Measuring Community College Math Students Self-Report of Learning Engagement When Interactive Whiteboards Are Used in Classroom Teaching

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Measuring Community College Math Students Self-Report of Learning Engagement

When Interactive Whiteboards Are Used in Classroom Teaching

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Abstract

Technology is becoming an important tool in the field of education, especially in post-secondary studies. Higher education in the 21st century age of technology is impacted greatly by instructional technology. The problem addressed in this study was the integration of technology as a teaching tool in community college math classrooms is not yet being fully embraced and funded despite the vital tool technology has become in mathematics. The purpose of this quantitative study was to gather data on community college math students' degree of learning engagement when interactive whiteboards are used in the classroom. The sample used in the study was a convenience non-probability sample of approximately n=100 community college students selected from four classrooms of two different math courses at the study site where smart boards are used in the math classes. The quantitative data collection method used in the study was a 13-item survey with a 4-point Likert scale ranging from strongly agrees to strongly disagree. Surveys were collected and an analysis was conducted to determine the degree, if any, of math students' self-report of learning engagement when whiteboards are used in the classroom. The results of this study showed that the respondents self- reported an increase in learning engagement in classrooms equipped with interactive whiteboard technology. In addition, this study revealed no significant differences in the findings from two separate independent groups. The findings propose the indications for further practice is the use of interactive whiteboard in math courses. The study findings also indicate a need for future research investigating the research question in other settings. Further, the need for research to investigate methods to increase professional development for instructor's usage was also indicated.

KEY TERMS: Interactive White Board, Learning Engagement

Acknowledgements

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Chapter 1: Introduction

The omnipresent existence of technology in society has been integrated into 21st-century pedagogy where instructors and students are inundated with the continued technological advances impacting educational delivery (Zientek, Skidmore, Saxon, & Edmonson, 2015). The technological innovations are changing the way teachers teach, and students learn (Hwang & Tsai, 2011; Yugar, 2014). The integration of technology in the classroom has become a standard in educational delivery, including post-secondary education (American Mathematical Association of Two-Year Colleges, 20007).

Increasingly, researchers have documented the positive effects of technology integration into the classroom in relationship to improving student performance in the classroom (Alarcia & Bravo, 2012) and creative applications of instructional technology in higher education platforms (Akkoyunlu & Erkan, 2013; Cook, 2014; Ellwein, Hartley, Donovan, & Billick, 2014). Another breakthrough in the use of instructional technology in the classroom addresses how instructional technology supports at-risk students' learning challenges (Darling-Hammond, Zielezinki, & Goldman, 2014; Ling, Ahmad & Singh, 2016). According to the American Association of Community Colleges (AACC; 2016), community college along with all higher education institutions will experience changes as environmental factors intensify and technology advances accelerate to positioning for the future. Further, community colleges have greater incentives to provide technological solutions to enhance quality, expand access, and contain costs, with the high number of nontraditional students (AACC, 2016).

Instructional technology is enabling multi-modal teaching, changing curricula and spawning rich forms of online research and collaboration. According to Dahlstrom, Arroway, Grajek, and Hatch (2012), to remain positioned for the future, community colleges and all higher education institutions will experience changes, where environmental factors intensify and technology advances accelerate. Further, community colleges, with the high number of nontraditional students, have greater incentive to provide technological solutions to enhance quality, expand access, and contain costs.

Srisawsdi and Panjaburee (2014) proposed the accelerated growth of science, technology, and mathematics posits the need for learning environments preparing students to meet the challenges of being creative and lifelong learners. The researchers further asserted that computers and communication technologies play an important part in meeting the challenge. Despite the lack of rigorous efficacy research in assessing the use of technology in developmental courses, the results of recent studies investigating the use of technology in developmental mathematics courses have increased in the literature (Zientek et al., 2015).

With the rapid growth of Science, Technology, Engineering, and Mathematics (STEM) instruction (Foshee, Elliott, & Atkinson, 2016), learning environments are needed to prepare students to be creative and promotes lifelong learning individuals (Van Seters, Ossevoort, Tramper, & Goedhart, 2012; Srisawasdi, Srikasee, & Panjaburee, 2012). Computers and communication technologies have been one way to overcome the need for this preparation (Van Seters et al., 2012). Consequently, computers and communication technologies play an important role in enhancing learning performance and providing more focus on personalized learning environments (Srisawasdi et al., 2012).

Statement of the Problem

The problem addressed in this study is despite the fact that technology is becoming an important teaching tool in mathematics impacting student learning engagement (Blair, 2012), the integration of technology as a teaching tool in community college math classrooms has not yet been fully embraced and funded (AMATYC, 2007). Technology has a major impact on how instructors teach, how students learn, and how interactions between teacher and student take place in the physical classroom (Hwang & Tsai, 2011; Yugar, 2014). The availability and use of digital technologies have existed since the four-function calculators of the1970s, but now classroom technology includes increasing use of sophisticated tools, such as the integration of graphic, symbolic manipulation, statistic and dynamic geometry packages, graphics calculators, symbolic manipulation, and statistical and dynamic web-based applications (AMATYC, 2007).

The emergence of technology in the classroom initiated in the early 1990s was mostly focused on K-12 mathematics curriculum and classrooms, but gradually over the next two decades technology became a part of postsecondary education (AMATYC, 2007). The use of technology, such as blackboards for Learning Management Systems (LMS) and assessment in mathematics classrooms, are widely recognized (Lutzer, Rodi, Kirkman, & Maxwell, 2007). Research examining the efficacy of technology in higher education learning has emanated primarily from the university levels and lagged at the community college level (Sitomer et al., 2014). Efforts to inform and improve community college mathematics education with the use of technology have been examined widely in the research on student learning (Hern & Snell, 2014; Liang, Huang &Tsai, 2012; Ngo & Kwon, 2015; Stigler, Givvin & Thompson, 2010).

Purpose of the Study

The purpose of this quantitative study was to investigate community college math students' degree of learning engagement when interactive whiteboards are used in the classroom. Community colleges serve almost half of the undergraduate students in the United States providing open access to postsecondary education delivery systems and prepare students for transfer to four-year institutions. In addition, community colleges are a vital part of America's postsecondary education delivery system serving almost half of the undergraduate students in the United States, providing open access to postsecondary education, preparing students for transfer to four-year institutions, providing workforce development and skills training, and offering noncredit programs (American Association of Community Colleges, 2015). The sample consisted of approximately 100 math students receiving instruction in two interactive whiteboard equipped classrooms in a community college study site in an eastern state. The math classes with approximately 25 students each were Introduction to College Mathematics (Math 100) two sessions taught by the same instructor, and Pre-Calculus (Math 119) two sessions taught by another instructor. The study examined the student engagement of math instruction in classrooms equipped with interactive whiteboards as self-reported by the study participants. The data were collected one time utilizing an anonymous survey composed of previously published analytics. The survey used in the study was a 13-item questionnaire with a 4-point Likert type scale ranging from strongly agrees to strongly disagree (Smart Resources, 2010). The survey was conducted to measure how the respondents self-report their degree of engagement in classes utilizing smart boards. Findings were shared with the community college study site, and findings may be of interest to other community colleges as well. Statistical power is defined as the probability of rejecting the null hypothesis while the alternative hypothesis is true. Factors that affect statistical power include the sample size, the specification of the parameter(s) in the null and alternative hypothesis, i.e. how far they are from each other, the precision or uncertainty that will be allowed for my study (generally the confidence or significance level) and the distribution of the means to be estimated.

Theoretical Framework

This study was conducted to investigate how instructional technology, specifically the use of the interactive whiteboard, impacts student engagement in the classroom. The theoretical framework was based on theories that posit a more authentic learning environment for students and contribute their success. The preparation of students for the demands of the 21st century has been changed by the way teaching and learning occurs in the modern-day classroom. Modern-day learning environments must become more authentic, giving the students greater opportunities to use higher order thinking and problem solving connected to real-world applications (Panda, Mishra & Mishra, 2015).

Recent theoretical frameworks have been developed to better understanding and improve the learning environment. Technology has emerged as one of the evolutionary factors changing education. The advents of different technological advancements in the classroom have led to vast changes in the nature and deliberation of education (Canuel, 2011; Panda, Mishra & Mishra, 2015; Steed, 2013). Many modern-day methods of teaching and learning practice have been transformed by information technology where the uses of different devices have become a standard part of the teaching process (Panda, Mishra & Mishra, 2015). The belief that instructional technology in the math classroom is supported the Engagement Theory (O'Brien & Toms, 2008) and the Situated-Cognition Theory (Brown, Collins, & Duguid,1989) inform this study.

