 2015; Pekrun et al., 2011; Raccanello & Hall, 2020).

The researcher of the current study conducted a construct validity and reliability analysis on the activity emotion and outcome emotion constructs and found the Cronbach's alpha values for the activity emotion construct as .91 and outcome emotion as .84. Cronbach's alpha values above .70 indicate construct reliability; therefore, the reliability for this study's activity emotion and outcome emotion constructs was established.

The Achievement Emotions Questionnaire uses a five-point Likert scale from 1 to 5 (1=completely disagree, 5=completely agree), while the Community of Inquiry Questionnaire uses a scale from 0 to 4 (0=Strongly Disagree, 4=Strongly Agree). In addition to the scale differences, the scale's adjectives are also different. The Achievement Emotions Questionnaire uses adjectives such as "completely", while the Community of Inquiry Questionnaire uses adjectives such as "strongly." The researcher decided to make both five-point Likert scales consistent to ensure consistency and avoid confusion. The scale was modified to range from 1 to 5. The adjectives were modified to be 1=Strongly Disagree, 2=Disagree, 3=Neither Disagree or Agree, 4=Agree, 5=Strongly Agree. These changes did not influence the established content validity of the instruments but improved the instruments' face validity.

The Likert scale values of 14 questions were reversed coded to make the semantic meaning of the questions consistent. For example, the first question in the Achievement

Emotions Questionnaire was "I enjoyed being in this class". If a participant chose 1 (i.e., Strongly Disagree), it meant the participant disliked the class strongly. If the participant chose 5 (i.e., Strongly Agree), it meant the participant liked the course strongly. Question 7 was "I feel hopeless". At this time, if a participant chose 1 (i.e., Strongly Disagree), it meant the participant was not hopeless but liked the class strongly. On the other hand, if the participant chose 5 (i.e., Strongly Agree), it meant the participant disliked the class strongly. This process caused a semantic issue. If not corrected, it would cause data analysis issues. For this reason, all the Likert scale values assessing the negative emotions of participants were reverse coded. For example, 1 was reversed to 5; 2 to 4, 4 to 2, and 5 to 1. Ten activity emotion scales (i.e., AE2, AE3, AE6, AE7, AE8, AE9, AE13, AE14, AE15, and AE16) and four outcome emotion scales (i.e., OE3, OE4, OE5, and OE7) were reverse coded. The researcher used the RStudio program to reverse the 14 Likert scale values above. A letter "R" was added to the end of the item number when they were reversed. See Appendix B for details.

Academic Achievement

Lindholm-Leary and Borsato (2005) described academic achievement in three levels: 1) communication (oral, reading, writing), 2) thinking, and 3) subject-area skills that enable a student's success in school and society. Therefore, the assessment of academic achievement in the Digital Identity course was aligned with Lindholm-Leary and Borsato's (2005) definition. In this section, an overview of the Digital Identity class is provided first. Then the reliability and validity of the academic achievement measure are discussed.

The Digital Identity online course was required for undergraduate students to satisfy the university's General Education Assessment (GEA) requirement.

The State required the General Education Assessment with four levels of knowledge and competencies. The first level was foundational knowledge such as communication, English, math, humanities, social sciences, natural sciences, and quantitative reasoning. The second level included intellectual and practical skills such as creative thinking, information and data literacy, and human and cultural diversity. The third level was personal and social responsibility which encompassed ethical reasoning and civic engagement. The fourth level was integrative and applied learning, which students must demonstrate in high-impact practices. The Digital Identity online course satisfied the third level of the General Education Assessment requirement on personal and social responsibility, ethical reasoning, and civic engagement.

The Digital Identity course was comprised of 16 modules with four sections. Each section was composed of four modules. In the first section, students created a goal to improve their digital identities by analyzing them. Then, each student refined their digital identity by studying digital identity threats and refining their social media identity. In the third section, students deepened their digital social identity by studying social issues such as marginalization, inequality, inequity, privacy, religion, and politics. In this section, students engaged in a social media campaign to promote a social cause for a non-for-profit organization to meet their personal and social responsibilities. In the fourth section, students first learned about gaming identity and identities through apps. Then they created a final capstone project by choosing one digital identity topic to create a website demonstrating their subject area competency.

The design of the Digital Identity course confirms the design principles outlined by Garrison et al. (2010) and Fiock (2020). Teaching presence, social presence, and cognitive presence are the three critical components in the design process of an online learning course. Fiock (2020) conducted a literature review and gathered a collection of instructional design

principles and best practices for teaching, social, and cognitive presence based on empirical research using the Community of Inquiry framework. Based on these design principles, the researcher of this study analyzed the design of the Digital Identity course and found the course confirmed the design principles of the Community of Inquiry framework.

First, teaching presence is the design, facilitation, and direction of cognitive and social presences and includes three design components: 1) instructional design and organization, 2) discourse facilitation, and 3) direct instruction. The Digital Identity course confirmed these three design components. For example, the curriculum of the Digital Identity course was organized into 16 modules (i.e., instructional design and organization). Each module starts with an overview followed by reading materials and learning videos (i.e., direct instruction). Next, the instructor facilitates the discussions or interacts with students' tweeting activities (i.e., discourse facilitation). In addition, feedback served as another means of direct instruction and discourse facilitation. In summary, all three components required by the teaching presence design components and principles were found in the Digital Identity course.

Second, social presence is the projection of students as real people in the online learning environment, and it includes three components: 1) affective expression, 2) open communication, and 3) group cohesion. To achieve the above three design goals, Fiock (2020) emphasized swift trust-building and multiple views sharing among students using multiple group interaction tools and through smaller groups. In the Digital Identity course, students start the course with an introduction and then quickly move into smaller teams composed of five people to conduct social media campaigns. The course instructors used recorded videos to teach lessons and communicate important messages. Students conducted video-conferencing meetings to plan and execute their social media campaign. The project-based small team often establishes GroupMe and Discord to

maintain group cohesion. Students are required to interact with others in the class to provide different perspectives or approaches on course topics. In summary, the design of the Digital Identity course confirmed the social presence design principles and provided multiple channels for affective expression, open communication, and group cohesion.

Third, cognitive presence enables students to construct meaning through sustained reflection through the Practical Inquiry Model in four phases: 1) triggering event, 2) exploration, 3) integration, and 4) resolution. Fiock (2020) outlined multiple techniques to design cognitive presence learning activities, focusing on active learning and higher-order thinking. The Digital Identity course triggers students to audit and analyze their online digital identity and then engages students to explore multiple topics to make their digital identity stronger. The social media campaign project integrates what students learn in this course into a real-world digital marketing event. Finally, the capstone website project allows students to provide a resolution on a digital identity issue with methods, examples, and solutions. In summary, the Digital Identity course utilized the four phases of the Practical Inquiry Model and designed higher-level order thinking active learning activities; therefore, strongly confirming the design principles of the Community of Inquiry.

Based on the standard contents and the design of this course, five types of assessments (i.e., quizzes, writing tweets, digital artifact creation, and GEA project work) were created to assess students' academic achievement. Quizzes were used to assess students' knowledge of digital identity based on their reading comprehension of the course's textbook. Writing tweets through Twitter assessed students' ability to write concisely using 140 characters. Discussion forums assessed how students analyzed a digital identity issue and provided solutions through collaboration. The creation of digital artifacts such as infographics, comic strips, and videos

assessed students' competency to visually present their digital identity to the public. The GEA project section of the assessment measured how students integrated all their digital identity knowledge holistically to support a social cause and solve a digital identity issue. All five assessments weighed differently on the final grade of a student. Quizzes weighed 10%, tweeting 15%, discussion, 20%, creation 25%, and projects 30%. Students' final grades ranged from 0 to 100. Higher scores represented higher academic achievements.

As reflected by the final grades, the academic achievement scores ranged from 8.54 to 99.54. The median was 94.62, the mean was 89.71, and the standard deviation was 12.93. The skewness was -3.28, and kurtosis was 15.10. Thus, although the academic achievement variable was negatively skewed, the kurtosis was a positive leptokurtic distribution. The Cronbach's alpha of the academic achievement composite variable was .94, indicating high reliability. Cronbach's alphas for the individual components that made up the overall value ranged from .73 to .91 showing good reliability (See Table 3). These statistics indicated that all the academic achievement subscales reliably and validly reflected the academic achievement measurement. The Pearson correlation coefficients for the individual components that made up the overall value were from 0.54 to 0.65, indicating moderate correlation (See Table 4). The moderate correlations for the subscales of the academic achievement construct indicated that all the assessments in the Digital Identity course maintained common measurement standards in the three key academic achievement skills (i.e., communication skills, thinking skills, and subject-area skills) but also measured their own subscales discriminately. Thus, the academic achievement construct was statistically valid, reliable, and was moderately distinct.

Table 3

Cronbach's Alpha Values on Academic Achievement Subscales (n=110)

AA Subscale Types[a]	Item Number[b]	Cronbach Alpha
Quiz	39	.73
Tweet	12	.90
Discussion	10	.91
Creation	11	.87
Projects	3	.90
Final Grade[c]	75	.94

Note. [a]AA stands for Academic Achievement, which is composed of five assessment types. [b]Item number is how many assessment items were included in each assessment type. For example, there were 39 quiz items dispersed into eight quizzes. Each quiz had 5 to 7 quiz questions. [c]Final grade represents the overall score of the Academic Achievement outcome variable.

All these academic achievement assessments were designed by an experienced professor in collaboration with the university's instructional design team, who followed the Quality Matters international online education certification rubrics. A board also approved this course in the university because it served as a General Education Assessment course. Before the commencement of the current research, 130 students from two semesters had already officially taken the course for credit. No content validity nor assessment validity issues were identified.

Table 4

Pearson Correlation Coefficient of Academic Achievement Subscales with Overall Academic Achievement (n=110)

Quiz	Tweet	Discussion	Creation	Projects
.65	.56	.58	.54	.56

Note. The item number for each assessment is the same as noted in Table 3.

Data Collection Procedures

Two steps were taken to collect data for this research. The first step was to collect data using the Community of Inquiry Questionnaire and the Achievement Emotions Questionnaire. The second step was to obtain the academic achievement scores from each of the instructors of the Digital Identity course. Consent for research from each participant was received at the beginning of administering the questionnaires. Participants had the option to opt-out the participation in this research. All participation was voluntary. Demographic information from each participant was obtained at the end of the survey.

Survey Data Collection

The Qualtrics software was used to collect data. Qualtrics is a cloud service that enabled the data collection process to be simultaneously monitored by the researcher and the researcher's major professor. The IRB approval for this research was obtained on June 22, 2021. The research data collection process commenced on July 1, 2021, for the first class, July 7, 2021, for the second class, and July 14, 2021, for the third class. All three courses were closed by the time the survey was commenced. The first two were closed by the end of the Spring semester of 2021. The third class was a May semester course and was completed on May 31, 2021. All students

had received their final grades from the university's registrar's office before they were invited to participate in this research.

An announcement from each instructor was programmed in the Qualtrics system to inform their students about their participation in this research. Then the researcher sent out the questionnaires to two classes to collect data. For the researcher's class, the researcher's major professor sent the invitation to collect data. This procedure further ensured students would answer the questionnaires honestly and enhanced the validity of this research.

The Qualtrics system could be programmed to send out reminders based on the survey completion status automatically. Reminders were programmed to send our daily reminders for the first week and then weekly for the remaining time. The entire data collection process was closed on July 15, 2021. Thus, all participants had 30 to 45 days to complete the survey.

Academic Achievement Data Collection

Students' academic achievement data were obtained once the survey data collection was completed. The academic achievement data were the final numerical grade and the scores in four subcomponents: quiz, tweet, discussion, digital artifact creation, and GEA projects.

Data Integration

Once the survey data were compiled, and the academic achievement data were obtained, both files were merged into one integrated file. Each participant was given a numerical number and a class number just if verifications were needed. The identifiers of each participant, such as names, university IDs, and email addresses, were stripped off from the integrated file to ensure anonymity, privacy, and confidentiality. This integrated file was converted into a CSV file to be imported into the RStudio and SmartPLS software for data analyses.

Summary

In summary, a quantitative non-experimental research design using the PLS-SEM statistical analysis method was the research design of this study. The participants were junior university students enrolled in an online course called Digital Identity in a large public university in the Central region of Florida. An *a priori* power analysis using the G*Power tool enabled the researcher to determine the sample size of this research as 95. The sample size was sufficient as 110 participated in the current study. The Community of Inquiry Questionnaire and the Achievement Emotions Questionnaire were used to collect perceptual data. In addition, participants' final numerical grades were collected to reflect the academic achievement outcome variable. A rigorous data collection procedure was defined to ensure the participants' and the instructors' privacy, anonymity, and confidentiality. For data analysis, RStudio and SPSS were used for descriptive and inferential statistical analysis. SmartPLS version 3.3.3 was used to conduct the PLS-SEM-related statistical analysis.

Chapter Four: Results

Introduction

This research aimed to explore the relationship among the Community of Inquiry, achievement emotions, and academic achievement in asynchronous online learning in higher education. In chapter four, descriptive, inferential, and PLS-SEM statistical analyses were used to answer the four research questions and all the hypotheses of this study.

Chapter Four includes three sections. The first section presents the descriptive statistical analysis results on the six main research variables. The second section is the inferential statistical analysis on whether the demographic and learning profile variables confounded the academic achievement outcome variables. The third section is the PLS-SEM measurement model analysis to establish this research's construct validity and reliability. Factor loading reliability, construct composite reliability, and discriminant validity were used to determine the validity and reliability of the measurement model constructs. The fourth section is the PLS-SEM structural model analysis used to evaluate the research hypotheses. Finally, the fifth section is the predictive quality analysis on those hypotheses that resulted in statistical significance.

Descriptive Statistical Analysis

This research contained five composite variables and one outcome variable. Descriptive statistical analyses on the outcome variable, academic achievement, research demographic data, and learning profile data can be found in Chapter Three's Sample and Participants section. Descriptive statistics on the composite variables in the Community of Inquiry and achievement

emotions are in Table 5. The five composite variables were measured through the Community of Inquiry and Achievement Emotions Questionnaires on a Likert scale from 1 (i.e., Strongly Disagree) to 5 (i.e., Strongly Agree). In addition, the indicator level (i.e., individual questionnaire items) descriptive statistics for each of the composite variables were analyzed, and data normality was achieved (See Appendix B).

Table 5

Composite Variable Descriptive Statistical Analysis (n=110)

		Mean	*SD*	Min	Max	Skewness	Kurtosis
Community of Inquiry	TP	4.00	0.14	1	5	-0.97	0.56
	SP	3.98	0.17	1	5	-0.88	0.60
	CP	4.01	0.14	1	5	-0.95	0.88
Achievement Emotions	AE	3.88	0.16	1	5	-0.91	0.60
	OE	3.93	0.18	1	5	-0.88	0.47
Academic Achievement	AA	89.71	12.93	8.54	99.54	-3.28	15.10

Note. The Likert Scale was from 1 to 5. *SD*=Standard Deviation, TP=Teaching Presence, SP=Social Presence, CP=Cognitive Presence, AE=Activity Emotions, OE=Outcome Emotions, AA=Academic Achievement.

Inferential Statistical Analysis

For the current study, determining whether the demographic variables (i.e., gender, race, and age), the learning profile variables (i.e., learning preferences, online learning experience, and hours studied), and the class each participant enrolled in were related to the academic achievement variable was critical. Furthermore, if relations existed, these variables needed to be

used as control variables when PLS-SEM was used to analyze the relationships among the Community of Inquiry, achievement emotion, and academic achievement variables.

A multiple regression analysis was conducted to analyze the relationship between the academic achievement outcome variable with the age, gender, classes, race, learning mode preference, online learning experience, and the hours studied variables. See Appendix F. No *p* values reached the statistical significance level of .05. This inferential statistical analysis revealed that the class, demographic, and learning profile variables did not affect or confound the academic achievement variable. Furthermore, this analysis indicated that the level of online learning experiences measured by the number of online courses taken did not confound the academic achievement variable in this research. Since all participants are experienced in online learning, the shut-down caused by COVID did not seem to have become a factor confounding the academic achievement variable in this research. Based on the result of this analysis, the PLS-SEM analysis could proceed without controlling the demographic and learning profile variables.

PLS-SEM Measurement Model Analysis

The purpose of the measurement model analysis was to establish indicator loading reliability, composite reliability, and discriminant validity (Henseler, 2021). In PLS-SEM, the purpose of the measurement model analysis is to confirm the reliability and validity of all the indicator and composite variables. Thus, a measurement model analysis starts with the indicator loading variable analysis and finishes with the composite variable analysis.

Indicator Loading Analysis

Indicator loading analysis included the indicator data normality analysis and indicator correlation analysis. SmartPLS Version 3.3.3 (Ringle et al., 2015) was used to conduct this analysis. After the final integrated research data were imported into SmartPLS as a CSV file,

SmartPLS generated the indictor normality table (See Appendix B). The item level data skewness and kurtosis were within the standard range of -2 to +2 (Ware et al., 2013). Thus, no normality issue was found at the indicator loadings.