Student engagement in higher education has increasingly become a matter of concern in recent year as it relates to important variables such as student retention and academic performance (Pascarella, Seifert & Blaich, 2010; Kuh, Cruce, Shoup, Kinzie & Gonyea, (2008). Student engagement has been posited as one of the major factors increasing student and success in higher education (Newman, 1992). Engagement is represented by active involvement, commitment, and concentrated attention, as opposed to the frivolous concurrence, apathy, or lack of interest. It is referred to the contribution that students make towards their learning, as with their time, commitment and resources

Engagement Theory is a framework learning positing the underlying idea that student must be meaningfully engaged in learning activities through interaction with others and worthwhile task (O'Brien & Toms, 2008). Kearsley and Schneiderman (1999) proposed that the use of Engagement Theory for technology-based teaching and learning provides guidelines specifically for instructional technology and increases the reliability of the notion of instructional technology in educational settings.

The other theory that provided the theoretical framework for this study was the distributed cognition theory. Distributed Cognition is a useful descriptive, theoretical framework for understanding the role and function of representational media and its implications for the design of technology for analyzing situations that involve problem-solving. The theory is a branch of cognitive science proposing cognition and knowledge is not confined to an individual; rather, it is distributed across objects, individuals, artifacts, and tools in the environment.

According to Brown, Collins & Duguid (1989), situated cognition theory asserts that an individual's knowledge is built within and linked to the activity, context, and culture in which it was learned. Learning is social indicated in how people learn when interacting with each other through shared activities and through language, and problem-solving (Katsioloudis, 2015; Moekotte, Gruwel, Ritzen & Simons, 2015; Zhu & Engles 2014). The situated-cognitive theory provides understanding focuses on what people learn in their everyday lives, which are authentic contexts for a variety of skills. The researcher further proposes that it helps educators understand how to capitalize on the knowledge and skills their students already have and helps them learn new content and skills.

Nature of the Study

The purpose of this quantitative study was to gather data on community college math students' self-report degree of learning engagement when interactive whiteboards are used in the classroom. The non-experimental research design was selected because the research question is about a single variable and is broad and exploratory (Salkind, 2010). Survey research was used to conduct a correlational study whereas the researcher is analyzing data for the first time looking for a basic framework to structure the process (Vinciullo & Bradley, 2009).

The target study sample size was 100 students in four math classes at the community college study site in an eastern state. Data were collected from community colleges students by administering an anonymous survey composed of previously published analytics. The dependent variable was student attendance in four classes of two different types of math courses using interactive whiteboard technology. The independent variable was the student's degree of learning engagement as measured by the Interactive Whiteboard Survey (Smart Resources, 2010), slightly modified, replacing the term Smartboard with an interactive whiteboard, as the study site does not use the Smartboard brand of interactive whiteboard. The survey measured the degree of self-reported learning engagement of community college math students in classrooms equipped with interactive whiteboards. The data was statistically analyzed utilizing SPSS ANOVA to compute the mean and standard deviation to determine if there is any statistical significance between students' engagement of learning in mathematics classrooms equipped with interactive whiteboard instructional technology. A regression analysis was conducted to determine if there is a significant difference in the degree of engagement of learning in the two different math classrooms, Math 100 and Math 119.

After the data was analyzed, a post hoc test in ANOVA was indicated and conducted to determine which of the mathematics classes had the greatest degree of learning engagement. The findings determined that high degrees of community math student engagement can be predicted where instruction is facilitated utilizing interactive whiteboards in the classroom, and the post hoc study was measured to see if there were any variations or higher degrees reported in individual classes. Study findings contributed to the limited body of research on the use of instructional technology in community college math classes.

Research Questions

Technology has been integrated into 21st-century pedagogy whereas instructors and students benefit from continued technological advances that improve educational delivery (Zientek et al., 2015). This study gathered data on community college math students' degree of learning engagement when interactive whiteboards are used in the classroom. The following questions guided the research.

Q1. How do community college math students self-report higher than average degrees of learning engagement when an interactive whiteboard is used in the classroom?

Q2. To what extent if any, do community college math students self-report higher than average degrees of learning engagement in Math 100 as compared to Math 119, when interactive whiteboards are used in the classroom?

Hypotheses

H1a. Community college math students' do not self-report a significantly higher degree of learning engagement when interactive whiteboards are used in the classroom.

H1o. Community college math students' self-report a statistically significantly higher than average degree of learning engagement when interactive whiteboards are used in the classroom.

H2a. Community college math students' do not self-report significantly higher degrees of learning engagement enrolled in different interactive whiteboard-equipped math courses.

H2o. Community college math students' statistically significantly self-report higher than average degree of learning engagement in one math class than the other math class where interactive whiteboards are used in both courses.

Significance of the Study

The importance of student learning engagement in higher education is highly recognized (Kahu, 2013; Khan, 2014). Innovative teaching solutions have emerged in high numbers and complexity to promote student engagement (Wankel & Blessinger, 2013). The research study measured the self-report impact of instructional technology on student learning engagement in math classes at a community college study site. There is significant literature recognizing the use of technology in the classroom, but the impact in community college math classes are limited (AMATYC, 2007). Student performance in the fundamental courses are a major challenge for community colleges, with 41 students at public 2-year institutions reported having ever taken remedial courses (Cervenanska, 2013; Chilton, 2012; Crawford, 2013).

Definitions of Key Terms

Interaction - Interaction is the silent, critical, creative conversation within the learner's mind that is spurred and supported by the learning environment (Martinovic, Freiman, & Karadag, 2012).

Interactive Whiteboard – This is an instructional tool that allows computer images to be displayed on a board using a digital projector. The instructor can then manipulate the elements on the board by using his finger as a mouse, directly on the screen. Items can be dragged, clicked and copied and the lecturer can handwrite notes, which can be transformed into text and saved interactive whiteboard that uses touch detection for user input (for example scrolling and right mouse-click) in the same way as normal PC input devices (BBC Active, 2015)

Instructional technology - Instructional Technology is the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning (Seels & Richey, 1994).

Interactivity - Interactivity refers to the extent to which users can participate in modifying the form and content of a mediated environment in real time or the interaction between learners and others in the classroom (Martinovic et al., 2012).

Learner-instructor interaction - Learner to instructor interaction refers to a two-way communication between the instructor and the learner, which occurs when the instructor seeks to stimulate interest, clarify questions, guide, motivate, and dialog with the learner (Bucker & Kim, 2014).

Learner-content interaction - This interaction is the process of a learner interacting with content intellectually, defined as the interaction between the learner and the content being studied (Palao, Hasties, Cruz, & Ortega, 2015).

Summary

Technology is becoming an important teaching tool in mathematics (Blair, 2012), but the integration of technology as a teaching tool in community college math classrooms has not yet been fully embraced and funded (AMATYC, 2007). The purpose of this quantitative study is to gather data on community college math students' degree of learning engagement when smart boards are used in the classroom. Non-probability convenience sampling will be used to select one hundred community college students, in math classes equipped with instructional technology. The data collection method to be used in the study is a 13-item survey with a 4-point Likert type scale ranging 10-item and a 4-point Likert type scale ranging from strongly agrees to strongly disagree. The statistical analysis will be performed to analyze the data collected from the survey respondents. The responses from each question will be averaged and converted to a mean score for analysis to be used to rate the participant's level of engagement related to the use of interactive whiteboards in the classroom.

Chapter 2: Literature Review

Increasingly, research has documented the benefits of technology integration in education and improving student performance in the classroom (Alarcia & Bravo, 2012) and creative applications of instructional technology in higher education platforms (Ellwein et al., 2014). The purpose of this quantitative survey study is to gather data on community college math students' degree of learning engagement when interactive whiteboards are used in the classroom. Community colleges have begun to join the rank of higher education responding to the increased use of technology for instruction. However, community colleges lag in the integration of technology.

This literature review informed the study exploring the impact of instructional technology in the classroom. The focus of the study was particularly focused on the impact on student learning engagement in mathematics classrooms equipped with an interactive whiteboard, also referred to as Smartboards. Related topics also discussed included instructional technology and mathematics, instructional technology in higher education, and interactive whiteboard technology. Finally, instructor attitudes and proficiency with instructional technology and student engagement were discussed.

Documentation

The review of the literature was performed using electronic searches through the library databases at Northcentral University to generate a broad overview of the research literature focused on the research question. The keyword search was conducted using such phrases as instructional technology, community college mathematics, mathematics at the community college, student engagement, and various combinations of the previous phrases. The literature presented below will provide a clear and concise review of the literature associated with the researcher's hypothesis for the research study.

Recognizing early in the investigation of the subject, the limited empirical data related to the impact of instructional technology in community college math classrooms, the researcher, developed a strategy involving several layers of research inquiry. The investigation began with a focus on the emersion of instructional technology in higher education with a particular focus on community college. The search was further focused on the use of technology in a mathematics classroom. Finally, the research was concentrated on the impact technology has on student engagement. Overall, the analytical review of the literature review provided indications of the positive impact instructional technology has on student engagement.