Indicator Loading Correlation Analysis

The goal for indicator loading correlation analysis was to ensure all loading correlations were lower than 1. Appendix C is the result of the indicator loading correlation data. No indicator loading correlation issue was found.

Model Specification

After the indicator loading analysis, the proposed conceptual model for this research was drawn in SmartPLS for further measurement model analysis. The indicators for each composite variable were dragged onto the SmartPLS canvas to draw the model. Then arrows were drawn to connect each composite variable based on the proposed conceptual model specified in Figure 2. The PLS Algorithm was chosen to conduct the measurement model analysis based on this specified model. The results of the PLS Algorithm were visually presented on the SmartPLS canvas (See Appendix D). Measurement model related statistics such as construct validity, discriminant validity, and reliability statistics were presented as tables and graphs in SmartPLS for the researcher to conduct analysis.

Outer Loading Analysis

The outer loading analysis determined how much each indicator contributed to the definition of a composite variable. In a confirmatory model analysis, outer loading should be greater than 0.70 (Hair et al., 2019). In exploratory research using reflective measures, the outer loading should be greater than 0.50 (Hair et al., 2019). Out loadings lower than 0.50 should be deleted as they do not contribute to the definition of the composite variable, but no more than

20% of outer loadings should be deleted (Hair et al., 2019). Three outer loading indicators (AE8R, AE14R, and OE8) were lower than 0.50. Therefore, they were deleted. The deletion of these three indicators constituted only 5% of the total indicators. The rest of the outer loadings were higher than -0.50 or +0.50; therefore, they met the outer loading criterion. Thus, the outer loading validity was achieved. See Appendix B for the complete outer loading analysis data.

Construct Reliability

After the outer loading reliability was established, the researcher conducted the composite level of construct reliability test. The Cronbach's alpha and the composite reliability statistics in PLS-SEM measure the internal consistency of constructs. A Cronbach's alpha and composite reliability value above .70 indicate acceptable construct reliability and composite reliability.

Table 6

Construct Reliability (n=110)

	Item Number	Cronbach's Alpha	Composite Reliability
Teaching Presence	13	.93	.94
Social Presence	9	.87	.90
Cognitive Presence	9	.92	.94
Activity Emotions	16	.91	.93
Outcome Emotions	8	.84	.88
Academic Achievement	75	.86	.94

Note. The Item Numbers indicated how indicator variables were in each composite variable.

See Table 6. The Cronbach's Alpha values and composite reliability values for all five composite constructs (i.e., teaching presence, social presence, cognitive presence, activity emotions, and outcome emotions) were above .70; therefore, the construct reliability for this research was established.

Discriminant Validity

Discriminant validity measures whether a construct is distinctively different from another. The Heterotrait-Monotrait Ratio (HTMT) method measures discriminant validity and

Table 7

Discriminant Validity Heterotrait-Monotrait Ratio (HTMT) Value (n=110)

	M	*SD*	AA	AE	CP	OE	SP
AA	89.71	12.93	-				
AE	3.88	0.17	.50				
CP	4.01	0.15	.18	.79			
OE	3.93	0.18	.49	.98	.74		
SP	3.98	0.17	.23	.67	.75	.72	
TP	4.00	0.15	.13	.72	.75	.71	.61

Notes. HTMT values are correlation values between two constructs. HTMT values below 0.90 for similar constructs or .85 for different constructs are considered valid (Hair et al., 2016; Hair et al., 2019; Henseler, 2021). The .98 value for the outcome emotion on activity emotion construct indicated a discriminant validity issue; therefore, further analysis was conducted. AA=Academic Achievement, AE=Activity Emotions, CP=Cognitive Presence, OE=Outcome Emotions, SP=Social Presence, TP=Teaching Presence.

indicates the true correlation between two variables if the variables were perfectly measured (Hair et al., 2016). HTMT measures the between-trait and within-trait correlations to determine a construct's discriminant validity. In addition, it measures the correlations of indicators across constructs measuring different phenomena relative to the correlations of indicators within the same construct (Henseler et al., 2015). If the HTMT value is closer to 1 between two variables, it indicates a lack of discriminant validity. The smaller the HTMT values, the better the construct entails discriminant validity.

HTMT values below .90 for similar constructs or .85 for different constructs are considered valid (Hair et al., 2016; Hair et al., 2019; Henseler, 2021). See Table 7. All HTMT scores for this study were below .85 except the outcome emotion construct. The high HTMT value between the outcome emotion and activity emotion constructs indicated that the outcome emotion construct was highly correlated with the activity emotion construct.

Cross Loading Analysis

To further validate the convergent validity of the outcome emotion construct in relationship with the activity emotion construct, a cross-loading analysis was conducted as recommended by Hair et al. (2016). Cross-loading is a correlation with the associated indicators. If the outer loading is greater than the cross-loading, it validates the construct validity at the indicator levels. In Table 8, all the Outcome Emotion Outer Loadings were greater than the Activity Emotion Cross Loading; therefore, the discriminant construct validity between the outcome emotion and activity emotion construct was established.

In summary, the measurement model analyses revealed that the five composite variables (i.e., teaching presence, social presence, cognitive presence, activity emotions, and

Table 8

Cross Loadings of Outcome Emotions on Activity Emotions (n=110)

	Outcome Emotion	Activity Emotion	
	Outer Loading	Cross Loading	Difference
OE1	.75	.57	.18
OE2	.74	.66	.08
OE3R	.79	.63	.16
OE4R	.82	.75	.08
OE5R	.69	.63	.06
OE6	.67	.58	.09
OE7R	.54	.50	.04

Note. Cross-loading is a correlation with the associated indicators. If the outer loading is greater than the cross-loading, it validates the construct validity at the indicator levels. For example, all the Outcome Emotion Outer Loadings were greater than the Activity Emotion Cross Loading, indicating discriminant validity for the outcome emotions construct.

outcome emotions) were valid and reliable constructs. First, loading reliability was established as all loadings were higher than .50 for an exploratory study. Second, the Cronbach's alpha values for all constructs were above .70, indicating construct reliability. Third, the composite reliability values of all five constructs were above .70, indicating composite reliability. Finally, the HTMT values revealed that all constructs had discriminant validity except the outcome emotion construct with an HTMT value above .90 in relation to the activity emotion construct. When an outer-loading and cross-loading analysis was conducted, the outcome emotion construct was

determined to have discriminant validity at the loading level. Overall, the measurement model analyses concluded that the five composite constructs were statistically valid and reliable; therefore, the foundation for the structural model analysis was established.

PLS-SEM Structural Model Analysis

The structural model analysis was used to analyze the relationships in the proposed conceptual model in Figure 2. Collinearity analysis was conducted first to ensure each exogenous variable distinctively predicted the endogenous variable. Then the predictive path coefficients were analyzed to decipher the research hypotheses. Finally, a predictive quality analysis was conducted based on the coefficient of determination and effect size statistics to determine the significance and size of the path coefficients.

Collinearity Assessment for Predictive Quality

Variance Inflation Factor (VIF) is the collinearity assessment method that measures how a predictor distinctively predicts an independent variable (Kline, 2015; Ware et al., 2013). A VIF value greater than 5 indicates potential collinearity issues, between 3 to 5 indicates possible collinearity issues, and smaller than 3 is ideal (Hair et al., 2016).

Analyses of the VIF values (See Table 9) indicated that the teaching presence, social presence, and cognitive presence constructs had no collinearity issues with the activity emotion and outcome emotion constructs. On the other hand, the VIF value for the cognitive presence (VIF=3.04) construct was just above the cutting point of 3 when correlated with the academic achievement construct; therefore, the cognitive presence might have a low-level collinearity issue. Moreover, the VIF values for the activity emotion (VIF=4.78) and outcome emotion (VIF=4.24) constructs were between 3 to 5 when correlated with the academic achievement construct; therefore, possible collinearity issues might exist.

Table 9

Variance Inflation Factor Values (n=110)

	Academic Achievement	Activity Emotions	Outcome Emotions
Activity Emotions	4.78		
Outcome Emotions	4.24		
Teaching Presence	2.28	2.03	2.03
Social Presence	2.12	1.88	1.88
Cognitive Presence	3.04	2.59	2.59

Note. VIF is a collinearity assessment indicator. A VIF value greater than 5 indicates potential collinearity issues, between 3 to 5 indicates possible collinearity issues, and smaller than 3 is ideal (Hair et al., 2016). The VIF values for the activity emotion (VIF=4.78) and outcome emotion (VIF=4.24) constructs indicate possible collinearity issues.

An analysis of the outer VIF values was conducted to further investigate these three collinearity issues (See Table 10). For example, if 70% of the outer VIF values are smaller than 3, the construct presents no significant collinearity issue (Hair et al., 2016; Hair et al., 2019; Henseler, 2021). Furthermore, 71.43% of the outer VIF values for the activity emotion construct were ideal. Likewise, 77.78% of the outer VIF values for the cognitive presence construct were ideal. Finally, 100% of the outer VIF values were ideal for the outcome emotion construct. Thus, all three constructs (i.e., cognitive presence, activity emotion, and outcome emotion) presented no significant collinearity issue.

Table 10

Outer VIF Values (n=110)

Indicators	VIF	Indicators	VIF	Indicators	VIF
AE1	4.24	CPex1	2.90	OE1	1.88
AE10	2.10	CPex2	2.47	OE2	1.77
AE11	2.97	CPex3	1.98	OE3R	2.31
AE12	2.52	CPre1	2.72	OE4R	2.29
AE13R	3.07	CPre2	2.61	OE5R	1.91
AE15R	3.92	CPre3	2.37	OE6	1.53
AE16R	3.90	CPte1	2.26	OE7R	1.37
AE2R	1.99	CPte2	3.48		
AE3R	2.21	CPte3	3.06		
AE4	1.87				
AE5	2.00				
AE6R	2.22				
AE7R	1.88				
AE9R	2.76				

Note. Outer VIF measures the discriminant validity at the item level. If 70% of the outer VIF values are smaller than 3, the construct presents no significant collinearity issue. No statistically significant collinearity issue was found with all three constructs at the composite variable level (i.e., cognitive presence, activity emotion, and outcome emotion).

Hypothesis Testing Overview

Of the 17 hypotheses defined in the four research questions, nine were supported, and eight were not supported. Two statistical analyses were conducted during the structural model analysis stage to test the 17 hypotheses. First, a statistical bootstrapping analysis was used to test the hypotheses defined in RQ1 to RQ3. Second, the mediation analysis method was used to test the hypotheses defined in RQ4. The *t*-statistics and *p* values were used to decipher the hypotheses of this research. The path coefficient (β) statistics were used to determine an exogenous variable's direct effect on an endogenous variable. The path coefficient is considered statistically significant when the *t*-statistical value is above 1.96, and the *p*-value is below .05. Table 11 contains the results of the bootstrapping statistics. Appendix D visually depicts each path coefficient on the path lines in the conceptualized research model specification diagram. Table 12 includes the mediation analysis statistics.

Hypothesis Testing for RQ1

RQ1. What is the relationship between asynchronous online students' perception of the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) and their achievement emotions (i.e., activity emotions and outcome emotions)?

First, H1 hypothesized that teaching presence (TP) had a significant positive effect on activity emotions (AE). The research results revealed teaching presence (TP) had a significant positive statistical effect on activities emotions (AE) ($\beta = 0.30$, $t=3.07$, $p=.002$). Hence, H1 was supported.

Second, H2 hypothesized that teaching presence (TP) had a significant positive effect on outcome emotions (OE). The research results revealed that teaching presence (TP) had a

significant positive statistical effect on outcome emotions (OE) (β = 0.30, t=2.54, p=.011). Hence, H2 was supported.

Table 11

Bootstrapping Path Coefficient Analysis (n=110)

Hypothesis	Path	Path coefficient (β)	*t*-statistics	*p*-value	Supported
H1	TP -> AE	.30	3.07	.002**	Yes
H2	TP -> OE	.30	2.93	.004**	Yes
H3	TP -> AA	-.27	2.54	.011**	Yes
H4	SP -> AE	.18	1.91	.057	No
H5	SP -> OE	.32	2.94	.003**	Yes
H6	SP -> AA	.02	0.14	.887	No
H7	CP -> AE	.41	3.67	.000***	Yes
H8	CP -> OE	.24	2.10	.036*	Yes
H9	CP -> AA	-.29	1.95	.052	No
H10	AE -> AA	.69	5.02	.000***	Yes
H11	OE -> AA	0.21	1.01	.311	No

Note. TP=Teaching Presence, AA=Academic Achievement, SP=Social Presence, AE=Activity Emotions, OE=Outcome Emotions, CP=Cognitive Presence.

*p<.05; **p<.01; *** p <.001.

Third, H4 hypothesized that social presence (SP) had a significant positive effect on activity emotions (AE). However, the research results revealed that social presence (SP) had no significant statistical effect on activity emotions (AE) (t=0.18, p=.057). Hence, H4 was not supported.

Fourth, H5 hypothesized that social presence (SP) had a significant positive effect on outcome emotions (OE). The research results revealed that social presence (SP) had a significant positive statistical effect on outcome emotions (OE) (β = 0.32, t=2.94, p=.003). Hence, H5 was supported.

Fifth, H7 hypothesized that cognitive presence (CP) had a significant positive effect on activity emotions (AE). The research results revealed that cognitive presence (CP) had a significant positive statistical positive effect on activity emotions (AE) (β = 0.41, t=3.67, p=.000). Hence, H7 was supported.

Sixth, H8 hypothesized that cognitive presence (CP) had a significant positive effect on outcome emotions (OE). The research results revealed that cognitive presence (CP) had a significant positive statistical effect on outcome emotions (OE) (β = 0.24, t=2.10, p=.036). Hence, H8 was supported.

Hypothesis Testing for RQ2

RQ2. What is the relationship between asynchronous online students' perception of the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) and their academic achievement?

First, H3 hypothesized that teaching presence (TP) had a significant positive effect on academic achievement (AA). The research results revealed that teaching presence (TP) had a significant negative statistical effect on academic achievement (AA) (β =-0.27, t=2.541, p=.011). Hence, the hypothesis was supported

Second, H6 hypothesized that social presence (SP) had a significant positive effect on academic achievement (AA). However, the research results revealed that social presence (SP)

had no significant statistical impact on academic achievement (AA) (t=0.02, p=.887). Hence, H6 was not supported.

Third, H9 hypothesized that cognitive presence (CP) had a significant positive effect on academic achievement (AA). However, the research results revealed that cognitive presence (CP) had no significant statistical impact on academic achievement (AA) (t=1.95, p=.052). Hence, H9 was not supported.

Hypothesis Testing for RQ3

RQ3. What is the relationship between asynchronous online students' perception of their achievement emotions (i.e., activity emotions and outcome emotions) and academic achievement?

First, H10 hypothesized that activity emotions (AE) had a significant positive effect on academic achievement (AA). The research results revealed that activity emotions (AE) had a significant positive statistical effect on academic achievement (AA) (β=0.69, t=5.02, p=.000). Hence, H10 was supported.

H11 hypothesized that outcome emotions (OE) had a significant positive effect on academic achievement (AA). However, the research results revealed that outcome emotions (OE) had no significant statistical impact on academic achievement (AA) (t=1.01, p=.311). Hence, H11 was not supported.

Hypothesis Testing for RQ4

RQ4. How do students' achievement emotions (i.e., activity emotions and outcome emotions) mediate the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) to impact their academic achievement in asynchronous online learning in higher education?

A PLS-SEM specific indirect effect analysis (See Table 12) was conducted to answer RQ4. The goal was to determine whether and how the achievement emotions (i.e., activity emotions and outcome emotions) mediated the Community of Inquiry (i.e., teaching presence, social presence, and cognitive presence) to impact the participants' academic achievement.

First, H12 hypothesized that activity emotions significantly meditated teaching presence (TP) to impact academic achievement. The research results revealed that activity emotions had a significant positive statistical mediation effect on teaching presence to impact academic achievement (β=0.23, t=2.31, p=.022). Hence, H12 was supported.

Table 12

Specific Indirect Effect Analysis on Academic Achievement (n=110)

Hypothesis	Path	Path coefficient (β)	*t* statistics	*p* values	Supported
H12	TP -> AE -> AA	0.23	2.31	.022*	Yes
H13	TP -> OE -> AA	0.05	0.77	.443	No
H14	SP -> AE -> AA	0.14	1.76	.079	No
H15	SP -> OE -> AA	0.05	0.78	.434	No
H16	CP -> AE -> AA	0.30	2.62	.009**	Yes
H17	CP -> OE -> AA	0.04	0.76	.446	No

Note. TP=Teaching Presence, AA=Academic Achievement, SP=Social Presence, AE=Activity Emotions, OE=Outcome Emotions, CP=Cognitive Presence.

*p<.05; **p<.01; *** p <.001.

Second, H13 hypothesized that outcome emotions significantly meditated teaching presence to impact academic achievement. However, the research results revealed that outcome

emotions had no significant statistical mediation effect on teaching presence (t=0.77, p=.443). Hence, H13 was not supported.