Instructional Technology in Higher Education

Johnson and Johnson (2014) proposed that technology provides opportunities for shared learning enabling learners to read and share the same or related material concurrently through technological devices such as the Nook, Kindle, and iPad. Also, students can work together, discuss and argue despite being in different physical locations, using technology such as Google Docs as a cooperative group (Johnson & Johnson, 2014). Savasci (2014) conducted a study to investigate the use of instructional technologies in science classrooms. The researcher's findings revealed that a variety of instructional technologies were available in classrooms, but teachers did not include the internet, interactive `smart boards, spreadsheets, computer simulations and educational software in their lesson plans. Findings also indicated a lack of teacher proficiency using instructional technology, and the attitudes of teachers regarding instructional technology could be barriers to selecting and implementing the instructional technology. Study conclusions were a need for increased teacher knowledge and skills regarding integrating instructional technologies into the classroom (Savasci, 2014).

Ferster (2014) conducted a study to gain greater insight into the aspects of emerging web-based technology in the community college. The study was performed in several phases. The first phase of the study explored the extent that Web 2.0 technology is integrated into face-to-face classroom activities and focused on the types and dynamics of Web 2.0 tools used by community college instructors (Ferster, 2014). The second phase of the study examined the instructors' technology preferences and the barriers faced during integration into the face-to-face classroom. The final phase of the study examined the level of training received by faculty and training was identified as the biggest barrier to their use of technology (Ferster, 2014). Study findings were that the lack of faculty training opportunities was the primary barrier to using technology. Further, there are significant advances in technology available for instructors in the face-to-face classroom, but the hesitancy of possible users is related to their lack of comfort with the technology (Ferster, 2014). Ferster (2015) explicitly proposed the need for both online and face-to-face course instructors to adapt to the technologies used by students and gain the computer skills required to incorporate the technology in their pedagogy.

Zhu and Engels (2014) examined the perceptions of 1051 students and teachers from six universities in China to determine their views and reactions to innovation in educational delivery about student-centered learning and the use of innovations in instructions. The study was conducted in response to the rapid social, technological, and economic changes in higher education, with the goal of understanding their overall impact. The results of the study showed the institutions utilized for the study differed in all levels of organizational structure, except the dimension of collaborative relationship (Zhu & Engels, 2014). Some of the reported differences included the first class universities having more innovation within their organizational structure than others. The study also reported the first-class institutions did not demonstrate higher levels of student engagement and support (Zhu & Engels, 2014)

Delialioglu (2012) conducted a study to investigate how the blending of two different instructional approaches with technology affected students' engagement. The blended study involved the design and implementation of an eight-week lecture-based learning environment, followed by a second eight weeks of a problem-based learning environment. The study findings revealed that the difference in active learning was not due to individual student differences but rather the learning environment provided in the problem-based blended environments (Delialioglu, 2012). The researchers concluded that educational institutions should direct their energy and resources to methodologies and technologies to improve student engagement in their institutions (Delialioglu, 2012).

West and Borup (2014) reviewed findings from a ten-year analysis of ten major journals in the field of instructional technology. The research revealed a strong emphasis on technology-related issues, distance education, communication strategies and instructional methods over cognitive-related topics and learning issues. Also, the findings revealed a strong history of theoretical inquiry and both qualitative and quantitative research published on the subject of instructional technology (West & Borup, 2014). The researcher's study results provided useful information on the patterns informing scholarship on instructional technology and found what is lacking was a broader analysis of patterns (including patterns of authorship, topics, and research methods) within the field of instructional design and technology (West & Borup, 2014).

Erbas, Ince, and Kay (2015) explored the effects of technology-supported learning environments utilizing an interactive whiteboard (IWB) and NuCalc graphing software. Also, the study compared the findings related to student achievement where instructional technology is used to those of a direct instruction-based environment. The significant findings of the study were that both the experimental and control group demonstrated an increase from pretest to posttest and similar decreases from post-test to retention test (Erbas et al., 2015). Further, the impact of using the interactive whiteboard and computer-based graphing utility positively affected students' attitudes towards technology and mathematics and improved the reasoning and interpretation skills of the students. The study findings are valuable as graphs, and graphing are considered to be the most important and fundamental concepts in all of the mathematics (Erbas et al., 2015).

The growth in the use of instructional technology in institutions of higher education has been inclusive of developmental courses. Martirosyan, Kennon, Saxon, Edmonson, and Skidmore (2017) examined the state of technology integration in developmental courses in two and four-year colleges in Texas. The study involved surveying seventy faculty members to identify any barriers that might impede technology integration into developmental education instruction. Findings revealed: (a) preference for traditional methods and limited usage; (b) preferences for online tools and resources, such as YouTube and interactive whiteboards; (c) preferences for specific software related to curriculum such as MyMathLab; (d) preferred use of specific technology equipment such as Internet, graphing calculators, and interactive whiteboards usage; and (e) those preferring usage had positive views of technology (Martirosyan et al., 2017). One of the major challenges reported was the lack of training by students who required specific training which hindered their usage (Martirosyan et al., 2017).

Further, findings revealed that a majority of the respondents reported using both software and hardware components of instructional technology in their developmental courses

(Martirosyan et al., 2017). The technologies described by the participants included clickers, interactive whiteboards, iPads, tablets, and nongraphic calculators. However, some of the participants reported not using instructional technology. Analysis of the answers to the open-ended questions revealed some of the reasons why instructional technology was not used: (a) it was not available, (b) there was limited or no technology support, and (c) instruction courses were focused only on reading and writing (Martirosyan et al., 2017).

The increasing expansion of instructional technology in higher education has increased dramatically over the years (Bell & Federman, 2013; Hora & Holden, 2013; Zhu & Engels, 2014). Bell and Federman (2013) conducted a study to determine the key issues in the growing use of e-learning in postsecondary education. The three main issues addressed in the study were: (a) whether e-learning is as effective as other delivery methods, (b) what particular features of e-learning influence its effectiveness, and (c) the barriers to the adoption of e-learning in post-secondary education. The research findings led the authors to conclude e-learning can be an effective means of delivering post-secondary education and urges researchers to conduct further studies to investigate the last two issues (Bell & Federman, 2013).

The challenges to improving student outcomes in pre-college mathematics at community colleges present significant challenges for the educator. Gerhard and Burn (2014) conducted a study to bridge the gap in the literature examining the impact technology has on improving learning outcomes for math students in community colleges. A qualitative case study with both tenured track and non-tenured track instructors was conducted to examine the nature and effectiveness of strategies and incentives to engage non-tenured track instructors in precollege mathematics reform (Gerhard & Burn, 2014). The study findings demonstrated the possibility of successfully engaging non-tenured faculty in efforts to improve pre-college mathematics in community college (Gerhard & Burn, 2014). The researchers found that sustained engagement was established when the non-tenured faculty was offered value-added opportunities linked to professional growth. Some of the opportunities included: (a) learning new curricular ideas and teaching strategies, (b) connecting with peers, (c) building professional relationships, and (d) deepening their commitment to student learning. The researchers concluded that those in charge of non-tenure track faculty professional development could enhance their efforts by engaging in those four components (Gerhard & Burn, 2014).

The highly reported passive use of inquiry-based teaching methods in undergraduate math and science disciplines prompted a study to investigate the use of instructional technology in higher education (Hora & Holden, 2013). The researchers employed a qualitative case study design investigate the practice and the processes used to make decisions about the use of instructional technology. The study sample included 40 math and science instructors. The purpose of the study was to examine the cognitive, cultural and contextual factors associated with institutions of higher learning in the United States (Hora & Holden, 2013).

The exploratory study involved the observation of forty faculty members in undergraduate math, physics and biology departments in three large research universities and one-on-one interviews with individual instructors (Hora & Holden, 2013). The study explored: (a) what instructional technology was being used in the classroom, (b) what role did the integration of technology in the education setting play in lesson planning and delivery, and (c) what role did instructional technology play in the varying types of teaching practices used by faculty (Hora & Holden, 2013).

The research findings were analyzed from the data collected from math, physics and biology classes collected through interviews and observation. The findings of the math faculty indicated that instructors relied primarily on chalkboards for their instruction and some use of interactive whiteboards and overhead projectors (Hora & Holden, 2013). The data collected from the physic faculty revealed that a higher incidence of usage was employed than math faculty. The physic instructors reported using lectures supported by instructional technology such as clickers, and overhead projectors. The data collected from the biology professors reported the use of lectures, powerpoint presentations and minimal use of other methods (Hora & Holden, 2013).

The study also investigated the reasons for the lag in the use of instructional technology in the classroom. The general findings propose that e research findings revealed pre-existing beliefs, experience with technology, the cost associated with technology, and the cultural representations of the disciplines impact instructional technology usage (Hora & Holden, 2013).