Third, H14 hypothesized that activity emotions significantly meditated social presence to impact academic achievement. However, the research results revealed that activity emotions had no significant statistical mediation effect on social presence to impact academic achievement (t=1.76, p=.079). Hence, H14 was not supported.

Fourth, H15 hypothesized that outcome emotions significantly meditated social presence to impact academic achievement. However, the research results revealed that outcome emotions had no significant statistical mediation effect on social presence to impact academic achievement (t=0.78, p=.434). Hence, H15 was not supported.

Fifth, H16 hypothesized that activity emotions significantly meditated cognitive presence to impact academic achievement. The research results revealed that activity emotions had a significant statistical mediation effect on cognitive presence to impact academic achievement (β =0.30, t=2.62, p=.009). Hence, H16 was supported.

Sixth, H17 hypothesized that outcome emotions significantly meditated cognitive presence to impact academic achievement. However, the research results revealed that outcome emotions had no significant statistical mediation effect on cognitive presence to impact academic achievement (t=0.76, p=.446). Hence, H17 was not supported.

Predictive Quality Analysis

The relationships among the Community of Inquiry, achievement emotions, and academic achievement were formulated after answering the four research questions and testing the 17 hypotheses. In addition, the coefficient of determination and effect size analyses were conducted to ensure predictive quality and answer the following two questions. First, how much

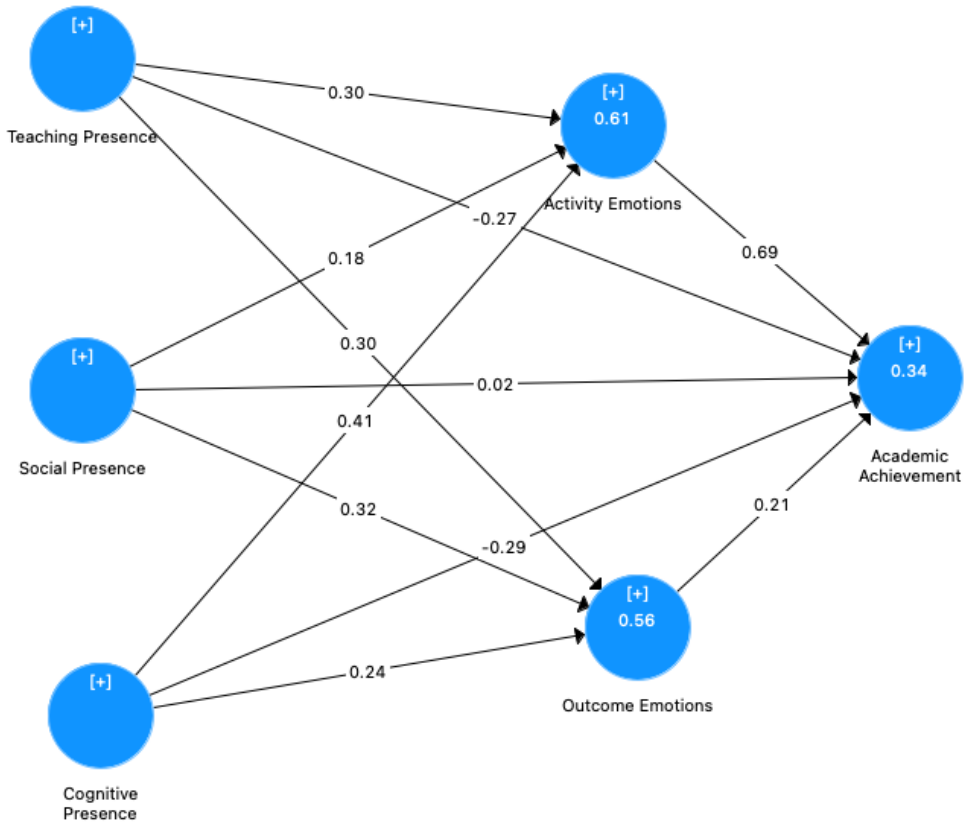
of the effect on academic achievement could be explained by achievement emotions (i.e., activity emotions and outcome emotions) and the Community of Inquiry (i.e., teaching presence, social presence, cognitive presence). Second, what would be the effect sizes for those relationships with significant statistical effects?

Coefficient of Determination (R2) Analysis

The coefficient of determination (R^2) explains how much of the variance in an endogenous outcome variable can be explained by the exogenous variables (Kline, 2015). R^2 values of .75, .50, and .25 indicate the substantial, moderate, or weak coefficient of determination.

Figure 6

Coefficient of Determination R^2 Values



As visualized in Figure 6, a moderate coefficient of determination (R^2=.34) on academic achievement was found in this research. The R^2 value indicated that 34% of academic achievement could be explained by the variables in the Community of Inquiry (i.e., teaching presence, cognitive presence, and social presence) and achievement emotions (i.e., activity emotions and outcome emotions). The coefficient of determination for activity emotions (R^2=.61) was moderate too. The R^2 value quantified that 61% of activity emotions could be explained by the variables in the Community of Inquiry (i.e., teaching presence, social presence, and cognitive presence). The coefficient of determination for outcome emotions (R^2=.56) was moderate. The R^2 value quantified that 56% of outcome emotions could be explained by the variables in the Community of Inquiry (i.e., teaching presence, social presence, and cognitive presence).

Effect Size (f^2) Analysis

In PLS-SEM, effect size (f^2) is used to conduct predictive accuracy (Hair et al., 2019; Henseler, 2021). The effect size value measures the change in R^2, especially when an endogenous variable was removed from the path model (Hair et al., 2016). An effect size greater than .35 is considered a significant effect, between .15 to .35, a medium effect, between .02 to .15, a small effect.

As illustrated in Table 13, teaching presence (f^2=.05) and cognitive presence (f^2=.04) had small effect sizes on academic achievement but not social presence (f^2=.00).

Cognitive presence had a medium impact on activity emotions (f^2=.17) but a negligible impact on outcome emotions (f^2=.05). Social presence had a negligible impact on outcome emotions (f^2=.13) and activity emotions (f^2=.04). However, social presence's effects on outcome emotions and activity emotions were significantly different. The impact on outcome emotions

was 69% larger than on activity emotions. Teaching presence had a negligible effect on activity emotions (f^2=.11) and outcome emotions (f^2=.10). The effect sizes were not much different.

Activity emotions had a medium impact on academic achievement (f^2=.15), while outcome emotions had a negligible impact (f^2=.02). However, the effect of activity emotions on academic achievement was 86% larger than outcome emotions.

Table 13

Effect Size (f^2) Values (n=110)

	Academic Achievement	Activity Emotions	Outcome Emotions
Activity Emotions	.15		
Outcome Emotions	.02		
Cognitive Presence	.04	.17	.05
Social Presence	.00	.04	.13
Teaching Presence	.05	.11	.10

Note. An effect size greater than .35 is considered a significant effect, between .15 to .35, a medium effect, between .02 to .15, a small effect. The activity emotion construct has a medium effect size (f^2=.15). The cognitive presence construct has a medium effect size on activity emotions (f^2=.17).

Summary

Three groups of research results were concluded in Chapter Four. The first group was on the relationships among the Community of Inquiry, achievement emotions, and academic achievement. The second group was on how much the academic achievement could be explained by the Community of Inquiry and achievement emotions. The third group was on the effect size

the Community of Inquiry and achievement emotions had on academic achievement. Overall, nine hypotheses were supported, and eight were not supported. The activity emotion construct was essential in predicting, mediating, and affecting the outcome variable, academic achievement.

Chapter Five: Discussion, Implications, and Recommendations

Twenty years after neuroscientists validated that emotion played an inextricable role in cognition and learning, the current research pinpointed, for the first time, that activity emotions were the most important predictors and mediators in affecting academic achievement in the Community of Inquiry framework. The findings of this research have implications to the Community of Inquiry framework, the Control Value Theory of Achievement Emotions, asynchronous online learning, new learning theory, and new learning design model development. The following sections are included in Chapter Five to explicate the significance, implications, limitations, and recommendations of this study: 1) key findings, 2) limitations of the research, 3) implications, and 4) recommendations.

Key Findings

The researcher of this study aimed to explore the relationships among the Community of Inquiry, achievement emotions, and academic achievement in an asynchronous online learning mode in the higher education setting. Four issues converged to provide compelling reasons to conduct the current study. First, research in cognitive neuroscience established emotion's inextricable role in cognition and learning. However, researchers in the Community of Inquiry have not agreed upon the role emotion plays in the online learning process despite multiple researchers proposing to add emotional presence as a fourth component (Campbell, 2006; Cleveland-Innes & Campbell, 2012; Mardi, 2020; Williams, 2017). Second, the Control-Value Theory of Achievement Emotions concluded that achievement emotions predicted academic achievement, but this finding was not applied in the Community of Inquiry research. Third,

researchers in the Community of Inquiry have focused on studying the inter-relationships among teaching presence, cognitive presence, and social presence, but not on the most crucial factor of learning: academic achievement (Annand, 2019; Castellanos-Reyes, 2020; Garrison & Arbaugh, 2007). Fourth, qualitative research methods dominated studies in the Community of Inquiry, and more quantitative studies were needed to investigate how emotion predicts, mediates, or moderates academic achievement. These four issues were addressed through the four research questions and 17 research hypotheses. As a result, four key findings were derived from this non-experimental quantitative research.

Activity Emotions Significantly Mediate and Affect Academic Achievements

The main finding of this research was that the activity emotion construct was the only factor that significantly predicted, mediated, and affected academic achievement with a medium effect size (f^2=0.15) in the context of the Community of Inquiry framework in an asynchronous online learning mode in a higher education setting. Three levels of statistical analyses supported this finding.

First, the activity emotion (β=.69, t=5.02, p=.000) construct was the only factor with the highest statistical significance in predicting academic achievement. Second, activity emotions significantly mediated both the teaching presence (β=.23, t=2.31, p=.022) and cognitive presence (β=.30, t=2.62, p=.009) in predicting and affecting academic achievement. This research discovered that both the teaching and cognitive presence constructs went through activity emotions to affect academic achievement. Third, the activity emotion (f^2=.15) construct was the only factor with a medium effect size on academic achievement. In addition, the researcher found that cognitive presence (f^2=.17) was the only factor that had a medium effect size on activity emotions. Moreover, the effect size of cognitive presence on activity emotions

(f^2=.17) was bigger than the effect size of activity emotions (f^2=.15) on academic achievement. The bigger effect size implied that cognitive presence played a significant role in affecting activity emotions and was the main factor in activating activity emotions.

This finding supported previous research findings that emotion affected cognitive resource allocation, learning strategies, and self-regulation (Barrett et al., 2016a; Camacho-Morles et al., 2021; Linnenbrink-Garcia & Pekrun, 2014; Pekrun et al., 2002). It also validated the findings from neuroscientists that emotion played an inextricable role in cognition and learning (Barrett, 2020; Damasio, 1999, 2005; Dirkex, 2001; Immordino-Yang & Damasio, 2007; Linnenbrink-Garcia & Pekrun, 2011; Tyng et al., 2017). In addition, this research empirically supported Moreno's (2007) theoretical claim that affect was an on and off switch to cognition and learning. The new value this research added to the extant literature was that the activity emotion construct was found to be the only variable in predicting, mediating, and affecting academic achievement in the context of the Community of Inquiry framework. This research provided empirical evidence on whether emotional presence plays a role in the Community of Inquiry. The conclusion is that activity emotion plays a critical role and singularly predicts, mediates, and affects academic achievement. Moreover, the researcher concluded that activity emotions must be activated first for teaching and cognitive presence to impact academic achievement; therefore, confirming that activity emotion is the gatekeeper for teaching presence and cognitive presence to impact academic achievement.

Teaching Presence and Cognitive Presence Predict and Affect Activity Emotions

The second finding of this research revealed that teaching presence (β = .30, t=3.07, p=.002) and cognitive presence (β = .41, t=3.67, p=.000) significantly predicted activity emotions, but social presence did not (t=.18, p=.057). Furthermore, the researcher also found that

61% of activity emotions (R^2=0.61) could be explained by the variables in the Community of Inquiry: teaching presence and cognitive presence.

This research finding provided empirical evidence to a study conducted by Swan et al. (2020), who theorized that teachers' attention to students' emotions was critical in fostering better activity emotions. This finding also provided empirical evidence to another study conducted by Nyanjom and Naylor (2020). They found that teachers often regulated their emotions and demonstrated empathy, concern, and friendliness while suppressing their emotions during online text-based interpersonal communications. In addition, this research supported the findings of the third study from Kang et al. (2014), who found cognitive presence predicted satisfaction consistently. The effect size analysis in this research revealed that cognitive presence (f^2=.17) was the only factor that had a medium effect size on activity emotions. As a result, the current study supported both findings from Kang et al. (2014), demonstrating the power of cognitive presence in activating activity emotions.

Unlike the above three cited studies, the current research added value to the Community of Inquiry research field by discovering that cognitive presence and teaching presence predicted and affected activity emotions. For this reason, this research not only surfaced the importance of activity emotions during an asynchronous online learning process but also discovered that cognitive presence (β = .41, t=3.67, p=.000) had a more significant effect on activity emotions than teaching presence (β = .30, t=3.07, p=.002). Additionally, this research discovered that the activity emotion construct was the only factor that had a medium effect size on academic achievement (f^2=.15). Thus, this research finding added conclusive value to the emotional presence research field that activity emotion was the only critical predictor and mediator between

the three presences in the Community of Inquiry (i.e., teaching presence, social presence, and cognitive presence) and academic achievement.

All in all, this research discovered that teaching presence and cognitive presence predicted activity emotions, but cognitive presence substantially affected activity emotions than teaching presence. This finding could lead researchers, teachers, and designers to consider designing more cognitively engaging learning activities to activate and sustain activity emotions for students to achieve better academic achievement results.

The CoI Presences Affect Outcome Emotions, but Not Academic Achievement

The third finding of this research was that teaching presence (β = .30, t=2.54, p=.011), social presence (β = .32, t=2.94, p=.003) and cognitive presence (β = .24, t=2.10, p=.036) all had significant statistical effects on outcome emotions, but the effect on academic achievement was not statistically significant. The research results revealed that social presence and cognitive presence had no significant statistical effect on academic achievement, but teaching presence had a significant negative statistical effect on academic achievement (β=-.27, t=2.541, p=.011). This finding was significant and explained why no previous research studied the relationship between teaching presence, social presence, and cognitive presence with academic achievement. Even though teaching, social, and cognitive presences significantly affected outcome emotions, outcome emotions did not affect academic achievement. This research finding indicated that outcome emotions were less important than activity emotions engendered by cognitive presence.

This finding supported, enhanced, and complemented past research results. Kang et al. (2014) deployed three studies to investigate which presences (i.e., cognitive presence, social presence, and emotional presence) predicted achievement and satisfaction. Study 1 was conducted in a blended learning environment. The researchers found that cognitive presence

predicted satisfaction and achievement, while emotional presence only predicted satisfaction. Study 2 was based on problem-solving in an online learning environment. The researchers found that cognitive presence predicted satisfaction and achievement, but not emotional presence. Study 3 was on collaborative online learning. The researchers found that cognitive presence and emotional presence predicted satisfaction but not the achievement result. These three studies from Kang et al. (2014) concluded that all three presences (i.e., teaching presence, social presence, and cognitive presence) predicted learning satisfaction. However, the prediction on achievement was inconclusive and contradictory. Two studies revealed that cognitive presence predicted achievement, but not the third when the learning environment was in a collaborative online learning setting.

The findings from the current study supported the conclusive finding from Kang et al. (2014) that cognitive presence predicted satisfaction, which could be interpreted as cognitive presence predicting positive activity emotions engendered during the learning process. Additionally, the current research provided empirical evidence to potentially resolve the inconclusive and contradictory finding on whether cognitive presence predicts achievement. The present study revealed that cognitive presence did not predict academic achievement, nor did social presence. In the current research, team-based collaborative projects were carried out through social media campaigns and discussion forums, contributing to 50% of students' final academic achievement. Thus, the present study validated the third study from Kang et al. (2014) that cognitive presence did not predict achievement but predicted satisfaction. Overall, the current study contradicted Kang et al. (2014) that cognitive presence predicted achievement. Moreover, the present study found that neither cognitive nor social presence affected academic

achievement directly. On the contrary, teaching presence negatively affected academic achievement.

The finding that none of the Community of Inquiry presences positively and directly impacted academic achievement was new and counterintuitive. In the past, researchers concluded that teaching presence predicted cognitive presence (Castellanos-Reyes, 2020; Garrison & Arbaugh, 2007) while social presence influenced cognitive presence (Fiock, 2020; Garrison et al., 2010), but no one conducted studies to investigate whether these three presences predicted and affected academic achievement. Moreover, researchers in the Community of Inquiry concluded that cognitive presence predicted and influenced learning outcomes, not teaching presence (Garrison et al., 2010; Garrison & Arbaugh, 2007). The current research found that all three presences had no positive direct effect on academic achievement, but teaching and cognitive presence had significant indirect effects. No study in the past reported such findings. Additional research is needed to investigate further why teaching presence could potentially negatively impact academic achievement and why cognitive presence and social presence did not directly affect academic achievement.

Limitations

The current study was conducted with 110 homogeneous participants in the same grade level in one university. Therefore, four limitations in the generalizability of this research exist.

Restriction to Population Generalization

The convenient sampling method used in this research restricted the generalizability of this study. This research is limited to participant sampling in the geographic settings of Central Florida with a homogeneous group of participants. Most of the participants were from the central Florida region. The race and ethnicity of the participants were somewhat diverse. The dominant

race of the participants was White (67%), with 16% Blacks, 11% Asians, 4% Latinos, and 6% Hispanics. The ages of the participants were homogenous, with 95% of the participants between the ages of 18 to 25. Therefore, caution should be taken to generalize the research results to populations beyond the same race, age, and geolocation.

Restriction to Subject Area Generalization

This research is restricted to one online course with standardized designs, contents, and assessments. The subject area of this course was digital identity, a social science. It is unknown whether activity emotions would play the same predictive and mediation role in other subject areas such as science-related subjects. Therefore, caution should be taken to generalize that activity emotion is the most significant predictor and mediator of academic achievements in other subjects without additional studies.

Restriction to Academic Achievement Assessment Methods

The academic achievement construct represented by the final grade was negatively skewed. Caution should be given in generalizing the research results if the academic achievement assessment definition is different and might be solely based on knowledge retention. Additionally, the academic achievement results for this research were an accumulation of 18 weeks of quizzes, discussions, digital artifact creations, and project work over one semester. Researchers should be cautious in generalizing the current research result to programs with a shorter duration and different academic assessment methods.

Restriction to Experimental Design

This study was a quantitative non-experimental study. Based on the Theory of Control-Value Theory of Achievement Emotions, the definition of the achievement emotion construct was not only a cognitive process but also a physiological, motivational, and behavioral process

(Linnenbrink-Garcia & Pekrun, 2011; Pekrun, 2006). No experimental group and controlled groups were involved in this study. Variables such as motivation, metacognition, self-efficacy, and self-regulation might have influenced the results of this study. For this reason, researchers should be cautious in generalizing the findings of this study when motivation, metacognition, self-efficacy, and self-regulation are emphasized during the learning process. The current research revealed that the activity emotion construct was the most critical predictor and mediator. In contrast, the outcome emotion construct had no statistical significance on academic achievement. Nonetheless, potential discriminant validity issues might exist as the activity and outcome emotion constructs were highly statistically correlated. The findings might be different if an experimental design approach were used to manipulate either activity emotions or outcome emotions. Thus, the conclusion that outcome emotions did not impact academic achievement should not be generalized unless additional studies were conducted.

Implications

For the first time, the current research pinpointed that activity emotions significantly predicted, mediated, and affected academic achievements in the Community of Inquiry framework in an asynchronous online learning mode in the higher education setting. This research empirically validated that emotion played an inextricable role in cognition and learning. The result of this research has theoretical, practical, and design implications in online learning.

Theoretical Implications

The first theoretical implication is on activity emotions and the Community of Inquiry. The current research discovered that activity emotion is critical in predicting, mediating, and affecting academic achievement. Researchers and practitioners of the Community of Inquiry have called for the need to address emotion-building as a pedagogical tool within the Community

of Inquiry framework (Campbell, 2006; Cleveland-Innes & Campbell, 2012; Lawson, 2019; Mardi, 2020; Stenbom et al., 2016; Williams, 2017) for 20 years. A construct called the emotional presence was even proposed, and multiple researchers have attempted to add emotional presence as a fourth component (Campbell, 2006; Cleveland-Innes & Campbell, 2012; Mardi, 2020; Williams, 2017) in the Community of Inquiry. Year to date, scholars in the Community of Inquiry have not acknowledged the critical predictive and mediating role emotion could play in online learning other than stating that emotions are an affective process subsumed by the social presence construct. The current research found that social presence had a significant effect on outcome emotions but not on activity emotions. No correlation between social presence and academic achievements was found. It was the activity emotion construct that significantly mediated teaching presence and cognitive presence.

The Community of Inquiry framework needs to be updated. A new theory should be created to give rise to emotion's critical role in learning. Instead of adding emotional presence as a fourth component, the Community of Inquiry researchers need to investigate the underpinning role activity emotions play in the entire learning process. The following questions should be considered in future studies.

1) Should activity emotions be considered immersive in the Community of Inquiry framework as illustrated in Figure 7 (i.e., A pink circle representing the immersion of activity emotions in the Community of Inquiry)?

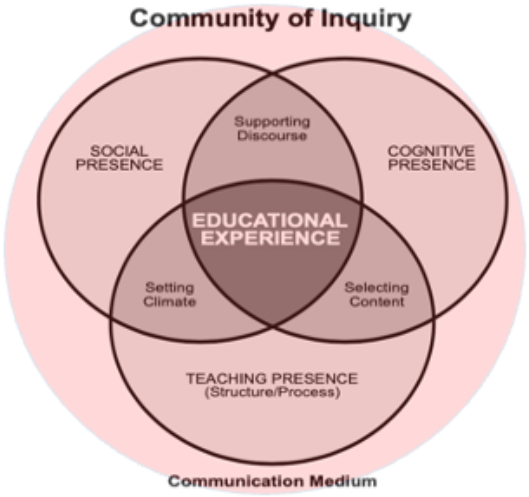
2) What activity emotion theory should be produced to improve online learning?

3) What emotional design models should be produced to guide practitioners to utilize the power of activity emotions to improve academic achievement?

Figure 7

Immersion of Activity Emotions in the Community of Inquiry

From "Critical inquiry in a text-based environment: Computer conferencing in higher education" by R. D. Garrison, T. Anderson, and W. Archer, *The Internet and Higher Education*, 2, p. 88. Copyright 1999 by Elsevier Science Inc. Adapted with permission.



The second theoretical implication is the creation of a new learning theory: Cogmotion Theory of Learning. "Emotion is the rudder of cognition" was concluded by one of the most famous neuroscientists, Damasio (1999, 2005). The current study supported Damasio's research findings and narrowed down the rudder of cognition and learning as activity emotions. No learning theory other than Bandura's Social Cognitive Learning Theory (1988) defined emotion or affect as part of a theoretical learning model. Bandura's social cognitive learning theory did not put emotion at the same level as cognition but only considered it a social component subservient to cognition. It is foreseeable that a new learning theory is needed so that emotion can be elevated from the subservient role to the same level of importance cognition commanded for centuries. Based on the research result of this study, the researcher simplified the structural path model in Figure 8 by deleting the insignificant and negative paths. As a result, a new

theoretical model emerged that depicted the relationship among cognition, emotion, and academic achievement.

Figure 8

Relationships Among Cognitive Presence, Activity Emotions, and Academic Achievement

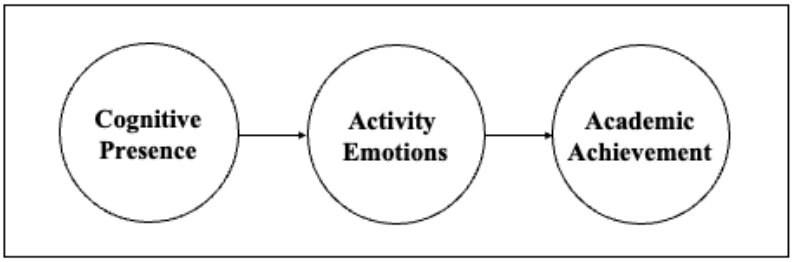
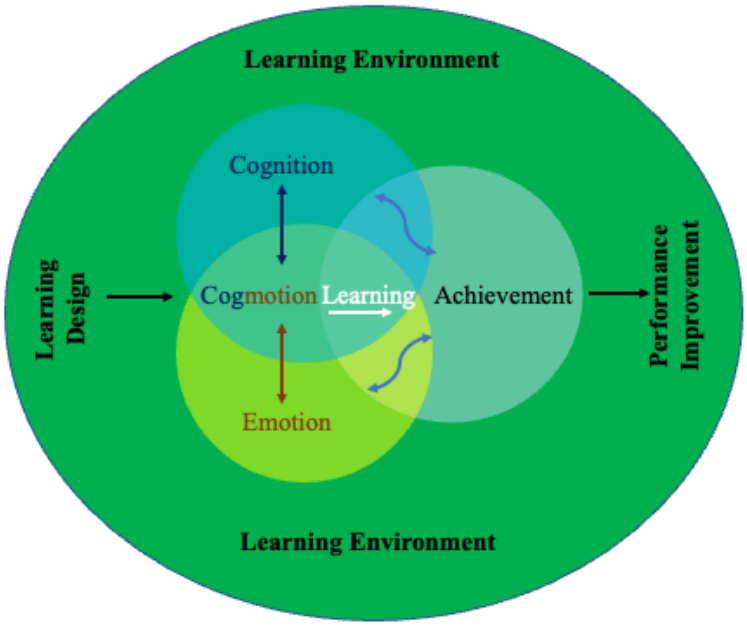


Figure 8 validated the Control-Value Theory of Achievement Emotions depicted in Figure 5. As part of the learning environment, cognitive presence engendered activity emotions through the control and value appraisal process to impact academic achievement. Figure 8 depicts a linear relationship among cognitive presence, activity emotions, and academic achievement. In reality, neuroscientists (Blair et al., 2020; Immordino-Yang, 2015; Lemaire, 2022; Rothermund & Koole, 2018) and educational psychologists (Linnenbrink-Garcia & Pekrun, 2011; Pekrun, 2006) have described the relationship between cognition and emotion as a recursive and instantaneous process. In addition, academic achievement also recursively influences the emotional and cognitive process (Camacho-Morles et al., 2021; Pekrun et al., 2017). Based on the above, the theoretical model in Figure 8 can be depicted in a new model illustrated in Figure 9. In this model, cognition, emotion, and achievement recursively influence each other, and learning happens in the center where cognition, emotion, and achievement overlap. Since no learning theory puts emotion at the same level of cognition, the researcher of this study combined cognition and emotion and created a new word called cogmotion to describe

the recursive mutual relationship between cognition and emotion during learning. Based on the above discussion that cognition, emotion, and achievement recursively influence each other, the researcher of the current study proposes a new theory called Cogmotion Theory of Learning for researchers to further validate and extend the result of the current research.

Figure 9

Cogmotion Theory of Learning



The Cogmotion Theory of Learning is a theory for the asynchronous online learning environment. This theory posits emotion as the rudder of learning and postulates deep learning takes place at the intersection of cognition, emotion, and achievement through a recursive interaction process. In this theory, the learning environment is designed to activate a learner's emotional (i.e., hypothalamus and amygdala) and cognitive (i.e., frontal cortex, hippocampus, and striatum) neurological processes, converging into cogmotion to realize learning and achievement. This is a new learning theory to guide the advancement of the asynchronous online

learning field, but researchers should use experimental designs to validate and extend this theory to other learning environments.

The Cogmotion Theory of Learning adds four new values to the online learning field. First, it elevates emotion to the same level of importance as cognition with an undergirded theory that cognition activates emotion, but emotion mediates cognition to impact achievement. Second, it theorizes that emotion is the rudder of cognition and calls educators to design engaging cognitive activities to invoke activity emotions for better achievement. Third, it theorizes that emotion (i.e., achievement emotion) is part of the overall achievement result and recursively affects cognition, emotion, and learning. Fourth, the Cogmotion Theory of Learning closed a long overdue theory gap in the extant literature and offered a theory to guide asynchronous online learning design and research.

While the Community of Inquiry can continue to serve as a framework for community-based online learning, the Cogmotion Theory of Learning can serve the asynchronous online learning paradigm. Future researchers should design self-paced asynchronous online learning programs to validate, enhance, and extend the Cogmotion Theory of Learning. If this learning theory is valid, researchers should produce design principles to substantiate the Cogmotion Theory of Learning.

Practical Implications

Activity emotions singularly mediated teaching presence and cognitive presence to predict and impact academic achievement. This finding indicated that learning might not successfully transpire and materialize if students' activity emotions were not properly activated, facilitated, and sustained. No teaching methodologies or design models formally address the role

of emotion in learning; therefore, the findings of this research could have transformative implications for educational practitioners such as teachers and instructional designers.

For teachers, four applications can be explicated from the findings of this research. First, teachers should pay attention to students' emotions, particularly activity emotions. If the activity emotions are not conducive to learning, teachers should consider providing their students with learning activities that foster positive activity emotions.

Second, online teachers should focus on cognitive presence as it is the only factor that impacts activity emotions. Thus, focusing on designing cognitively engaging learning activities could theoretically improve students' academic achievement.

Third, teachers should minimize teacher presence and social presence in an asynchronous learning environment. Social presence did not have any significant correlation with academic achievement. Excess teacher presence might negatively impact students' academic achievement and take away the valuable learning time from online learners. Teachers should focus on designing engaging cognitive activities and then leave the students alone to study independently and at their own pace.

Fourth, teachers should minimize their focus on outcome emotions as outcome emotions were found to have no relationship with academic achievement. Outcome emotions include two categories of emotions: prospective emotions and retrospective emotions. Prospective emotions are emotions in anticipation of learning activities, including hope, anxiety, and hopelessness. Retrospective emotions are engendered by the outcomes of learning activities such as test scores and include emotions such as pride, relief, and shame. The current research did not find any correlation between outcome emotions and academic achievement but did find that teaching presence, social presence, and cognitive presence generated outcome emotions. Although

additional research is still needed to delineate the effect prospective and retrospective emotions have on learning, this research suggests that a teacher's focus should be on activity emotions during the learning process.

For Instructional Designers, no instructional design models situated emotion as a central component to guide instructional designers. Most of the instructional design models are process-driven. Learner emotions are addressed at the motivation, interest, and satisfaction level, not the activity emotion level. Instructional designers intuitively consider learner emotions while designing instructions, but not systematically as there are no emotional design learning theories to follow. With the findings from this research, instructional designers could purposefully design learning activities to invoke activity emotions during the instructional design process. For example, at the on-start of a learning module, an instructional designer could design a scenario to surprise a learner to create cognitive dissonance (Ligneul et al., 2018; Silvia, 2009). The surprise emotion could enable a learner to pay more attention to the learning materials. During the learning process, instructional designers should consider designing learning activities to generate the enjoyment activity emotion (Rosenthal & Ratan, 2022; Schukajlow et al., 2021). Toward the end of a learning module, an instructional designer should consider developing activities to enable learners to feel the pride activity emotion (Heckel & Ringeisen, 2019; Shuttleworth & Munro, 2020). Although extensive research is needed to explicate how to design each of the eight activity emotions (i.e., enjoyment, pride, anxiety, boredom, relief, hopelessness, shame, and anger), instructional designers could use evidence-based research methodology (Brackett et al., 2019) to start experimenting how to minimize negative activity emotions (i.e., hopelessness, shame, and anger), activate positive activity emotions (i.e., enjoyment and pride), and leverage neutral activity emotions (i.e., anxiety, boredom, and relief).

Policy Implications

With the rapid growth of online learning, the findings of this research could have policy implications for schools that are growing their online learning programs. First, the participants of this research indicated that they preferred either the face-to-face classroom learning mode or asynchronous online self-study mode. Therefore, schools should focus on creating asynchronous self-study courses and limit developing synchronous live online learning courses. More efforts should be put into designing activity emotions for better learning outcomes instead of simply flipping traditional classroom learning programs online (Akçayır & Akçayır, 2018; le Roux & Nagel, 2018; F. H. Wang, 2019).

Second, since teacher presence could potentially negatively impact academic achievement, school administrators should consider centralizing and enlarging their online design team and avoid moving the traditional one-teacher-per-class model into the online learning programs. One consideration is to hire online learning specialists and experts to focus on the first part of the teaching presence: design and organization. For example, suppose an asynchronous online course could be well designed. Online students could follow the online instructions to study at any time and place without depending on a teacher. In addition, teachers can be organized into an online help center to help multiple classes and students without being constrained to one course at a time. This approach could lower the cost of a school, improve efficiency, make learning more convenient for students, and scale up a school's online learning operation.

Third, social presence was found to have no significance in this study. Thus, minimizing social activities for asynchronous self-study courses, especially for adult learners, might be more beneficial and cost-effective for learning institutions.

Fourth, policymakers should consider measuring activity emotions to understand how well their online learning programs are performing without waiting until the end of the semester to use the course evaluation results to measure the effectiveness of their online learning programs. The research results of this study indicated that activity emotions were indicators of academic achievement. Activity emotions predicted academic achievement and mediated teaching presence and cognitive presence. If a school administer could dynamically measure the activity emotions of their online learning programs, they could have real-time feedback on how well their students are doing in their online learning programs. Moreover, measuring activity emotions might help a learning institution identify learning issues early and implement timely solutions to mitigate problems and improve students' academic achievements.

Recommendations and Future Research

The current study found that activity emotions played a significant role in predicting, mediating, and affecting academic achievement. This finding is the first in the Community of Inquiry research field. More research is needed to mitigate the limitations of this research and substantiate the implications. Three areas of future research are recommended.