Kay and Kletskin (2012) investigated two distinct teaching approaches utilizing technology in the classroom: receptive viewing and problem-based teaching. Receptive visualization involves the use of learning material in various formats, such as slides, lectures, and videos. The problem-based approach involves the use of web-based support for students in mathematics or science (Kay & Kletskin, 2012). The study involved 288 higher education math students with access to a series of 59 problem-based video podcasts over a three week period. The researchers' findings revealed that two-thirds of the respondents preferred problem-based approaches to learning mathematics citing the improvement it made in learning. The study findings demonstrated that dynamic visualizations from the internet facilitated greater learning than in powerpoint lectures in math classroom (Kay & Kletskin, 2012).

Anderson and Horn (2012) examined the self-reported influence of information literacy in community college students learning. The study involved community college students planning to transfer to four-year universities. The goal of the study was to find empirical data to provide a better understanding of computer literacy and how well community colleges are preparing its students to make the transition to more technology-driven education delivery systems (Anderson & Horn, 2012). The researchers investigated the relationship between students' use of technology and their self-reported educational and technology gains. Study findings demonstrated a significant relationship between community college students' use of technology for educational purposes and their overall educational performance (Anderson & Horn, 2012). Based on study findings, the researchers recommended the need for setting greater priorities in higher education for the integration of technology into its educational delivery. Results of the study aligned with prior research findings on continued integration of technology into educational delivery in institutions of higher learning (Anderson & Horn, 2012).

Davies, Dean, and Ball (2013) conducted a study to understand how technology can best be integrated into college-level delivery systems. The research study involved the use of a pretest-posttest quasi-experimental research design, with a cross-case comparative approach to the data analysis. The study was conducted in an introductory to MS Excel classroom taught by information systems in the Marriott School of Management at Brigham Young University (Davies et al., 2013). The strategy assumed the researchers understood if any elements of instructional technology had a greater impact on student learning than traditional delivery systems. Study findings supported the conclusion that technology-enhanced classrooms and improved student learning (Davies et al., 2013). Further, the researchers reported that reduction in motivation resulted from frustration by the participants related to the classic classroom instruction and assessment and led to the preference for technology-driven instruction.

Technology and Student Engagement

The rise in the use of instructional technology, as described earlier in this chapter, has benefits and widespread use, as student engagement has a significant impact on student learning. The next section of this review focuses on the impact that technology has on student engagement.

Kahu (2013) proposed student engagement as a widely recognized influence on achievement and learning in higher education. Student engagement is being widely theorized and researched and is broadly acknowledged as a significant influence on performance and learning in higher education. The researcher reviewed and criticized four dominant research perspectives on student engagement: (a) the behavioral perspective with the focus on student and institutional practice; (b) the psychological viewpoint, whereas engagement is viewed as a psycho-social process; (c) the socio-cultural perspective, which is focused on the critical role of socio-political context; and (d) the holistic perspective, a broader view of engagement. Kahu (2013) concluded that every possible antecedent and consequence of student engagement could not be captured in the study and proposed a conceptual framework for further research to be constructed.

The emerging use of technology in education has been the impetus for research by investigating its impact on engagement, successful outcomes, and academic achievement (Hodges & Prater, 2014; Reiser & Dempsey, 2012; Stevens & Kirst, 2015). The findings of the researchers support some of the contentions this study,

Zielinski (2016) explored the relevance of instructional technology research in the adoption of technology to enhance teaching and learning and an increase in student engagement. The author reviewed 60 research articles on instructional technology focused on student engagement and technology. Zielinski (2016) found that using technology to encourage student collaboration and interaction, while also allowing the student-users to direct their instruction increased student's success by using familiar tools. The researcher suggested that in higher education, teaching effectiveness is an important issue, as it is positively linked with better student performance. Student-centered learning (constructivism) is an effective pedagogy in the college classroom and was identified an effective method for increasing student learning (Zielinski, 2016).

Gunuc and Kuzu (2015) conducted a study to understand student engagement and technology. The researchers sought to explain the relationships between student engagement and technology theoretically. The study consisted of 322 teaching students using the causal research method. Findings revealed that the variables of valuing and belonging predicted emotional engagement while emotional engagement predicted behavioral engagement (Gunuc & Kuzu, 2015). Also, behavioral engagement predicted cognitive engagement. Finally, technology was found to be one of the causes predicting and increasing class engagement. The results of the study revealed the use of technology in and out of classrooms improved the level of student engagement (Gunuc & Kuzu, 2015).

Rashid and Asghar (2016) investigated whether the reported increase in educational technology in higher education resulted in enhancing academic success and fostering student engagement. The research study was comprised of 761 female; undergraduate students enrolled in a private university in Saudi Arabia. The findings revealed a correlation between the use of technology and increases in student engagement and self-directed learning (Rashid & Asghar, 2016).

Technology and Student Interaction

Studies on the impact of technology on learner interaction have focused on the impact that distance learning has on learner to learner interaction and learner to instructor interaction (Delialioglu, 2012; Hora & Ferrare, 2013; Pittman & Edmond, 2016). Most of these studies focused on identifying how learning over a web interface either synchronously or asynchronously affected the manner in which learners' interacted with other learners during discussion forums, or how web interface impacted the manner in which the instructor interacted with the learner and the general impact on learner performance (Pittman & Edmond, 2016). Despite the emphasis by a majority of the earlier studies in the field of distance learning, a few other studies have been conducted focusing on the impact of the use of laptops and mobile devices on learning interaction (Mango, 2015). With that said, the question then becomes whether or not these types of studies are properly focused on the newest models of technology available to learners identified in the defined population. Bassani (2014) suggested that interaction is at the center of every learning process, especially those using technology. The researcher defined interaction primarily as a reciprocal occurrence requiring at least two actions and two objects mutually influencing each other (Bassani, 2014).

Alarcia and Bravo (2012) examined the methodological changes Information Communication Technologies (ICTs) brought to teaching and learning from an interaction perspective at the University of Lleida. Research findings indicated that interaction, a fundamental factor in all educational processes, increased in face-to-face, e-learning, and blended learning environments using technological tools like email, chats, and social networks. Alarcia and Bravo (2012) emphasized the importance of interaction, particularly between the lecturer and the student. They approached methodological changes that ICTs brought to learning from the viewpoint of the interactions they generated. The researchers stated, "It is a matter of evaluating the extent to which the interaction between and among the various agents of the educational process also has a place in the e-learning model" (Alarcia & Bravo, 2012, p. 215).

Specific Technology Uses and Their Effect on Learning Interaction

There is extensive literature focused on the impact of specific technologies on learning interaction. Bassani (2014) discussed the positive impact and value of Virtual Learning Environments (VLE) software, such as Web 2.0 tools (e.g., wikis, blogs, social networks) on learning engagement. Higgins, Xiao, and Katsipataki (2012) conducted a study to identify repercussions for potential investment in the use of digital technology for teaching and learning in schools. The researchers conducted a meta-analysis on effects of the use of digital technology in schools on learners' academic achievement beginning with an overview of the extensive research on the general impacts of technology on learning. Subsequently, the researchers reviewed the evidence from a qualitative synthesis of studies into the impact of digital technology (Higgins et al., 2012). Higgins et al. (2012) found there was an association between high ICT use and higher learner achievement in community colleges, and this connection was consistent with other studies. There was a relationship that existed among students' achievement in learning, teaching contexts, and learning interactions. Higgins et al. (2012) also found the use of digital technologies is usually more productive when it supports teaching and learning cooperation and interaction.

Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, and Sendurur (2012) found that today's students seem to rely more on technology than traditional methods to gain the knowledge necessary to make it in the world, both inside as well as outside of the classroom. According to Ifenthaler and Schweinbenz (2013), teachers who use traditional methods of delivering classroom objectives to students in today's world have a harder time keeping the students' attention resulting in poorer performances in the classroom.

Matthews and Kitchin (2015) investigated the impact interactive whiteboards (IWBs) have on both instructors and learners pedagogic styles. The researchers found that activities for connecting and learning become possible through digital whiteboards rather than physical whiteboards, and notions of propinquity, time, and technology-enabled different necessities and prerequisites for interaction. Matthews & Kitchin (2015) also found that interactive whiteboards improved presentation activity and revealed student's developmental progress, which influenced the tutoring and learning interaction in the classroom. Bassani (2014) stated that it is reasonable to review how Web 2.0 tools affect interactions. Web 2.0 technologies are frequently represented as collaborative and interactive tools, which make these capacities particularly attractive to education (Jordan & Elsen-Clifton, 2013).

Instructor Attitudes and Proficiencies with Technology

The review of the literature examined the use of technology in the higher education classroom, as well as its impact on learning and engagement. One of the areas identified in the research was related to the impact that instructor proficiency has on instructional technology use. This section of the literature review examines research related to college instructors' attitudes regarding instructional technology.