Experimental Research

To determine whether the current research findings are replicable, experimental research is needed to manipulate variables such as activity emotions and outcome emotions. It is unknown why outcome emotions did not play any significant role in the present study, even though emotion regulation studies indicated that prospective emotions and retrospective emotions played essential roles in learning (Pekrun, 2006). To manipulate the outcome emotion construct, students should be randomly assigned to two classes of the same course. The experimental group should be designed to activate students' outcome emotions by having students project their

prospective emotions for the learning materials while the control group carries on their learning without this component. Academic achievement should be measured and compared. If the experimental group's academic achievement is the same as the control group, the result of the current research is further validated.

Different Subject Area and Different Population

The research participants were homogeneous, and the research content was only on one subject area, digital identity. This might be why teaching presence was concluded to affect academic achievement negatively. Future research should include a larger sample size with heterogeneous participants enrolled in different online courses studying different subjects taught by different instructors. More studies with diverse participants and subject areas will increase the generalizability of the current research findings. Consequently, activity emotion design models or principles can be produced for additional empirical tests. As a result, new learning theories such as the Cogmotion Theory of Learning (Figure 9) proposed in this research could be further validated.

Model and Questionnaire Improvement

The Community of Inquiry Questionnaire and Achievement Emotions Questionnaire were created 20 years ago. The Community of Inquiry (Garrison & Arbaugh, 2007a) was created when computer-mediated communication was rapidly adopted and when online learning needed a model for guidance. The communication medium has changed significantly, but some of the questions in the survey still used old terms such as whether the web was a suitable online communication medium. More importantly, scholars in the Community of Inquiry field should conclude the role emotion plays in online learning. Therefore, the questions related to affect in

the Community of Inquiry Questionnaire should be moved to a separate section that focuses on learning emotions or activity emotions.

The Achievement Emotions Questionnaire was created for the classroom. However, some of the questions in the survey described the context of the traditional classroom. Therefore, the Achievement Emotions Questionnaire should be improved, or a new questionnaire specifically designed for the asynchronous online self-study learning mode should be created. In addition, researchers should conduct studies on enabling teachers to recognize activity emotions so that teachers can foster conducive activity emotions for better academic achievement.

Conclusion

In conclusion, the main finding of this research was that activity emotions significantly predicated, mediated, and affected academic achievement in the context of the Community of Inquiry framework in an asynchronous online learning mode in a higher education setting. Based on the results of this study, a new learning theory called the Cogmotion Theory of Learning was proposed for the asynchronous online learning environment. While the Community of Inquiry can continue to serve as a framework for community-based collaborative learning, the Cogmotion Theory of Learning can serve as a theory for the asynchronous learning environment. Future researchers should replicate this study in different subject areas taught by various instructors to a diverse population. In addition, experimental and mixed research methods should be used to delineate activity emotions and outcome emotions. Finally, activity emotion design models and principles should be produced to guide teachers and instructional designers to utilize the power of activity emotions to help students for better academic achievement.

References

Adolphs, R., Tranel, D., Damasio, H., & Damasio, A. (1994). Impaired recognition of emotion in facial expressions following bilateral damage to the human amygdala. *Nature*, *372*(6507), 669–672. https://doi.org/10.1038/372669a0

Akçayır, G., & Akçayır, M. (2018). The flipped classroom: A review of its advantages and challenges. *Computers & Education*, *126*, 334–345. https://doi.org/10.1016/j.compedu.2018.07.021

ALvi, I. (2021). *Direct, Indirect and Conditional Indirect Effects of Communication and Career Anxiety on Perceived Stress during Interviews in University Students–A PLS SEM Model*.

Anderman, E. M., & Corno, L. (2016). *Handbook of educational psychology* (Third edition.). Routledge.

Annand, D. (2019). Limitations of the community of inquiry framework. *International Journal of E-Learning & Distance Education*, *34*(2), Article 2. https://eric.ed.gov/?id=EJ1242715

Arbaugh, J. B., Cleveland-Innes, M., Diaz, S. R., Garrison, D. R., Ice, P., Richardson, J. C., & Swan, K. P. (2008). Developing a community of inquiry instrument: Testing a measure of the Community of Inquiry framework using a multi-institutional sample. *The Internet and Higher Education*, *11*(3), 133–136. https://doi.org/10.1016/j.iheduc.2008.06.003

Balaž, B., Marković, I. H., & Brajša-Žganec, A. (2021). The exploration of the relationship between positive achievement emotions and academic success: Testing the assumptions of the control-value theory of achievement emotions. *The Educational and Developmental Psychologist*, *0*(0), 1–11. https://doi.org/10.1080/20590776.2020.1856623

Bandura, A. (1988). Self-Regulation of Motivation and Action Through Goal Systems. In V. Hamilton, G. H. Bower, & N. H. Frijda (Eds.), *Cognitive Perspectives on Emotion and Motivation* (pp. 37–61). Springer Netherlands. https://doi.org/10.1007/978-94-009-2792-6_2

Barrett, L. F. (2013). Psychological construction: The Darwinian approach to the science of emotion. *Emotion Review*, *5*(4), 379–389. https://doi.org/10.1177/1754073913489753

Barrett, L. F. (2016). The theory of constructed emotion: An active inference account of interoception and categorization. *Social Cognitive and Affective Neuroscience*, nsw154. https://doi.org/10.1093/scan/nsw154

Barrett, L. F. (2017a). *How emotions are made: The secret life of the brain*. Mariner Books.

Barrett, L. F. (2017b, April 7). The secret history of emotions. *Chronicle of Higher Education*, *31*, 1–1.

Barrett, L. F. (2020). *Seven and a half lessons about the brain*. Houghton Mifflin Harcourt.

Barrett, L. F., Lewis, M., & Haviland-Jones, J. M. (2016a). *Handbook of Emotions, Fourth Edition: Vol. Fourth edition*. The Guilford Press.

Barrett, L. F., Lewis, M., & Haviland-Jones, J. M. (2016b). *Handbook of emotions: Vol. Fourth edition*. The Guilford Press.

Bechara, A., Damasio, H., Tranel, D., & Damasio, A. R. (2005). The Iowa Gambling Task and the somatic marker hypothesis: Some questions and answers. *Trends in Cognitive Sciences*, *9*(4), 159–162. https://doi.org/10.1016/j.tics.2005.02.002

Benozzo, A. (2011). An Experienced Academic Becomes Participant in a Training Course. *Creative Approaches to Research*, *4*(1), 19.

Bhansali, A., & Sharma, M. D. (2020). The Achievement Emotions Questionnaire: Validation and implementation for undergraduate physics practicals. *International Journal of Innovation in Science and Mathematics Education*, *27*(9). https://doi.org/10.30722/IJISME.27.09.003

Bieleke, M., Gogol, K., Goetz, T., Daniels, L., & Pekrun, R. (2020). The AEQ-S: A Short Version of the Achievement Emotions Questionnaire. *Contemporary Educational Psychology*, 101940. https://doi.org/10.1016/j.cedpsych.2020.101940

Blair, K. S., Smith, B. W., Mitchell, D. G. V., Morton, J., Vythilingam, M., Pessoa, L., Fridberg, D., Zametkin, A., Nelson, E. E., Drevets, W. C., Pine, D. S., Martin, A., & Blair, R. J. R. (2020). Modulation of emotion by cognition and cognition by emotion. *NeuroImage*, *35*(1), 430–440.

Bosse, T., Jonker, C. M., & Treur, J. (2008). Formalisation of Damasio's theory of emotion, feeling and core consciousness. *Consciousness and Cognition*, *17*(1), 94–113. https://doi.org/10.1016/j.concog.2007.06.006

Bozkurt, A., Insung Jung, Junhong Xiao, Vladimirschi, V., Schuwer, R., Egorov, G., Lambert, S. R., Al-Freih, M., Pete, J., Olcott Jr., D., Rodes, V., Aranciaga, I., Bali, M., Alvarez Jr., A. V., Roberts, J., Pazurek, A., Raffaghelli, J. E., Panagiotou, N., de Coëtlogon, P., & Shahadu, S. (2020). A global outlook to the interruption of education due to COVID-19 Pandemic: Navigating in a time of uncertainty and crisis. *Asian Journal of Distance Education*, *15*(1), 1–126. https://doi.org/10.5281/zenodo.3878572

Brackett, M. A., Bailey, C. S., Hoffmann, J. D., & Simmons, D. N. (2019). RULER: A theory-driven, systemic approach to social, emotional, and academic learning. *Educational Psychologist*, *54*(3), 144–161.

Buck, R. (1980). Nonverbal behavior and the theory of emotion: The facial feedback hypothesis. *Journal of Personality and Social Psychology*, *38*(5), 811.

Camacho-Morles, J., Slemp, G. R., Pekrun, R., Loderer, K., Hou, H., & Oades, L. G. (2021). Activity achievement emotions and academic performance: A meta-analysis. *Educational Psychology Review*. https://doi.org/10.1007/s10648-020-09585-3

Campbell, P., & Cleveland-Innes, M. (2005). *Educational Presence in the Community of Inquiry Model: The Student's Viewpoint*.

Campbell, P. M. (2006). *Affect as a Presence in the Community of Inquiry Model* [Thesis]. https://auspace.athabascau.ca/handle/2149/525

Castellanos-Reyes, D. (2020). 20 years of the community of inquiry framework. *TechTrends*, *64*(4), 557–560. https://doi.org/10.1007/s11528-020-00491-7

Chin, W., Cheah, J.-H., Liu, Y., Ting, H., Lim, X.-J., & Cham, T. H. (2020). Demystifying the role of causal-predictive modeling using partial least squares structural equation modeling in information systems research. *Industrial Management & Data Systems*, *120*(12), 2161–2209. https://doi.org/10.1108/IMDS-10-2019-0529

Chou, M.-H. (2021). The mediating role of achievement emotions in the relationship between instructional clarity, English proficiency, and reading strategies. *Educational Psychology*, 1–20. https://doi.org/10.1080/01443410.2021.1882660

Chuan, C. L., & Penyelidikan, J. (2006). Sample size estimation using Krejcie and Morgan and Cohen statistical power analysis: A comparison. *Jurnal Penyelidikan IPBL*, *7*(1), 78–86.

Cleveland-Innes, M. (2020, September 5). *Educational Presence in the Community of Inquiry Model: The Student's Viewpoint*. ResearchGate. https://www.researchgate.net/publication/241855409_Educational_Presence_in_the_Community_of_Inquiry_Model_The_Student's_Viewpoint

Cleveland-Innes, M., Ally, M., Wark, N., & Fung, T. (2013). Emotional Presence and Mobile Learning: Learner-driven Responses in a Wireless World. *European Journal of Open, Distance and E-Learning*, *16*(2), Article 2. https://www.researchgate.net/profile/Norine-Wark/publication/334122869_EMOTIONAL_PRESENCE_AND_MOBILE_LEARNING_LEARNER-DRIVEN_RESPONSES_IN_A_WIRELESS_WORLD/links/5d18ed80299bf1547c8c3c8b/EMOTIONAL-PRESENCE-AND-MOBILE-LEARNING-LEARNER-DRIVEN-RESPONSES-IN-A-WIRELESS-WORLD.pdf

Cleveland-Innes, M., & Campbell, P. (2012). Emotional presence, learning, and the online learning environment. *The International Review of Research in Open and Distributed Learning*, *13*(4), 269–292. https://doi.org/10.19173/irrodl.v13i4.1234

Cleveland-Innes, M., Feng, X., Garner, A., Jaldemark, J., & McKenzie, G. (2019). *Assessing emotional presence in Communities of Inquiry: From the instructors point of view*. The 28th ICDE World Conference on Online Learning, Dublin, Ireland, 3-7 November, 2019. http://urn.kb.se/resolve?urn=urn:nbn:se:miun:diva-37919

Cohen, J. (2003). *A power primer.*

Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education*. Taylor & Francis Group. http://ebookcentral.proquest.com/lib/usf/detail.action?docID=1144438

Damasio, A. R. (1999). *The feeling of what happens: Body and emotion in the making of consciousness* (1st ed). Harcourt Brace.

Damasio, A. R. (2005). *Descartes' error: Emotion, reason, and the human brain* (Reprint Edition). Penguin Books.

Damasio, H., Grabowski, T., Frank, R., Galaburda, A. M., & Damasio, A. R. (1994a). The return of Phineas Gage: Clues about the brain from the skull of a famous patient. *Science*, *264*(5162), 1102–1105. https://doi.org/10.1126/science.8178168

Damasio, H., Grabowski, T., Frank, R., Galaburda, A. M., & Damasio, A. R. (1994b). The return of Phineas Gage: Clues about the brain from the skull of a famous patient. *Science*, *264*(5162), 1102–1105. https://doi.org/10.1126/science.8178168

Daniels, L. M., & Stupnisky, R. H. (2012). Not that different in theory: Discussing the control-value theory of emotions in online learning environments. *The Internet and Higher Education*, *15*(3), 222–226. https://doi.org/10.1016/j.iheduc.2012.04.002

Darwin, C. (1872). *The expression of the emotions in man and animals* [Electronic resource]. John Murray. http://content.apa.org/books/2004-16316-000

Darwin, C., & Prodger, P. (1998). *The Expression of the Emotions in Man and Animals*. Oxford University Press.

Davari, H., Karami, H., Nourzadeh, S., & Iranmehr, A. (2020). Examining the validity of the Achievement Emotions Questionnaire for measuring more emotions in the foreign language classroom. *Journal of Multilingual and Multicultural Development*, *0*(0), 1–14. https://doi.org/10.1080/01434632.2020.1766054

Descartes, R., & Voss, S. H. (1989). *Passions of the soul*. Hackett Publishing Company, Inc.

Dhawan, S. (2020). Online Learning: A Panacea in the Time of COVID-19 Crisis. *Journal of Educational Technology Systems*, *49*(1), 5–22. https://doi.org/10.1177/0047239520934018

Dirkex, J. M. (2001). The power of feelings: Emotion, imagination, and the construction of meaning in adult learning. *New Directions for Adult & Continuing Education*, *89*, 63–72. https://doi.org/10.1002/ace.9

Dror, O. E. (2014). The Cannon–Bard thalamic theory of emotions: A brief genealogy and reappraisal. *Emotion Review*, *6*(1), 13–20.

Dror, O. E. (2017). Deconstructing the "two factors": The historical origins of the Schachter–Singer theory of emotions. *Emotion Review*, *9*(1), 7–16.

Durant, W. (1943). *The story of philosophy* (2d ed). Garden City Pub. Co.

Educationdata.org. (2021). *U.S. number of college students 1965-2020*. Statista. https://www.statista.com/statistics/183995/us-college-enrollment-and-projections-in-public-and-private-institutions/

Ekman, P. (1992). Are there basic emotions? *Psychological Review*, *99*(3), 550–553. https://doi.org/10.1037/0033-295X.99.3.550

Ekman, P. (2006). *Darwin and facial expression: A century of research in review*. ISHK.

Ekman, P., & Cordaro, D. (2011). What is meant by calling emotions basic. *Emotion Review*, *3*(4), 364.

Employment Department. (2021). *Growth in distance learning outpaces total enrollment growth*. https://www.qualityinfo.org/-/growth-in-distance-learning-outpaces-total-enrollment-growth

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Fiock, H. (2020). Designing a community of inquiry in online courses. *The International Review of Research in Open and Distributed Learning*, *21*(1), 135–153. https://doi.org/10.19173/irrodl.v20i5.3985

Fugate, J. M. B., Lindquist, K. A., & Feldman Barrett, L. (2013). Emotion: Generation or construction? In *The Oxford Handbook of Cognitive Neuroscience: Volume 2: The Cutting Edges*. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199988709.013.0003

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical Inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, *2*(2), 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education*, *15*(1), 7–23. https://doi.org/10.1080/08923640109527071

Garrison, D. R., Anderson, T., & Archer, W. (2010). The first decade of the community of inquiry framework: A retrospective. *The Internet and Higher Education*, *13*(1), 5–9. https://doi.org/10.1016/j.iheduc.2009.10.003

Garrison, D. R., & Arbaugh, J. B. (2007a). Researching the community of inquiry framework: Review, issues, and future directions. *The Internet and Higher Education*, *10*(3), 157–172. https://doi.org/10.1016/j.iheduc.2007.04.001

Garrison, D. R., & Arbaugh, J. B. (2007b). Researching the community of inquiry framework: Review, issues, and future directions. *The Internet and Higher Education*, *10*(3), 157–172. https://doi.org/10.1016/j.iheduc.2007.04.001

Genesee, F., Lindholm-Leary, K., Saunders, W. M., & Christian, D. (2005). *Educating English language learners: A synthesis of research evidence*. Cambridge.

Gross, J. J. (2014). Emotion regulation: Conceptual and empirical foundations. In J. J. Gross (Ed.), *Handbook of emotion regulation., 2nd ed.* (2013-44085-001; pp. 3–20). Guilford Press.