Azlim, Amran, and Rusli (2015) explored the barriers in utilizing educational technology among lecturers in their teaching practice in community colleges in Malaysia. The study also sought to identify the faculty members' usage of educational technology categorized in three areas: (a) instructor's self-efficacy, (b) accessibility of the educational technology, and (c) technical support in using the technology. Azlim et al., (2015) found the use of educational technology enhanced their teaching practices and student performance. Also, study results indicated the importance of preparing students to become professionals in the field of engineering, accountancy, information technology and communication, hospitality, landscape, and services requires the preparation of students with the utilization of educational technology. Azlim et al. (2015) proposed that despite the positive perspective of instructors utilizing educational technology, insufficient technical support remains a significant barrier to usage. Efforts to enhance services to address the deficiency would help to reduce the deficits posed by the need for technical support directly to individual competence in using IT (Azlim et al., 2015).

Farrah and Sumari (2015) conducted an exploratory research study to investigate pre-service teachers' learning styles and their preferences from amongst 15 technology-based instructional activities and collaborative work tasks. The researchers utilized the Felder and Silverman's online Index of Learning Style (ILS) and a survey questionnaire to measure students' learning styles and preferences about the respective technology tools. The study sample included 53 third year pre-service teachers in early childhood education and the Islamic Studies program at a Malaysian public university (Farrah & Sumari, 2015). The mixed methodology provided both descriptive and inferential statistical findings. The main conclusions from the study were that pre-service teachers tended to be reflective in the way they process information, sensitive in the way they perceive information, visual in the way they receive information, and sequential in the way they understand information (Farrah & Sumari, 2015). The survey findings provided no correlation between students' learning style and preference. The qualitative findings revealed interesting trends that proposed that active, intuitive, and global learners tended to dislike collaborative and group work activities when compared to reflective, sensing, and sequential learners (Farrah & Sumari, 2015).

The challenges presented by technology for students can sometimes undermine efforts to integrate technology in the classroom (Nadeleson et al., 2013). Nadelson et al. (2013) conducted a study with 52 students ranging from ages 19-54 to determine the preferences held by preservice teachers regarding instructional technology. Over 50% of the participants were preservice high school teachers, and the remainder were preparing to be middle or junior high school teachers. The purpose of the study was to determine pre-service teachers' experience, preferences and confidence using instructional technology for learning (Nadelson et al., 2013). The study also investigated whether personal characteristics were determinants of experience, confidence, and preferences.

The results of the study revealed a misalignment between the teacher's comfort, perceptions, and intentions for using technology for teaching (Nadelson et al., 2013). Study findings revealed that it is critical for instructors to have the knowledge, comfort, and vision to use instructional technology to provide productive learning opportunities for their students' learning. The responses to the question about the participants experience using varying types of technology revealed the participants had a higher level of experience using email, learning management systems, computer/laptops, internet-based research and online videos (Nadelson et al., 2013). Also, the respondents also reported a limited experience using tablets, virtual worlds, podcast, and gaming learning. The responses to the question about the faculty's confidence in instructional technology revealed similar findings (Nadelson et al., 2013). A majority of the respondents reported high confidence with email, learning management systems, laptop/desktop computers and cellular phones and moderate confidence with other devices (Nadelson et al., 2013). In response to the question of what technology tools were most likely to be used in teaching, the respondents reported a low likelihood of using gaming, virtual worlds, video conferences/webinars, podcast, smartphones or social networking for teaching. Also, the findings revealed that the respondents comfort in using technology was not linked to the likelihood of using technology, suggesting that confidence using instructional technology might not be related to likelihood to using the technology (Nadelson et al., 2013).

The advancement of new instructional technologies has been widely considered in higher education. Funda (2014) investigated what instructional technologies are used by science teachers. The study involved 63 teachers who had completed an alternative teaching certificate program in one of the largest universities in Turkey. The participants were asked to design a lesson plan utilizing instructional technologies of their choice (Funda, 2014). The study findings revealed the most used instructional technology tool was PowerPoint. Chemistry and biology teachers most widely used PowerPoint slides in their instruction, while physics teachers most widely used whiteboards (Funda, 2014). The least used technology was animations. None of the respondents selected the Internet, interactive smartboards, spreadsheets, computer simulations, and educational software. The reason for this finding may be because they may be unfamiliar with those technologies or they may not know how to use those technologies in their lessons (Funda, 2014).

Despite the emergence of instructional technology in higher education, institutions of higher learning still face challenges obtaining full participation from all the faculty (Martirosyan et al., 2017; Reid, 2017). Reid (2017) conducted a review of the literature to investigate further what barriers prevent the use of instructional technology. One of the major findings of the study was that faculty members adopting new technologies face a series of obstacles related to their lack of self-efficacy with technology. The study results identified five categories of barriers to adopting new technology: (a) individual/personal preferences, (b) beliefs, (c) comfort level, (d) content, and (d) technology mix (Reid, 2017).

Tambunan (2014) investigated teacher information technology competence. The survey research study was conducted with a sample of 245 teachers. The study findings revealed that instructors having the necessary technical skills for designing and implementing instructional delivery to learners had been shown to have student higher achievement using Internet-based laboratories than in classes where students are taught from a traditional classroom approach (Tambunan, 2014). Internet-based delivery was deemed relevant instructional knowledge as combined with computer education experience. The fundamental proposition remains that competent instruction using technology for learning goals must adhere to stringent guidelines for teacher aptitude in designing, implementing, and maintaining high standards (Tambunan, 2014).

In addition, the study findings showed teacher perception of IT connects to the influence: (a) their interpersonal communication with peers, (b) use of IT and how it directly affects teachers' perceptions about IT, (c) interpersonal communication that directly affects teacher self-improvement, (d) the individual teacher understanding of IT directly affect self-improvement, (e) teacher interpersonal communication that directly affects their competency in using IT, (f) IT that directly influences teachers' IT competency, and (g) teacher self-improvement efficacy that directly connects to teachers' IT competency (Tambunan, 2014).

It is a complicated process that typically flows slowly and connects to the general cognitive/intelligence of designers, instructors, and student abilities and skills for integrating technical thinking along with other key factors (Nigmatov & Nasibullov, 2015; Ifenthaler, Sampson, Spector, & Isaias, 2012; Karami, Karami, & Attaran, 2013; Schoenfeld, 2013). "Professional teachers can guarantee the progress and the promotion of society because fostering the development of the next generation of learners is up to them and depends on their professional knowledge which has two kinds of sources; content knowledge and teaching skill" (Karami et al., 2013, p. 36). With the competencies of teachers in using technology, the practical implications for effective instruction and learners achieving their academic goals go hand-in-hand.

Paver, Walker, and Hung (2015) investigated the integration of technology for instruction in community colleges by adjunct professors, as the disparity that adjunct professors represent 68.5% of faculty teaching at community colleges was significant. The researchers found different perceptions amongst full-time faculty and adjunct faculty about the use of instructional technology and its impact on student learning and engagement (Paver et al., 2015). The results demonstrated variance in the intention to integrate technology into teaching by community college adjunct faculty. Further, the findings proposed that community college administrators play a significant role in increasing technology integration (Paver et al., 2015).

Ifenthaler and Schweinbenz (2013) investigated the attitudes of teachers regarding the use of PCs, tablets, and e-readers as it relates to students' success. The researchers conducted summative and formative evaluations to determine the student success rate. Ifenthaler and Schweinbenz (2013) found that teachers are more receptive to integrating technology for daily use when they experience its benefit. The research findings are echoed by the results of studies conducted by Kim, Kim, Lee, Spector, and DeMeester (2013) showing how video games and other technology-related activities better help students learn specific concepts and help student associate fun with learning. While video games and other technology-related activities are better suited for younger students, Kim et al. (2013) also discussed how this is used for older students.

Instructional Technology and Mathematics

The review of the literature examined the rise of technology in education. The use of instructional technology in higher education has also been reviewed. Review of the use of technology in the mathematics classroom was conducted to narrow the literature review search. This section of the literature review discusses findings of studies focused on the use of instructional technology in mathematics.

Jarvis, Lavicza, and Buteau (2014) examined two mathematics departments in which the sustained use of technology was strategically established in a mathematics degree program. The two study sites revealed certain areas of overlap, similarity evident in the areas of program rationale, curriculum and assessment practices, obstacles that must be overcome in planning and implementation, and key strategies that were found to be particularly advantageous (Jarvis et al., 2014). Also, the researchers found similar results at both sites where students were encouraged with the use of technology. The study concluded that the use of technology heavily impacted professors' perspectives regarding the successful use of technology in the math classroom (Jarvis et al., 2014).

Zientek et al. (2015) compiled the findings from a statewide survey of developmental mathematics instructors seeking to determine the preferences and priorities about instructional technology in mathematics classrooms. The purpose of the study was to gain information that can be utilized by educators and administrators to prepare professional development opportunities for the teaching corps and to assist in the understanding of the best selection of technology for mathematical instruction based on teacher preference. Study findings revealed mathematic instructors were familiar with and considered the use of educational technology a priority, and the use of technology was reported higher in full-time instructions based instructional software and calculators as the most important technology for content delivery

(Zientek et al., 2015). The overall findings support the contention that math instructors are favorable to and have a reasonable knowledge of instructional technology in the classroom (Zientek et al., 2015).

Hopkins, Lyle, Hieb, and Ralston (2016) investigated the challenges college students face retaining the knowledge they acquire in their classes, especially in cumulative disciplines such as engineering, and the techniques that might improve retention. One of the methods examined involved retrieving course content following initial learning. Hopkins et al. (2016) reported that students' spaced content was better retained than massed content in the pre-calculus course. Also, students whose retrieval practices were spaced compared to those for whom all practices were passed, performed better on the final exam in the pre-calculus class and on exams in the calculus class. Hopkins et al. (2016) found that spaced retrieval practice can have a meaningful, long-lasting impact on educational outcomes.

Tran et al. (2011) conducted a correlational research study on teacher instructional practices to gain an understanding of effective mathematics teaching and learning methods. The study findings suggested a strong correlation between math participation and the integration of math elements into the formal curriculum to express an understanding of how instructional practices increase student learning. Further, the researchers explored the changes in teaching efficacy and practice with the use of the computer-based approach to mathematics' instruction (Tran et al., 2011).

Agyei and Voogt (2015) investigated the impact of the use of technology on student mathematics achievement. The data were conducted utilizing interviews with 12 teachers and three school leaders. The findings of the study showed a difference in the use of technology based on a variety of factors, such as large classrooms, electrical and technical problems, lack of time, and lack of technology tools (Agyei & Voogt, 2015). The study also revealed that the support of school management was a critical factor in determining the use of instructional technology.

Eyyam and Yaratan (2014) investigated student attitudes toward the use of technology in the mathematics classroom. The study involved the random selection of 41 seventh grade students from three mathematics classes in a private secondary school to form the experimental group and 41 seventh grade students from two mathematics classes to form the control group. The experimental group was taught lessons using instructional technology, and the control group was taught the same lesson with the use of traditional methods (Eyyam & Yaratan, 2014). The study findings revealed that teaching, learning, and technology worked synergistically together and had a positive impact on student achievement and success. In addition, the researchers found that within sound educational settings students became: (a) capable information technology users; (b) information seeking, analyzers, and evaluators; (c) problem solvers and decision makers; (d) creative and active users of proactivity tools; (e) communicators, collaborators, publishers, and producers; and (f) informed, responsible, and contributing members of society (Eyyam & Yaratan, 2014). The research findings provided implications for future professional development programs aimed at developing technology integration knowledge and skills.

Foshee et al. (2016) conducted a study to improve the mathematics performance of first-year college students. The study sample size included 2880 students enrolled in a single semester of remedial mathematics course. The purpose of the study was to investigate how the integration of faculty-led instruction with technology-enhanced learning (TEL) impacted student mathematic performance. The study findings were that TEL had a positive, statistically significant effect on student learning and academic competence. (Foshee et al., 2016).

Javis, Lavicza, and Buteau (2013) research contributed to the growing number of international studies focused on the Computer Algebra Systems instructions and its potential to positively impact teaching and learning of mathematics throughout the education system. The researchers investigated the impact instructional technology has on mathematics learning and engagement. The study was conducted in two mathematics departments. The research findings indicated that systemic methodology alters the way instructors teach. (Javis et al., 2013). Also, the research study results from the two sites demonstrated numerous challenges to the implementation of technology. The researchers suggested the need for further investigation to help the successful transition to technology-based mathematics because of its high level of potential in meeting the needs of the millennial generation (Javis et al., 2013).

Interactive WhiteBoard Technology/Smartboards

De Vita, Verschaffel, and Elen (2014) conducted a three-step systematic literature review involving retrieval, selection, and analysis of the literature focused on interactive whiteboard technology. The analysis included several criteria: (a) large-scale studies not reliant on experimental methods, (b) quasi-experimental research designs investigating the impact of IWB use on student gains, (c) case studies from schools often integrated with the teacher and student interviews, and (d) contributions reporting interventions aimed at enhancing IWB use. The literature review demonstrated that in recent years, interactive whiteboards (IWBs) had become a regular part of the equipment of many classrooms, especially around the world. Also, the findings provided extensive evidence on demonstrating the value of IWB in mathematics education (De Vita et al., 2014).

Bidaki and Mobasheri (2013) conducted a study to assess interactive whiteboard's impact on whole-class teaching. The researchers found that interactive whiteboards enhanced pedagogical skills and increased student attention and saved instructors time. Bidaki and Mobasheri (2013) concluded that the use of interactive smartboards had improved some students' abilities to work in teams and to participate in scholarly discourse. However, one of the challenges to the new technology is the problems related to training teachers, reducing the expenses for buying IWBs and providing more practical IWB software. Primarily, the cost of the technology is a challenge, despite the efficacy existing in the use of the software (Bidaki & Mobasheri, 2013). The researchers concluded that the effectiveness of IWBs contributed to the problem of integrating it into classroom delivery. The efficacy of IWBs in foreign language classes is manifested in several ways: (a) assisting the presentation of new linguistic and cultural elements, (b) helping interaction with the class, and (c) supporting the teachers' organizational skills (Bidaki & Mobasheri, 2013). The challenges found in the technology are the need for greater training and personal development regarding integrating technology into the classroom. Bidaki and Mobasheri (2013) concluded that interactive whiteboards modify the methods of teaching in a variety of subject areas providing positive reinforcement and delivery of pedagogy.

Emeagwali and Naghdipour (2013) investigated the use of interactive whiteboards to increase student learning and engagement in universities in North Cyprus. The researchers investigated the perceptions of instructors and teachers on the efficacy of interactive whiteboards in the classroom. The study involved a total of 350 faculty and students from six universities (Emeagwali & Naghdipour, 2013). The findings demonstrated that 50% of all universities perceived the use of interactive whiteboards as useful in the learning and teaching processes. The researchers concluded that today's students present with skill sets astronomically different from that of previous generations of learners (Emeagwali & Naghdipour, 2013). Consequently, the researchers suggested the global cultural disposition of today's students towards learning can be argued to be distinct from their counterparts in the past. Further, there is a need to provide students with updated access to technology that caters to cognitive and learning predispositions of modern-day students (Emeagwali & Naghdipour, 2013). Ultimately, the study findings revealed that both teachers and students have a high perception of the use of interactive whiteboard in their classrooms. Also, the overall usage has been most favorable with the rapid adoption of the interactive whiteboard (Emeagwali & Naghdipour, 2013).

Heemskerk, Kuiper, and Meijer (2014) investigated the benefits of using an interactive whiteboard and a virtual learning environment on mathematics performance and motivation. The researchers examined the short-term effect of an interactive whiteboard and virtual learning on students' performance in math and at the long-term impact of the use of the IWB in mathematics lessons on students' motivation for mathematics. Heemskerk et al. (2014) monitored the mathematics performance of the students for five years in classes taught with an Interactive White Boards. The study findings did not determine any relation between frequency of being taught with an IWB and mathematics performance. However, the results of the study did demonstrate student motivation for math increased in technology-equipped classrooms where lessons were maintained in virtual learning environments. Student motivation for mathematics appeared to be positively related to the combination of lessons made for the IWB and availability of these lessons on the VLE used mostly to prepare for tests and examinations (Heemskerk et al., 2014).

Ling et al. (2016) investigated the factors that influence the behavioral intention of teachers' use of interactive whiteboards in western countries. The quantitative study involved surveying 55 teachers to investigate whether the Unified Theory of Acceptance and Technology model influenced teacher's behavioral intentions to use interactive whiteboards. The four fundamental constructs were: (a) performance expectancy, (b) effort expectancy, (c) social influence, and (d) facilitating conditions. Ling et al. (2016) found that the use of interactive whiteboards was beneficial to both students and teachers.

Al-Qirim (2016) explored the use of interactive whiteboard Technology (IWBT) at UAE University. The researcher found that IWBT was the most preferred instructional technology for use in the college classroom. Results also showed that the smartboard increased the effectiveness of qualitative and quantitative teaching (Al-Qirim, 2016. One of the major conclusions of the study was that IWBT promises to improve education and represents the opportunity for student-centered collaborative environments fostering increased student achievement. Al-Qirim (2016) concluded that there is a need for greater research to investigate the use of IWBT in particular subjects and a comparative analysis of the attitudes of the teachers versus the students.