Hair, J. F. (2020). Next-generation prediction metrics for composite-based PLS-SEM. *Industrial Management & Data Systems*. https://doi.org/10.1108/IMDS-08-2020-0505

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., & Thiele, K. O. (2017). Mirror, mirror on the wall: A comparative evaluation of composite-based structural equation modeling methods. *Journal of the Academy of Marketing Science*, *45*(5), 616–632. https://doi.org/10.1007/s11747-017-0517-x

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Hair, J., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2016). *A Primer on Partial Least Squares Structural Equation Modeling* (Second edition). SAGE Publications, Inc.

Heckel, C., & Ringeisen, T. (2019). Pride and anxiety in online learning environments: Achievement emotions as mediators between learners' characteristics and learning outcomes. *Journal of Computer Assisted Learning*, *5*, 667. https://doi.org/10.1111/jcal.12367

Henseler, J. (2021). *Composite-Based Structural Equation Modeling: Analyzing Latent and Emergent Variables*. Guilford Publications. http://ebookcentral.proquest.com/lib/usf/detail.action?docID=6438337

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Houghton, T. (2011). Does positivism really "work" in the social sciences. *E-International Students*.

Huang, C. (2011). Achievement goals and achievement emotions: A meta-analysis. *Educational Psychology Review*, *23*(3), 359.

Immordino-Yang, M. H. (2015). *Emotions, learning, and the brain: Exploring the educational implications of affective neuroscience (the Norton series on the social neuroscience of education)*. WW Norton & Company.

Immordino-Yang, M. H., & Damasio, A. (2007). We feel, therefore we learn: The relevance of affective and social neuroscience to education. *Mind Brain and Education*, *1*, 3.

Jarrell, A., Harley, J. M., Lajoie, S., & Naismith, L. (2017). Success, failure and emotions: Examining the relationship between performance feedback and emotions in diagnostic reasoning. *Educational Technology Research and Development*, *65*(5), 1263–1284. https://doi.org/10.1007/s11423-017-9521-6

Kahneman, D. (2011). *Thinking, fast and slow* (St. Petersburg Circulating Collection BF441 .K238 2011; 1st ed.). Farrar, Straus and Giroux.

Kang, M., Liew, B. T., Kim, J., & Park, Y. (2014). Learning presence as a predictor of achievement and satisfaction in online learning environments. *International Journal on E-Learning*, *13*(2), 193–208.

Kirwan, S. (2018). Relationships between achievement emotions and academic performance in nursing students: A non-experimental predictive correlation analysis. *Doctoral Dissertations and Projects*. https://digitalcommons.liberty.edu/doctoral/1754

Kivunja, C., & Kuyini, A. B. (2017). Understanding and applying research paradigms in educational contexts. *International Journal of Higher Education*, *6*(5), 26. https://doi.org/10.5430/ijhe.v6n5p26

Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling, Fourth Edition*. Guilford Publications. http://ebookcentral.proquest.com/lib/usf/detail.action?docID=4000663

Krish, P., Maros, M., & Stapa, S. H. (2012). Sociocultural factors and social presence in an online learning environment. *GEMA Online® Journal of Language Studies*, *12*(1), Article 1. http://ejournals.ukm.my/gema/article/view/29

Kucuk, S., & Richardson, J. C. 2. (2019). A structural equation model of predictors of online learners' engagement and satisfaction. *Online Learning*, *23*(2), 196–216. https://doi.org/10.24059/olj.v23i2.1455

Kuhn, T. S., & Hacking, I. (2012). *The structure of scientific revolutions* (Fourth edition). The University of Chicago Press.

Lawson, T. M. (2019). *Community of inquiry: Measuring online learners' emotional presence, self-efficacy, and perceived quality of online learning* [PhD Thesis]. Grand Canyon University.

le Roux, I., & Nagel, L. (2018). Seeking the best blend for deep learning in a flipped classroom – viewing student perceptions through the Community of Inquiry lens. *International Journal of Educational Technology in Higher Education*, *15*(1), 16. https://doi.org/10.1186/s41239-018-0098-x

Lemaire, P. (2022). *Emotion and Cognition: An Introduction.* Taylor & Francis Group.

Lichtenfeld, S., Pekrun, R., Stupnisky, R. H., Reiss, K., & Murayama, K. (2012). Measuring students' emotions in the early years: The Achievement Emotions Questionnaire-Elementary School (AEQ-ES). *Learning and Individual Differences*, *22*(2), 190–201. https://doi.org/10.1016/j.lindif.2011.04.009

Ligneul, R., Mermillod, M., & Morisseau, T. (2018). From relief to surprise: Dual control of epistemic curiosity in the human brain. *NeuroImage*, *181*, 490–500. https://doi.org/10.1016/j.neuroimage.2018.07.038

Linnenbrink-Garcia, L., & Pekrun, R. (2011). Students' emotions and academic engagement: Introduction to the special issue. *Contemporary Educational Psychology*, *36*(1), 1–3. https://doi.org/10.1016/j.cedpsych.2010.11.004

Linnenbrink-Garcia, L., & Pekrun, R. (2014). *International Handbook of Emotions in Education*. Routledge.

Loderer, K., Pekrun, R., & Lester, J. C. (2018). Beyond cold technology: A systematic review and meta-analysis on emotions in technology-based learning environments. *Learning and Instruction*, 101162. https://doi.org/10.1016/j.learninstruc.2018.08.002

Lukenchuk, A. (2013). *Paradigms of research for the 21st century: Perspectives and examples from practice*. Peter Lang.

MacNabb, D. G. C. (1951). *David Hume: His theory of knowledge and morality*. Routledge. http://ebookcentral.proquest.com/lib/usf/detail.action?docID=5755857

Maehr, M. L., & Zusho, A. (2009). Achievement goal theory: The past, present, and future. In K. R. Wenzel & A. Wigfield (Eds.), *Handbook of motivation at school.* (2009-24219-005; pp. 77–104). Routledge/Taylor & Francis Group.

Majeski, R. A., Stover, M., & Valais, T. (2018). The community of inquiry and emotional presence. *Adult Learning*, *29*(2), 53–61. https://doi.org/10.1177/1045159518758696

Mardi, F. (2020). Gears in motion: Changing perspectives of interactions among online presences. *International Journal of Virtual and Personal Learning Environments*, *10*(2), 35–49. Scopus. https://doi.org/10.4018/IJVPLE.2020070103

Molinillo, S., Aguilar-Illescas, R., Anaya-Sánchez, R., & Vallespín-Arán, M. (2018). Exploring the impacts of interactions, social presence and emotional engagement on active collaborative learning in a social web-based environment. *Computers & Education*, *123*, 41–52. https://doi.org/10.1016/j.compedu.2018.04.012

Moore, M. (1993). The theory of transactional distance. In *Theoretical Principles of Distance Education*.

Nazari, N., & Far, D. M. (2019). The relationship between teaching skills, academic emotion, academic stress and mindset in university student academic achievement prediction: A PLS-SEM approach. *Journal of Intellectual Disability-Diagnosis and Treatment*, *7*(3), 119–133.

Nyanjom, J., & Naylor, D. (2020). Performing emotional labour while teaching online. *Educational Research*, *0*(0), 1–17. https://doi.org/10.1080/00131881.2020.1836989

Paoloni, P. V., Vaja, A. B., & Muñoz, V. L. (2014). Achievement Emotions Questionnaire. *Electronic Journal of Research in Educational Psychology*, *34*, 22.

Parker, P. C., Perry, R. P., Chipperfield, J. G., Hamm, J. M., & Pekrun, R. (2018). An attribution-based motivation treatment for low control students who are bored in online learning environments. *Motivation Science*, *4*(2), 177–184. https://doi.org/10.1037/mot0000081

Parker, P. C., Perry, R. P., Hamm, J. M., Chipperfield, J. G., Pekrun, R., Dryden, R. P., Daniels, L. M., & Tze, V. M. C. (2021). A motivation perspective on achievement appraisals, emotions, and performance in an online learning environment. *International Journal of Educational Research*, *108*, 101772. https://doi.org/10.1016/j.ijer.2021.101772

Peixoto, F., Mata, L., Monteiro, V., Sanches, C., & Pekrun, R. (2015). The Achievement Emotions Questionnaire: Validation for pre-adolescent students. *European Journal of Developmental Psychology*, *12*(4), 472–481. https://doi.org/10.1080/17405629.2015.1040757

Pekrun, R. (2000). *A social-cognitive, control-value theory of achievement emotions.*

Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review*, *18*(4), 315–341.

Pekrun, R. (2009). *Global and local perspectives on human affect: Implications of the control-value theory of achievement emotions.*

Pekrun, R. (2019). Inquiry on emotions in higher education: Progress and open problems. *Studies in Higher Education*, *44*(10), 1806–1811. https://doi.org/10.1080/03075079.2019.1665335

Pekrun, R., Elliot, A. J., & Maier, M. A. (2009). Achievement goals and achievement emotions: Testing a model of their joint relations with academic performance. *Journal of Educational Psychology*, *101*(1), 115.

Pekrun, R., Goetz, T., Frenzel, A. C., Barchfeld, P., & Perry, R. P. (2011). Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology*, *36*(1), 36–48. https://doi.org/10.1016/j.cedpsych.2010.10.002

Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist*, *37*(2), 91–105. https://doi.org/10.1207/S15326985EP3702_4

Pekrun, R., Lichtenfeld, S., Marsh, H. W., Murayama, K., & Goetz, T. (2017). Achievement emotions and academic performance: Longitudinal models of reciprocal effects. *Child Development*, *88*(5), 1653–1670. https://doi.org/10.1111/cdev.12704

Plass, J. L., Heidig, S., Hayward, E. O., Homer, B. D., & Um, E. (2014). Emotional design in multimedia learning: Effects of shape and color on affect and learning. *Learning and Instruction*, *29*, 128–140. https://doi.org/10.1016/j.learninstruc.2013.02.006

Plass, J. L., & Kaplan, U. (2016). Emotional design in digital media for learning. In S. Y. Tettegah & M. Gartmeier (Eds.), *Emotions, Technology, Design, and Learning* (pp. 131–161). Academic Press. https://doi.org/10.1016/B978-0-12-801856-9.00007-4

Pool, J., Reitsma, G. M., & Van den Berg, D. N. (2017). *Revised Community of Inquiry framework: Examining learning presence in a blended mode of delivery*.

Putwain, D. W., Gallard, D., & Beaumont, J. (2020). Academic buoyancy protects achievement against minor academic adversities. *Learning and Individual Differences*, *83–84*, 101936. https://doi.org/10.1016/j.lindif.2020.101936

Raccanello, D., Brondino, M., Crescentini, A., Castelli, L., & Calvo, S. (2021). A brief measure for school-related achievement emotions: The achievement Emotions Adjective List (AEAL) for secondary students. *European Journal of Developmental Psychology*, 1–19. https://doi.org/10.1080/17405629.2021.1898940

Raccanello, D., & Hall, R. (2020). An intervention promoting understanding of achievement emotions with middle school students. *European Journal of Psychology of Education*. https://doi.org/10.1007/s10212-020-00498-x

Richardson, J. C., Maeda, Y., Lv, J., & Caskurlu, S. (2017). Social presence in relation to students' satisfaction and learning in the online environment: A meta-analysis. *Computers in Human Behavior*, *71*, 402–417. https://doi.org/10.1016/j.chb.2017.02.001

Rönkkö, M., McIntosh, C. N., Antonakis, J., & Edwards, J. R. (2016). Partial least squares path modeling: Time for some serious second thoughts. *Journal of Operations Management*, *47–48*(1), 9–27. https://doi.org/10.1016/j.jom.2016.05.002

Rosenthal, S., & Ratan, R. A. (2022). Balancing learning and enjoyment in serious games: Kerbal Space Program and the communication mediation model. *Computers & Education*, 104480. https://doi.org/10.1016/j.compedu.2022.104480

Rothermund, K., & Koole, S. L. (2018). Three decades of Cognition & Emotion: A brief review of past highlights and future prospects. *Cognition & Emotion*, *32*(1), 1–12. https://doi.org/10.1080/02699931.2018.1418197

Rouse, A., & Corbitt, B. (2008). There's SEM and "SEM": A Critique of the Use of PLS Regression in Information Systems Research. *ACIS 2008 Proceedings*. https://aisel.aisnet.org/acis2008/81

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *39*(6), 1161.

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review*, *110*(1), 145–172. https://doi.org/10.1037/0033-295X.110.1.145

Russell, J. A., & Barrett, L. F. (1999). Core affect, prototypical emotional episodes, and other things called emotion: Dissecting the elephant. *JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY*, *5*, 805.

Russell, J. A., & Barrett, L. F. (2014). *The psychological construction of emotion*. The Guilford Press.

Scherer, K. R., & Ekman, P. (2014). *Approaches to emotion*. Psychology Press.

Schukajlow, S., Blomberg, J., Rellensmann, J., & Leopold, C. (2021). Do emotions and prior performance facilitate the use of the learner-generated drawing strategy? Effects of enjoyment, anxiety, and intramathematical performance on the use of the drawing strategy and modelling performance. *Contemporary Educational Psychology*, *65*, 101967. https://doi.org/10.1016/j.cedpsych.2021.101967

Shuman, V., & Scherer, K. R. (2014). Concepts and structures of emotions. In R. Pekrun & L. Linnenbrink-Garcia (Eds.), *International handbook of emotions in education.* (2014-09239-002; pp. 13–35). Routledge/Taylor & Francis Group.

Shuttleworth, T., & Munro, N. (2020). *Visualising achievement emotions through photo elicitation interviews: A methodology for generating data on the dialectical tensions between pride, sadness and hope among high achieving undergraduate students* (p. 131).

Silvia, P. J. (2009). Looking past pleasure: Anger, confusion, disgust, pride, surprise, and other unusual aesthetic emotions. *Psychology of Aesthetics, Creativity, and the Arts*, *3*(1), 48.

Smith, C. A., & Lazarus, R. S. (1993). Appraisal components, core relational themes, and the emotions. *Cognition & Emotion*, *7*(3/4), 233.

Soroya, S. H., Iqbal, M. M. Y., Soroya, M. S., & Mahmood, K. (2020). Predictors of information literacy self-efficacy among medical students: PLS-SEM analysis. *Library Hi Tech*.

Statista. (2021). *College enrollment statistics [2021]: Total + by demographic*. EducationData. https://educationdata.org/college-enrollment-statistics

Stenbom, S. (2018). A systematic review of the Community of Inquiry survey. *The Internet and Higher Education*, *39*, 22–32. https://doi.org/10.1016/j.iheduc.2018.06.001

Stenbom, S., Hrastinski, S., & Cleveland-Innes, M. (2016). Emotional presence in a relationship of inquiry: The case of one-to-one online math coaching. *Online Learning*, *20*(1), 41–56.

Stephan, M., Markus, S., & Gläser-Zikuda, M. (2019). Students' Achievement Emotions and Online Learning in Teacher Education. *Frontiers in Education*, *4*. https://doi.org/10.3389/feduc.2019.00109

Swan, K., Chen, C.-C. B., & Bockmier-Sommers, D. K. (2020). Relationships between Carl Rogers' Person-Centered Education and the Community of Inquiry Framework: A Preliminary Exploration. *Online Learning*, *24*(3). https://doi.org/10.24059/olj.v24i3.2279

Swan, K., Garrison, D. R., & Richardson, J. C. (2009). *A constructivist approach to online learning: The Community of Inquiry Framework*. Information Technology and Constructivism in Higher Education: Progressive Learning Frameworks; IGI Global. https://doi.org/10.4018/978-1-60566-654-9.ch004

Swan, K., Richardson, J., Ice, P., Garrison, D., Cleveland-Innes, M., & Arbaugh, J. B. (2008). Validating a measurement tool of presence in online Communities of Inquiry. *E-Mentor*, *2*.

Thaler, R., Javetski, B., & Koller, T. (2018). Debiasing the corporation: An interview with Nobel laureate Richard Thaler. *McKinsey Quarterly*, *3*, 109–115.

Titchener, E. B. (1914). An historical note on the James-Lange Theory of Emotion. *The American Journal of Psychology*, *25*(3), 427–447. https://doi.org/10.2307/1412861

Trevors, G. J., Muis, K. R., Pekrun, R., Sinatra, G. M., & Winne, P. H. (2016). Identity and epistemic emotions during knowledge revision: A potential account for the backfire effect. *Discourse Processes*, *53*(5–6), 339–370. https://doi.org/10.1080/0163853X.2015.1136507

Tyng, C. M., Amin, H. U., Saad, M. N. M., & Malik, A. S. (2017). The influences of emotion on learning and memory. *Frontiers in Psychology*, *8*. https://doi.org/10.3389/fpsyg.2017.01454

Wang, F. H. (2019). On the relationships between behaviors and achievement in technology-mediated flipped classrooms: A two-phase online behavioral PLS-SEM model. *Computers & Education*, *142*, 103653.

Wang, Y. A., & Rhemtulla, M. (2021). Power analysis for parameter estimation in structural equation modeling: A discussion and tutorial. *Advances in Methods and Practices in Psychological Science*, *4*(1), 2515245920918253. https://doi.org/10.1177/2515245920918253

Ware, W. B., Ferron, J. M., & Miller, B. M. (2013). *Introductory statistics: A conceptual approach using R*. Routledge/Taylor & Francis Group.