Erbas et al. (2015) explored the effect of technology-supported learning environments utilizing an interactive whiteboard (IWB) and NuCalc graphing software. The research study participants were 65 recent high school graduates preparing for entrance into higher education universities. The study results revealed the use of the IWB and NuCalc graphing software had positive effects on the student's attitudes toward technology and mathematics (Erbas et al., 2015). Also, the study results demonstrated student reasoning and interpretation skills regarding graphs of quadratic functions were improved with the use of IWB and NuCalc graphing software (Erbas et al., 2015).

Kilic, Güler, Çelik, and Tatli (2015) investigated the attitudes of mathematics teachers and their use of smartboard technology in mathematics pedagogy. The study findings indicated mathematic teachers had positives attitudes using the interactive whiteboard in teaching math and preferred it to traditional blackboards. The study also revealed the need for greater training as the integration of smart board technology would inevitably become the standard in education classroom delivery Kilic, et al. (2015). The researcher's findings also included the ability of users to use whiteboards in an educational environment where knowledge can be transferred; using technology in the real word gives students the opportunity to be more actively involved in the integration. Kilic et al. (2015) concluded that when student's self-efficacy increases their usage increases.

Sumak & Sorgo (2016) reported that the integration of interactive whiteboards into classrooms provides challenges for institutions of higher learning experiencing resistance from some faculty. The study population included 18800 elementary school teachers and 7300 upper secondary school teachers and approximately 1700 professors at higher education institutions. The findings from the study indicated that the use of interactive whiteboards was higher in elementary schools where the respondents were self-reported experienced technology users with greater than three-year experience. The study findings demonstrated that individuals who had previous use of technology had greater utilization of interactive whiteboards (Sumak & Sorgo; 2016).

Ormanci, Cepni, Deveci, and Aydin (2015) conducted a thematic review of the use of interactive whiteboard in science education. The articles utilized in the study were obtained from various research databases focused on technology. The findings of the study demonstrated that teachers using interactive whiteboards enabled features such as highlighting, screen-shading, spotlighting, annotating, capturing, recording, handwriting recognition, zooming, network screen sharing (Ormanci et al., 2015). Whiteboards also help students focus attention on the class content, permits them to visualize processes, more quickly identify mistakes, and promotes the sharing of knowledge through listening and talking. Finally, the immediate access to the Internet provides teachers direct access to a multitude of educational websites, videos, photos and textual materials that substantially enriches the classroom teaching environment. The study findings showed that interactive whiteboards provide benefits to teachers and students when implemented into the classroom (Ormanci et al., 2015).

International Research on the Use of Interactive Whiteboards

Jabbour (2013) investigated the impact of the use of mobile technologies on learning in Lebanese higher education. The experimental research design consisted of two sets of approximately 20 college students and the tool used was a survey. The two separate groups included one class with the instructional technology available and used and the other class where technology was not utilized (Jabbour, 2013). The research questions were focused on student attitudes toward technology, students' learning achievement, the impact of mobile technologies on achievement and the impact of mobile technologies on instructional strategies. The study results confirmed mobile technology does influence student interaction between students and between students and instructor interaction. However, one of the study limitations is there was no real correlation between learning outcomes and the specific types of technology used by the study participants (Jabbour, 2013).

The importance of fostering the development of the next generation of teachers is an important responsibility for institutions of learning. Karami et al. (2013) conducted a study to investigate the effect of integrating problem-based learning with information and communication technology in the development of content knowledge and teaching skills of trainee teachers. The research design was quasi-experimental and involved two groups of teachers at the training center of Hamadan, Iran (Karami et al., 2013). The study findings suggested that trainee teachers developed greater professional content knowledge and teachings skills when problem-based learning with ICT was utilized in their development. Also, the integration of problem-based learning with ICT helped student-teachers to learn better the mathematical concepts of elementary schools and apply them in practices (Karami et al., 2013).

Sad and Ozhan (2012) investigated the views of primary students about interactive whiteboards in the classrooms using a qualitative phenomenological study to collect the attitudinal and pedagogical perspectives of use of interactive whiteboards in the classroom. The fifty study participants were selected utilizing a purposive sampling method to select the participants who were then selected as part of a focus group. The research findings were that students referred primarily to the practical and economical use of the interactive whiteboards as the most attractive feature (Sad & Ozhan, 2012). The second attractive feature of the interactive whiteboard was its efficacy when viewing geometrical shapes and colors. Finally, the researchers reported that the interactive whiteboard was effective in saving instructional time (Sad & Ozhan, 2012). The research findings also reported what students found least attractive about interactive whiteboard. The least attractive feature was technical problems, either in hardware or software failure or the lack of expertise of the instructor (Sad & Ozhan, 2012).

Akdemir and Yasaroglu (2013) conducted a study comparing the use of traditional blackboards and the use of the interactive whiteboard confirming higher student success when the IWB was implemented in the classroom. The study sample included 183 students who had used the Smartboard during the 2012-2013 school year and the 36 teachers of the students

(Akdemir & Yasaroglu, 2013). The findings of the study showed that students embraced smart boards and believed school participation was increased by its use. The teachers also agreed that the use of smart boards increased the interest and motivation of the students. While the technical problem was listed as one of the main challenges in the integration of technology, the benefits and advantages of smartboard outweighed the challenges (Akdemir & Yasaroglu, 2013).

There is literature available that maps out the integration and use of various types of technology over the past decades in the education system as a whole. According to Higgins et al. (2012), research over the last 40 years on the impact of technologies on learning indicates positive benefits. Some forms of technologies applied in education have a more recent history. For instance, distance learning that requires communication technology has grown over the last two centuries (Moore, Dickson-Deane, & Galyen, 2011). Moore et al. (2011) agreed with Higgins et al. (2012) that new technologies have transformed the nature of education in the past decades. These new technologies provide a means for teachers and learners to interact with one another regardless of their geographical locations.

The use of interactive whiteboards as educational resources in higher education is being used all over the world in such countries as Romania, USA, Canada, Mexico, Taiwan, Japan, Singapore, Malaysia, China, and Russia (Mata, Lazar, & Lazar. 2016). However, much of the research on interactive whiteboard technology has been focused on primary education rather than in universities. Mata et al. (2016) found there were very few standardized tools to assess students' attitude towards using IWB at the level of higher education. Also, the researchers found that the emphasis of the research has focused more on studies that measure the impact of IWB upon the results of learning rather than research aimed at exploring student attitudes and perceptions regarding these new technologies in the process of education (Mata et al., 2016).

Therefore, Mata et al. (2016) conducted a quantitative study to explore the effects of interactive whiteboards on learning. The study consisted of a sample of 246 undergraduate, graduate, and doctoral students. The study focused on four areas which included the availability of IWB and the components of pedagogy, psychology, and group interaction (Mata et al., 2016). The results of the study revealed relevant differences between students at different levels regarding attitude towards certain factors that define pedagogical, psychological, group interaction, and the availability of IWB in the classroom. The results of the study also revealed that most students strongly agreed with the use of IWBs in the classroom (Mata et al., 2016). Also, the researchers concluded that there is no standardized tool to assess the students' attitude towards using IWB at the level of higher education. Finally, the researchers found that research has already moved toward the focus of student attitudes on the use of tablets (Mata et al., 2016).

Turel and Johnson (2012) examined the usage and behaviors associated with the interactive whiteboard in an academic setting in Turkey. The study evaluated both teachers' perceptions regarding the use of instructional technology. The findings of the study demonstrated teacher's belief in the utilization of the interactive whiteboard to facilitate learning and instruction under the flowing three conditions: (a) collaboration with colleagues, (b) training for effective instructional strategies using IWB, and (c) more regular teacher use of IWBs to improve IWB competency (Turel & Johnson, 2012).

Challenges to Integrating Instructional Technology in the Classroom

Despite the rise in the use of technology in higher education delivery, institutions of higher learning continue to report lags in usage without real understandings of the barriers leading to the lack of use of instructional technology. The researchers investigated obstacles presented to institutions of higher learning in the implementation of technology. The barriers included: administrative structure, legal issues, organizational change, technical expertise, support, student support services, and faculty compensation and time. Reid (2014) concluded that there is an unlikelihood that the full benefits of technology can be realized without institutional changes. Further, findings suggested the unavailability of technology are obvious barriers, but poor user self-efficacy wrought the greatest impact. The importance of the findings can be found in the understanding that awareness of the user's barriers helps in strategizing to improve student performances (Reid, 2014).

In response to the evolution of instructional technology in 21st-century education, Thiele, Mai, and Post (2014) evaluated web applications currently being integrated into the classroom and provided an overview of their integration into the modern day classroom. The case report described how instructional technology is being integrated into face-to-face classroom educational delivery. Three main points emerged from the analysis of the survey responses: (a) students have basic knowledge of computer concepts but are limited in the use of the web, (b) students like technology in the classroom, and (c) students recognize the limitation of technology is based on the faculty and student's comfort level with technology (Thiele et al., 2014). The researchers concluded that technology can enhance learning in the classroom but requires student-centered integration whereby students use is contingent upon their comfort level with technology.