Weiner, B. (1986). *An attributional theory of motivation and emotion* (ONLINE RESOURCE BF1-990). Springer US.

Williams, L. S. (2017). The managed heart: Adult learners and emotional presence online. *The Journal of Continuing Higher Education*, *65*(2), 124–131. https://doi.org/10.1080/07377363.2017.1320204

Appendices

Appendix A: Institutional Review Board Research Approval

UNIVERSITY of SOUTH FLORIDA

APPROVAL

June 22, 2021

David Tai
25702 Ferdinand Court
Wesley Chapel, FL 33544

Dear Mr. Tai:

On 6/22/2021, the IRB reviewed and approved the following protocol:

Application Type:	Initial Study
IRB ID:	STUDY002722
Review Type:	Expedited 5 and 7
Title:	Relationship Between the Community of Inquiry, Achievement Emotions, and Academic Achievement in Asynchronous Online Courses in Higher Education
Funding:	None
IND, IDE, or HDE:	None
Approved Protocol and Consent(s)/Assent(s):	• 2722 Protocol Version #1 6.18.21.docx; • 002722 Online Consent Form Version #1 6.18.21.pdf; Approved study documents can be found under the 'Documents' tab in the main study workspace. Use the stamped consent found under the 'Last Finalized' column under the 'Documents' tab.

Within 30 days of the anniversary date of study approval, confirm your research is ongoing by clicking Confirm Ongoing Research in BullsIRB, or if your research is complete, submit a study closure request in BullsIRB by clicking Create Modification/CR.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Your study qualifies for a waiver of the requirements for the documentation of informed consent for the online survey as outlined in the federal regulations at 45 CFR 46.117(c).

Appendix B: Indicator Loading Normality Data

Table 14

Indicator Loading Normality Data

Indicator	Mean	Median	Min	Max	Standard Deviation	Kurtosis	Skewness
AE1	3.84	4	1	5	1.20	0.13	-1.02
AE2R	4.18	4	1	5	0.94	2.36	-1.45
AE3R	3.63	4	1	5	1.21	-0.75	-0.55
AE4	4.36	4	1	5	0.74	3.31	-1.40
AE5	4.16	4	1	5	0.82	1.64	-1.09
AE6R	3.41	3	1	5	1.06	-0.63	-0.24
AE7R	3.68	4	1	5	1.13	-0.33	-0.69
AE8R	3.96	4	1	5	1.04	1.16	-1.19
AE9R	4.06	4	1	5	0.98	0.67	-1.02
AE10	3.51	4	1	5	1.01	0.06	-0.68
AE11	4.04	4	1	5	0.93	1.31	-1.16
AE12	3.79	4	1	5	1.10	-0.23	-0.72
AE13R	3.44	4	1	5	1.28	-1.08	-0.31
AE14R	3.40	4	1	5	1.27	-1.01	-0.30
AE15R	4.36	5	2	5	0.80	0.97	-1.20
AE16R	4.25	5	1	5	1.05	1.96	-1.57
OE1	3.96	4	1	5	0.98	0.84	-0.98
OE2	4.03	4	1	5	0.99	1.51	-1.21
OE3R	3.87	4	1	5	1.26	-0.90	-0.67
OE4R	3.65	4	1	5	1.25	-0.89	-0.52
OE5R	4.23	5	1	5	0.99	1.85	-1.45
OE6	3.56	4	1	5	1.01	-0.58	-0.36
OE7R	3.98	4	1	5	1.01	0.84	-1.09
OE8	4.19	4	2	5	0.69	1.13	-0.78
TPdo1	4.07	4	1	5	1.04	1.14	-1.32
TPdo2	4.17	4	1	5	0.94	1.50	-1.28
TPdo3	3.88	4	1	5	1.17	0.29	-1.02
TPdo4	4.16	4	1	5	0.99	1.84	-1.43
TPfa1	3.78	4	1	5	0.99	-0.58	-0.45
TPfa2	3.86	4	1	5	1.06	-0.19	-0.80
TPfa3	4.06	4	1	5	1.00	0.73	-1.11
TPfa4	3.92	4	1	5	1.03	0.05	-0.85
TPfa5	4.41	5	2	5	0.68	0.39	-0.91
TPfa6	4.21	4	1	5	0.84	2.95	-1.43

Table 14. (Continued)

Indicator	Mean	Median	Min	Max	Standard Deviation	Kurtosis	Skewness
TPdi1	4.16	4	2	5	0.84	0.22	-0.85
TPdi2	3.58	4	1	5	1.18	-0.81	-0.42
TPdi3	3.76	4	1	5	1.17	-0.25	-0.79
SPae1	3.88	4	1	5	0.99	0.58	-0.90
SPae2	3.87	4	1	5	1.01	-0.40	-0.65
SPae3	3.67	4	1	5	1.28	-0.79	-0.58
SPoc1	4.08	4	1	5	0.93	0.46	-0.93
SPoc2	4.29	4	2	5	0.77	0.99	-1.05
SPoc3	4.17	4	1	5	0.77	2.81	-1.27
SPgc1	3.98	4	2	5	0.79	0.34	-0.65
SPgc2	4.06	4	1	5	0.85	0.98	-0.91
SPgc3	3.80	4	1	5	1.07	0.47	-1.00
CPte1	3.90	4	1	5	0.93	0.01	-0.68
CPte2	3.96	4	1	5	1.09	1.22	-1.31
CPte3	3.80	4	1	5	1.09	-0.22	-0.82
CPex1	4.13	4	2	5	0.83	0.86	-1.01
CPex2	4.07	4	2	5	0.82	1.14	-1.05
CPex3	3.86	4	1	5	1.01	0.46	-0.94
CPre1	4.07	4	1	5	0.75	3.31	-1.31
CPre2	4.17	4	2	5	0.74	0.45	-0.70
CPre3	4.08	4	2	5	0.76	0.67	-0.76

Appendix C: Indicator Loading Correlation Data

Table 15

Indicator Loading Correlation Data

	AE1	AE2R	AE3R	AE4	AE5	AE6R	AE7R	AE8R	AE9R	AE10
AE1	1									
AE2R	0.56	1								
AE3R	0.64	0.40	1							
AE4	0.57	0.42	0.53	1						
AE5	0.42	0.22	0.37	0.37	1					
AE6R	0.50	0.48	0.51	0.46	0.39	1				
AE7R	0.28	0.30	0.39	0.41	0.43	0.44	1			
AE8R	0.08	0.26	0.31	0.35	0.21	0.28	0.56	1		
AE9R	0.65	0.33	0.58	0.53	0.33	0.52	0.31	0.08	1	
AE10	0.68	0.42	0.43	0.41	0.37	0.47	0.22	0.08	0.46	1
AE10	0.68	0.42	0.43	0.41	0.37	0.47	0.22	0.08	0.46	1.00
AE11	0.49	0.25	0.44	0.37	0.60	0.37	0.27	0.10	0.39	0.41
AE12	0.44	0.21	0.34	0.31	0.55	0.24	0.28	0.10	0.21	0.43
AE13R	0.69	0.44	0.63	0.45	0.40	0.54	0.41	0.18	0.67	0.52
AE14R	0.16	0.27	0.24	0.15	0.19	0.20	0.54	0.48	0.17	0.08
AE15R	0.31	0.39	0.31	0.29	0.40	0.20	0.49	0.36	0.26	0.31
AE16R	0.38	0.34	0.33	0.29	0.53	0.25	0.41	0.27	0.41	0.30
OE1	0.49	0.47	0.29	0.23	0.41	0.37	0.25	0.06	0.32	0.44
OE2	0.55	0.38	0.39	0.34	0.56	0.47	0.34	0.15	0.42	0.35
OE3R	0.57	0.54	0.47	0.33	0.32	0.43	0.32	0.20	0.36	0.42
OE4R	0.66	0.55	0.50	0.50	0.45	0.44	0.46	0.27	0.58	0.50
OE5R	0.49	0.56	0.39	0.51	0.34	0.28	0.42	0.27	0.37	0.33
OE6	0.46	0.30	0.42	0.35	0.45	0.54	0.24	0.05	0.40	0.48
OE7R	0.22	0.26	0.39	0.35	0.39	0.35	0.62	0.72	0.24	0.16
OE8	0.21	0.09	0.25	0.24	0.35	0.24	0.21	0.02	0.16	0.25
TPdo1	0.42	0.31	0.45	0.24	0.27	0.29	0.17	-0.01	0.27	0.40
TPdo2	0.31	0.19	0.41	0.25	0.27	0.29	0.27	0.10	0.26	0.35
TPdo3	0.38	0.24	0.35	0.21	0.16	0.33	0.21	0.02	0.29	0.32
TPdo4	0.42	0.38	0.39	0.48	0.19	0.36	0.28	0.22	0.31	0.34
TPfa1	0.50	0.40	0.49	0.30	0.28	0.27	0.37	0.12	0.24	0.52
TPfa2	0.62	0.39	0.49	0.37	0.30	0.36	0.28	0.03	0.34	0.59
TPfa3	0.45	0.23	0.48	0.31	0.26	0.24	0.26	0.05	0.25	0.53
TPfa4	0.51	0.42	0.46	0.39	0.28	0.35	0.30	0.12	0.29	0.44
TPfa5	0.34	0.17	0.27	0.25	0.38	0.26	0.22	-0.01	0.32	0.36

Table 15. (Continued)

	AE1	AE2R	AE3R	AE4	AE5	AE6R	AE7R	AE8R	AE9R	AE10
TPfa6	0.39	0.37	0.34	0.27	0.19	0.21	0.19	0.02	0.17	0.40
TPdi1	0.45	0.26	0.45	0.42	0.36	0.29	0.19	0.07	0.34	0.43
TPdi2	0.43	0.24	0.30	0.21	0.09	0.19	0.11	-0.09	0.17	0.43
TPdi3	0.28	0.13	0.33	0.18	0.13	0.07	0.21	0.07	0.20	0.25
SPae1	0.34	0.17	0.27	0.27	0.31	0.25	0.20	-0.01	0.25	0.34
SPae2	0.34	0.30	0.36	0.22	0.21	0.20	0.23	0.02	0.20	0.23
SPae3	0.26	0.03	0.27	0.30	0.32	0.23	0.13	0.12	0.26	0.14
SPoc1	0.27	0.28	0.29	0.25	0.52	0.25	0.27	0.26	0.16	0.29
SPoc2	0.43	0.40	0.31	0.28	0.48	0.33	0.28	0.05	0.29	0.44
SPoc3	0.29	0.36	0.20	0.29	0.43	0.33	0.27	0.12	0.20	0.30
SPgc1	0.33	0.25	0.19	0.26	0.20	0.29	0.13	-0.08	0.27	0.29
SPgc2	0.36	0.20	0.30	0.36	0.57	0.37	0.38	0.12	0.36	0.29
SPgc3	0.52	0.16	0.30	0.32	0.41	0.25	0.20	0.06	0.37	0.43
CPte1	0.59	0.28	0.50	0.44	0.36	0.34	0.21	-0.01	0.47	0.54
CPte2	0.66	0.26	0.51	0.47	0.43	0.36	0.29	0.01	0.68	0.57
CPte3	0.67	0.36	0.53	0.42	0.40	0.37	0.23	-0.05	0.58	0.61
CPex1	0.44	0.16	0.37	0.33	0.42	0.30	0.31	0.10	0.49	0.44
CPex2	0.48	0.14	0.39	0.27	0.46	0.26	0.20	-0.06	0.39	0.38
CPex3	0.50	0.30	0.43	0.40	0.37	0.34	0.30	0.12	0.46	0.47
CPre1	0.48	0.28	0.30	0.33	0.28	0.24	0.17	0.09	0.42	0.45
CPre2	0.47	0.31	0.37	0.40	0.42	0.33	0.25	0.10	0.34	0.47
CPre3	0.49	0.27	0.44	0.37	0.50	0.40	0.29	0.08	0.41	0.45

Table 15. (Continued)

	AE11	AE12	AE13R	AE14R	AE15R	AE16R	OE1	OE2	OE3R
AE11	1								
AE12	0.70	1							
AE13R	0.41	0.34	1						
AE14R	0.23	0.09	0.30	1					
AE15R	0.53	0.54	0.47	0.46	1				
AE16R	0.64	0.55	0.47	0.43	0.79	1			
OE1	0.47	0.31	0.51	0.21	0.42	0.41	1		
OE2	0.65	0.46	0.45	0.28	0.42	0.52	0.55	1	
OE3R	0.41	0.29	0.70	0.31	0.41	0.46	0.54	0.41	1
OE4R	0.43	0.36	0.69	0.31	0.48	0.57	0.51	0.44	0.66
OE5R	0.42	0.35	0.49	0.41	0.53	0.56	0.32	0.36	0.62

Table 15. (Continued)

	AE11	AE12	AE13R	AE14R	AE15R	AE16R	OE1	OE2	OE3R
OE6	0.45	0.37	0.46	0.15	0.28	0.35	0.44	0.50	0.37
OE7R	0.33	0.27	0.35	0.42	0.50	0.50	0.18	0.37	0.35
OE8	0.51	0.41	0.20	0.14	0.32	0.27	0.34	0.34	0.10
TPdo1	0.45	0.39	0.45	0.14	0.34	0.36	0.37	0.34	0.48
TPdo2	0.40	0.42	0.41	0.16	0.35	0.34	0.32	0.37	0.36
TPdo3	0.43	0.31	0.38	0.16	0.31	0.31	0.36	0.33	0.35
TPdo4	0.39	0.32	0.34	0.22	0.27	0.25	0.37	0.32	0.34
TPfa1	0.38	0.45	0.48	0.20	0.40	0.33	0.53	0.35	0.47
TPfa2	0.43	0.43	0.48	0.12	0.32	0.26	0.50	0.40	0.44
TPfa3	0.38	0.41	0.42	0.11	0.27	0.21	0.36	0.30	0.35
TPfa4	0.48	0.48	0.47	0.27	0.43	0.38	0.46	0.42	0.57
TPfa5	0.47	0.43	0.42	0.05	0.38	0.33	0.41	0.38	0.33
TPfa6	0.33	0.42	0.38	0.10	0.25	0.18	0.38	0.30	0.33
TPdi1	0.58	0.50	0.43	0.14	0.35	0.41	0.42	0.39	0.38
TPdi2	0.23	0.32	0.34	0.05	0.21	0.19	0.40	0.27	0.38
TPdi3	0.19	0.19	0.38	0.12	0.32	0.21	0.26	0.15	0.31
SPae1	0.32	0.31	0.22	-0.03	0.15	0.13	0.42	0.34	0.17
SPae2	0.15	0.20	0.18	-0.02	0.13	0.09	0.34	0.28	0.12
SPae3	0.39	0.29	0.24	-0.03	0.16	0.30	0.27	0.32	0.25
SPoc1	0.44	0.39	0.32	0.12	0.38	0.37	0.47	0.50	0.37
SPoc2	0.34	0.32	0.37	0.10	0.32	0.30	0.52	0.46	0.39
SPoc3	0.37	0.32	0.27	0.13	0.25	0.26	0.53	0.52	0.33
SPgc1	0.16	0.16	0.26	-0.01	0.04	0.11	0.43	0.28	0.22
SPgc2	0.39	0.36	0.33	0.05	0.21	0.31	0.43	0.41	0.23
SPgc3	0.44	0.39	0.44	0.11	0.28	0.41	0.45	0.45	0.42
CPte1	0.40	0.37	0.52	0.08	0.21	0.27	0.39	0.31	0.42
CPte2	0.43	0.34	0.62	0.06	0.26	0.30	0.43	0.43	0.30
CPte3	0.39	0.33	0.58	0.04	0.27	0.30	0.43	0.40	0.37
CPex1	0.44	0.38	0.46	0.20	0.29	0.40	0.42	0.38	0.33
CPex2	0.44	0.38	0.43	-0.02	0.18	0.30	0.44	0.42	0.36
CPex3	0.32	0.28	0.47	0.07	0.06	0.17	0.40	0.37	0.39
CPre1	0.39	0.38	0.55	0.20	0.40	0.43	0.48	0.44	0.42
CPre2	0.52	0.45	0.46	0.20	0.44	0.46	0.47	0.47	0.37
CPre3	0.47	0.44	0.50	0.11	0.30	0.32	0.57	0.38	0.41

Table 15. (Continued)

	OE4R	OE5R	OE6	OE7R	OE8	TPdo1	TPdo2	TPdo3
OE4R	1							
OE5R	0.59	1						
OE6	0.47	0.27	1					
OE7R	0.41	0.41	0.31	1				
OE8	0.17	0.11	0.33	0.17	1			
TPdo1	0.41	0.33	0.31	0.15	0.16	1		
TPdo2	0.36	0.26	0.31	0.24	0.23	0.77	1	
TPdo3	0.35	0.21	0.18	0.18	0.20	0.64	0.62	1
TPdo4	0.40	0.38	0.26	0.30	0.31	0.36	0.39	0.48
TPfa1	0.47	0.37	0.41	0.24	0.27	0.60	0.60	0.54
TPfa2	0.43	0.32	0.42	0.22	0.33	0.60	0.57	0.62
TPfa3	0.34	0.27	0.28	0.15	0.35	0.52	0.49	0.45
TPfa4	0.50	0.44	0.34	0.19	0.28	0.55	0.49	0.57
TPfa5	0.34	0.19	0.33	0.29	0.39	0.41	0.40	0.46
TPfa6	0.29	0.41	0.28	0.07	0.24	0.50	0.40	0.28
TPdi1	0.36	0.33	0.34	0.14	0.43	0.56	0.55	0.54
TPdi2	0.38	0.20	0.38	0.07	0.14	0.54	0.38	0.45
TPdi3	0.30	0.17	0.11	0.15	0.04	0.50	0.48	0.43
SPae1	0.25	0.18	0.37	0.07	0.30	0.32	0.24	0.16
SPae2	0.23	0.19	0.23	0.12	0.23	0.23	0.15	0.10
SPae3	0.22	0.17	0.18	0.24	0.16	0.38	0.28	0.30
SPoc1	0.37	0.23	0.38	0.34	0.25	0.26	0.30	0.16
SPoc2	0.42	0.23	0.47	0.18	0.31	0.34	0.32	0.21
SPoc3	0.34	0.15	0.43	0.21	0.23	0.23	0.28	0.14
SPgc1	0.31	0.09	0.30	-0.01	0.12	0.18	0.21	0.22
SPgc2	0.40	0.20	0.37	0.25	0.23	0.24	0.23	0.21
SPgc3	0.47	0.36	0.32	0.21	0.16	0.36	0.30	0.31
CPte1	0.45	0.38	0.34	0.06	0.21	0.48	0.37	0.42
CPte2	0.48	0.32	0.47	0.16	0.25	0.30	0.28	0.26
CPte3	0.46	0.39	0.43	0.10	0.21	0.46	0.29	0.30
CPex1	0.46	0.31	0.32	0.21	0.35	0.34	0.33	0.28
CPex2	0.39	0.32	0.39	0.17	0.36	0.37	0.37	0.28
CPex3	0.48	0.31	0.33	0.14	0.22	0.32	0.28	0.20
CPre1	0.40	0.41	0.38	0.24	0.24	0.41	0.37	0.42
CPre2	0.39	0.31	0.44	0.26	0.38	0.41	0.40	0.41
CPre3	0.44	0.28	0.34	0.26	0.33	0.44	0.35	0.34

Table 15. (Continued)

	TPdo4	TPfa1	TPfa2	TPfa3	TPfa4	TPfa5	TPfa6	TPdi1
TPdo4	1							
TPfa1	0.42	1						
TPfa2	0.54	0.75	1					
TPfa3	0.47	0.60	0.67	1				
TPfa4	0.56	0.57	0.66	0.66	1			
TPfa5	0.38	0.46	0.52	0.53	0.49	1		
TPfa6	0.40	0.55	0.53	0.61	0.51	0.47	1	
TPdi1	0.55	0.53	0.58	0.55	0.56	0.43	0.52	1
TPdi2	0.29	0.61	0.60	0.44	0.51	0.33	0.43	0.39
TPdi3	0.19	0.40	0.44	0.33	0.39	0.30	0.30	0.23
SPae1	0.30	0.51	0.45	0.39	0.30	0.26	0.34	0.33
SPae2	0.24	0.42	0.44	0.29	0.24	0.18	0.28	0.14
SPae3	0.39	0.29	0.29	0.25	0.24	0.27	0.32	0.38
SPoc1	0.26	0.35	0.24	0.29	0.36	0.25	0.26	0.36
SPoc2	0.19	0.51	0.39	0.30	0.34	0.28	0.30	0.34
SPoc3	0.24	0.38	0.30	0.32	0.38	0.20	0.31	0.31
SPgc1	0.16	0.40	0.35	0.19	0.23	0.15	0.35	0.24
SPgc2	0.26	0.36	0.36	0.28	0.32	0.34	0.34	0.33
SPgc3	0.26	0.37	0.43	0.33	0.33	0.35	0.38	0.33
CPte1	0.34	0.56	0.55	0.52	0.49	0.34	0.47	0.57
CPte2	0.43	0.41	0.49	0.47	0.36	0.44	0.39	0.50
CPte3	0.43	0.44	0.53	0.41	0.37	0.32	0.41	0.51
CPex1	0.48	0.36	0.38	0.47	0.43	0.42	0.40	0.52
CPex2	0.40	0.46	0.44	0.46	0.38	0.47	0.39	0.49
CPex3	0.40	0.49	0.49	0.53	0.37	0.29	0.50	0.35
CPre1	0.43	0.44	0.46	0.41	0.52	0.50	0.48	0.62
CPre2	0.49	0.45	0.46	0.43	0.54	0.48	0.41	0.59
CPre3	0.46	0.43	0.46	0.46	0.47	0.50	0.37	0.53

Table 15. (Continued)

	TPdi2	TPdi3	SPae1	SPae2	SPae3	SPoc1	SPoc2	SPoc3
TPdi2	1							
TPdi3	0.50	1						
SPae1	0.35	0.06	1					
SPae2	0.35	0.16	0.59	1				
SPae3	0.30	0.14	0.47	0.29	1			
SPoc1	0.15	0.08	0.36	0.25	0.45	1		
SPoc2	0.28	0.14	0.43	0.34	0.16	0.65	1	
SPoc3	0.20	0.09	0.44	0.27	0.31	0.74	0.70	1
SPgc1	0.32	0.20	0.36	0.33	0.27	0.38	0.51	0.59
SPgc2	0.27	0.16	0.42	0.30	0.40	0.50	0.55	0.51
SPgc3	0.40	0.17	0.42	0.27	0.50	0.40	0.38	0.32
CPte1	0.38	0.22	0.45	0.21	0.41	0.29	0.37	0.28
CPte2	0.30	0.25	0.39	0.25	0.27	0.25	0.40	0.29
CPte3	0.39	0.25	0.43	0.36	0.31	0.23	0.37	0.19
CPex1	0.18	0.15	0.30	0.19	0.30	0.38	0.41	0.33
CPex2	0.29	0.12	0.32	0.27	0.36	0.40	0.46	0.33
CPex3	0.29	0.20	0.45	0.32	0.38	0.33	0.45	0.41
CPre1	0.34	0.23	0.25	0.17	0.23	0.32	0.41	0.31
CPre2	0.32	0.28	0.34	0.27	0.31	0.38	0.46	0.40
CPre3	0.29	0.15	0.39	0.31	0.35	0.48	0.50	0.41

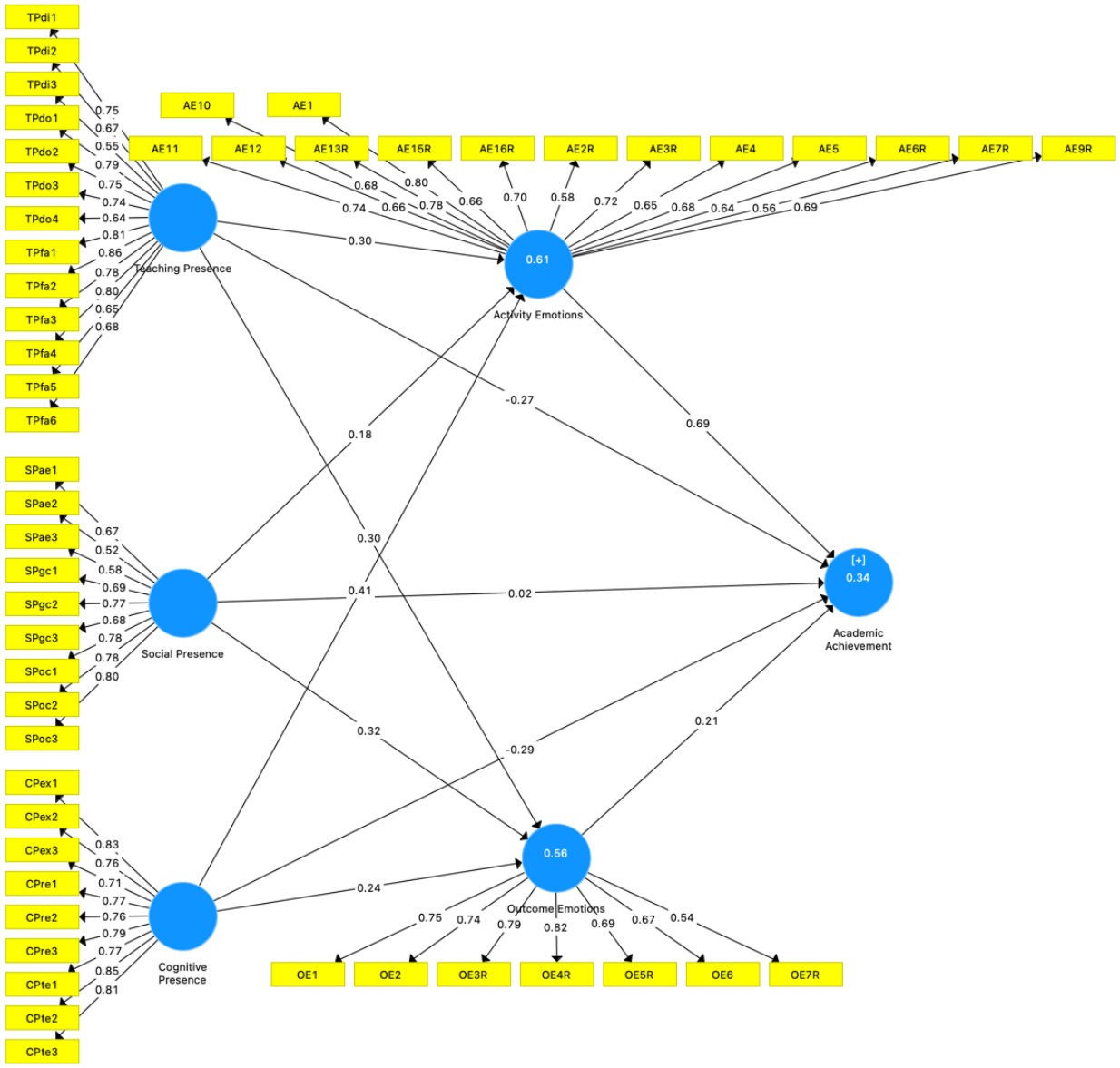
Table 15. (Continued)

	SPgc1	SPgc2	SPgc3	CPte1	CPte2	CPte3	CPex1	CPex2
SPgc1	1							
SPgc2	0.60	1						
SPgc3	0.42	0.50	1					
CPte1	0.37	0.33	0.53	1				
CPte2	0.28	0.45	0.50	0.62	1			
CPte3	0.24	0.33	0.48	0.68	0.77	1		
CPex1	0.34	0.47	0.48	0.58	0.64	0.55	1	
CPex2	0.30	0.52	0.49	0.52	0.61	0.49	0.71	1
CPex3	0.42	0.52	0.61	0.55	0.61	0.49	0.59	0.56
CPre1	0.31	0.35	0.47	0.51	0.62	0.56	0.60	0.50
CPre2	0.32	0.43	0.51	0.49	0.56	0.54	0.57	0.43
CPre3	0.37	0.57	0.49	0.53	0.56	0.56	0.66	0.63

Table 15. (Continued)

	CPex3	CPre1	CPre2	CPre3
CPex3	1			
CPre1	0.36	1		
CPre2	0.40	0.74	1	
CPre3	0.50	0.55	0.60	1

Appendix D: Hypothesized Conceptual Model Specification



Appendix E: Outer Loading Analysis Data

Table 16

Outer Loading Analysis Data

	Activity Emotions	Cognitive Presence	Outcome Emotions	Social Presence	Teaching Presence
AE1	0.80				
AE10	0.68				
AE11	0.74				
AE12	0.66				
AE13R	0.78				
AE15R	0.66				
AE16R	0.70				
AE2R	0.58				
AE3R	0.72				
AE4	0.66				
AE5	0.68				
AE6R	0.64				
AE7R	0.56				
AE9R	0.69				
CPex1		0.83			
CPex2		0.77			
CPex3		0.71			
CPre1		0.77			
CPre2		0.76			
CPre3		0.79			
CPte1		0.77			
CPte2		0.85			
CPte3		0.81			
OE1			0.75		
OE2			0.74		
OE3R			0.79		
OE4R			0.82		
OE5R			0.69		
OE6			0.67		
OE7R			0.54		
SPae1				0.67	
SPae2				0.52	
SPae3				0.58	

Table 16. (Continued)

	Activity Emotions	Cognitive Presence	Outcome Emotions	Social Presence	Teaching Presence
SPgc1				0.69	
SPgc2				0.77	
SPgc3				0.68	
SPoc1				0.78	
SPoc2				0.78	
SPoc3				0.80	
TPdi1					0.75
TPdi2					0.67
TPdi3					0.55
TPdo1					0.79
TPdo2					0.75
TPdo3					0.74
TPdo4					0.64
TPfa1					0.81
TPfa2					0.86
TPfa3					0.78
TPfa4					0.80
TPfa5					0.65
TPfa6					0.68

Appendix F: Multiple Regression Analysis of Demographic and Learning Profile Data with the Academic Achievement Outcome Variable (Table 17)

	Unstandardized Coefficients	Standard Error	Standardized Coefficients Beta	*t*	*p*-value
(Constant)	86.21	8.36		10.32	.000
Age	0.02	0.34	0.01	0.05	.961
Male[a]	1.62	2.94	0.06	0.55	.582
Class[b] 1	-3.23	3.34	-0.12	-0.97	.336
Class[b] 3	-5.09	4.31	-0.13	-1.18	.240
Asian[c]	3.88	4.36	0.09	0.89	.377
Black[c]	4.22	4.05	0.11	1.04	.300
Hispanic[c]	7.90	5.79	0.14	1.37	.175
Mixed[c]	-5.18	5.71	-0.09	-0.91	.367
Learning Mode[d] 1	-7.58	4.96	-0.16	-1.53	.130
Learning Mode[d] 2	3.43	2.98	0.12	1.15	.253
Online Courses[e]	0.16	0.23	0.07	0.69	.494
Hours Studied[f]	0.12	0.23	0.06	0.51	.609

Note. The dependent variable was the final grade represented by a percentage that ranged from 0 to 100%. [a]For gender, the reference category was female. [b]There were 3 class sections. Class 2 was the reference category. [c]The race categories were Asian, Black, White, Hispanic, and Mixed. The reference category was White. Mixed races represented the rest of the participants who chose other races. [d]For Learning Mode Preference, the reference category was the face-to-face traditional classroom learning mode. [e]Online courses were the number of online courses taken by participants. They represented the online learning experience of participants. [f]Hours studied were the amount of time participants spent to the Digital Identity course.

Appendix G: Reprint Permissions from Publishers

ELSEVIER LICENSE
TERMS AND CONDITIONS

Feb 27, 2022

This Agreement between Dr. David Tai ("You") and Elsevier ("Elsevier") consists of your license details and the terms and conditions provided by Elsevier and Copyright Clearance Center.

License Number	5257151381610
License date	Feb 27, 2022
Licensed Content Publisher	Elsevier
Licensed Content Publication	The Internet and Higher Education
Licensed Content Title	Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education
Licensed Content Author	D.Randy Garrison,Terry Anderson,Walter Archer
Licensed Content Date	Spring 1999
Licensed Content Volume	2
Licensed Content Issue	2-3
Licensed Content Pages	19

SPRINGER NATURE LICENSE
TERMS AND CONDITIONS

Feb 26, 2022

This Agreement between Dr. David Tai ("You") and Springer Nature ("Springer Nature") consists of your license details and the terms and conditions provided by Springer Nature and Copyright Clearance Center.

License Number	5256681340615
License date	Feb 26, 2022
Licensed Content Publisher	Springer Nature
Licensed Content Publication	Educational Psychology Review
Licensed Content Title	The Control-Value Theory of Achievement Emotions: Assumptions, Corollaries, and Implications for Educational Research and Practice
Licensed Content Author	Reinhard Pekrun
Licensed Content Date	Nov 5, 2006
Type of Use	Thesis/Dissertation
Requestor type	academic/university or research institute
Format	electronic

AMERICAN PSYCHOLOGICAL ASSOCIATION LICENSE
TERMS AND CONDITIONS

Feb 27, 2022

This Agreement between Dr. David Tai ("You") and American Psychological Association ("American Psychological Association") consists of your license details and the terms and conditions provided by American Psychological Association and Copyright Clearance Center.

License Number	5257210827087
License date	Feb 27, 2022
Licensed Content Publisher	American Psychological Association
Licensed Content Publication	Psychological Review
Licensed Content Title	Core affect and the psychological construction of emotion.
Licensed copyright line	Copyright © 2003, American Psychological Association
Licensed Content Author	Russell, James A.
Licensed Content Date	Jan 1, 2003
Licensed Content Volume	110
Licensed Content Issue	1