Amirault (2015) suggested one of the challenges faced by the educator regarding instructional technologies is the rapid replacement of newer upgrades in technology. The researcher defined this phenomenon as technology transience, whereas distinct incarnations of technology change at the rapid pace, the length of time they are in existence, and their use within a historical context. Also, lifespan development, societal adaptation and many other factors involving technology create challenges in the integration of instructional technology (Amirault, 2015).

Fang (2014) predicted the interaction between learners and the educational content they receive would be changed to a more interactive electronically delivered content and away from the tradition paper-driven pedagogy. The researchers explored the numerous perspectives about technology and its emersion into 21st education. Some researchers believe that the way in which education will be permanently changed is the interconnected network of learners with their instructors as the facilitators of the learning process from the instructor-to-student orientation (Amirault, 2015; Ferster, 2014; Liu, 2013).

Hora and Holden (2013) proposed that faculty adaptation to technology-based innovations in education is slow and inconsistent, despite the role instructional technology is having in teaching reform in the 21st century. The researchers conducted an exploratory study drawing on the system of practice theory to provide the framework for creating accurate accounts of technology use. Hora and Holden (20130 found that technology plays a vital role in teaching reform efforts at the postsecondary education level. Results included: (a) the awareness of the local resource base for the use of technology, (b) the decision-making process in tool use, and (c) the confirmed classroom use of technology. The findings from the exploratory study revealed that adoption, adaption or rejection of integration of technology is influenced by the potential user's pre-existing beliefs and goals, past experiences with technology innovations, the perceived affordance of particular tools, and the cultural conventions of the disciplines (Hora & Holden, 2013). One of the areas of pedagogy where there is limited use is with mathematics and biology. The researchers concluded that greater understanding of the insights available regarding technology should be integrated into design strategy, especially in assuring that innovations resonate with the existing belief system and practices of the targeted users (Hora & Holden, 2013).

Considerable efforts are being made by the federal government institutions of higher learning to adopt inquiry-based teaching methods, particularly in undergraduate math and science, as these disciplines are viewed as central to national economic competitiveness (Office of Technology and Policy, 2014). Pedagogical advances combining new technologies and constructivist teaching approaches are an emerging strategy being used in educational reform at the postsecondary level, but evidence demonstrates that the adoption of instructional technology is limited and slow. The white paper proposed that the lag in use of technology cannot be solely blamed on the faculty, but instructional designers and policymakers are also faced with the challenge of introducing instructional technology must also be cognizant of the need to introduce technologies into established patterns of tool use and educational practices (Office of Technology and Policy, 2014).

In consideration of the focus of this study, it was important to highlight the data as it relates to mathematics. Hora and Holden (2013) found that math instructors relied mostly on single instructional technology, such as the chalkboard, with a secondary set of tools used less frequently. The use of chalkboard was observed in 75% of the users represented in the study, indicating that the chalkboard was the primary instrument used in math classrooms particularly with the instructor writing out equations, theorems, or definitions, followed by a verbal elaboration on these points. Also, the chalkboard was also observed with faculty working out computational problems. Hora and Holden (2013) concluded that this data indicated the chalkboard could be used to not only present theorems and other rules for rote memorization, but also to engage in extensive computational problem solving, and therefore the emergence of the interactive whiteboard might be an excellent integrative tool.

Reid (2014) posited that despite the research proposing the value of technology use and the millions of dollars spent on instructional technologies, higher education administrators are reporting a lag in usage in the classrooms. The researcher conducted a review of the literature focused on instructional technology to explore and understand the barriers to instructor's adoption of instructional technology. The findings revealed several layers of barriers: technology, process, administration, environment, and faculty (Reid, 2014). The list of barriers provided a framework for institutions as a starting point for adopting instructional technology understanding some of the obstacles and increasing the success rate of the adoption of new technology into the pedagogy process.

According to Potter and Rockinson-Szapkiw (2012), one of the challenges of the integration of technology in the classroom is the very often underused technology. The researchers identified a primary reason for the lack of technology integration is ineffectively developed professional development opportunities for teachers. The findings of the inquiry led to the recommendation of a sustained, administratively-supported and mentor-supported approach to professional development rather than utilization of the ineffective traditional approach (Potter & Rockinson-Szapkiw, 2012). Finally, the researchers propose the importance of considering the role of teachers' attitudes and beliefs on their use of technology in professional development is also discussed

Summary

The purpose of this quantitative study is to gather data on community college math students' degree of learning engagement when smartboards are used in the classroom. A compilation of articles about recent and important developments in key aspects of instructional technology has been published in the research literature (Alarcia & Bravo, 2012; Johnson & Johnson, 2014; Hora & Holden, 2013; West & Borup, 2014).

The rise of instructional technology in higher education (Ellwein et al., 2014; Ferster, 2014; Huang, 2010), its use in mathematics (Jarvis et al., 2014; Gerhard & Burn, 2014; Zientek, et al., 2015), and its impact on student interaction (Delialioglu, 2012; Hora & Ferrare, 2013; Pittman & Edmond, 2016; Mango, 2015) is widely explored by researchers. Some challenges associated with the integration of literature in the classroom include instructors' attitudes and proficiency with technology (Azlim et al., 2015; Reid, 2014; Farrah & Sumari, 2015; Nadelson et al., 2013).

The use of instructional technology in higher education is revolutionizing the delivery of education in institutions of higher learning with the use of interactive whiteboards (De Vita, Verschaffel, & Elen, 2014; Bidaki & Mobasheri, 2013; Emeagwali & Naghdipour, 2013; Heemskerk, Kuiper, & Meijer, 2014). Instructional technology has been found to be an effective instructional tool in classrooms in the United States (Al-Qirim, 2016; Erbas et al., 2015) and abroad (Ormanci et al., 2015; Yildiz & Tufekci, 2012; Mata et al., 2016).

Several studies have identified the positive impact of instructional technology on student learning and engagement (Kahu, 2013; Hodges & Prater, 2014; Reiser & Dempsey, 2012; Stevens & Kirst, 2015). Although some studies have indicated factors, such as the unavailability of technical support and training (Reid, 2014; Thiele et al., 2014), and the ever-changing evolution of technology (Amirault, 2015; Ananthanarayanan, 2015), as challenges to institutions of higher learning in the implementation and integration of the classroom (Paver et al., 2015; Ugur & Guven, 2013).

While a number of technology devices are available for use in education and are widely discussed in the research literature (Dell et al., 2012; Drayton, Falk, Stroud, Hobbs, & Hammerman, 2010), the use of the interactive whiteboard in mathematics and science classrooms have proven to be highly effective in instruction (De Vita et al., 2014; Bidaki & Mobasheri, 2013; Emeagwali & Naghdipour, 2013).

The technological innovations impacting education have made a tremendous impact on higher education in math courses utilizing a wide range of resources and various mathematical software systems (Hwang & Tsai, 2011). The use of instructional technology in community colleges is an area with limited research findings and the findings of this review of the literature support further study.

Chapter 3: Research Method

The integration of technology in the classroom has become a standard in educational delivery, including post-secondary education (American Mathematical Association of Two-Year Colleges, 2007). The problem to be addressed in this study is that technology is becoming an important teaching tool in mathematics (Blair, 2012), but the integration of technology as a teaching tool in community college math classrooms has not yet been fully embraced and funded (AMATYC, 2007). The purpose of this quantitative survey study was to gather data on community college math students' degree of learning engagement when Smartboards are used in the classroom. Community colleges are a vital part of the postsecondary education delivery system. The following questions guided the research:

Q1. How do community college math students self-report higher than average degrees of learning when a whiteboard is used in the classroom?

H1a. Community college math students' do not self-report a significantly higher degree of learning engagement when interactive whiteboards are used in the classroom.

H1o. Community college math students' self-report a statistically significantly higher than average degree of learning engagement when interactive whiteboards are used in the classroom.

Q2. To what extent if any, do community college math students self-report higher than average degrees of learning in Math 100 as compared to Math 119, or vice versa, when whiteboards are used in the classroom?

This chapter begins by introducing the research design used in this study and the rationale for its use. The discussion will be followed by a description of the data collection methodology and data analysis procedures. Finally, the assumptions, limitations, delimitations, and ethical assurances will be described.

Research Methodology and Design

A non-experimental design was selected for this study, as it is appropriate when the research questions or hypothesis refers to a single variable rather than a statistical relationship between two variables (Agyei & Voogt 2015; Muijs, 2011; Parsad, 2003). The non-experimental design allows a researcher to gather evidence, conclusions, and determine whether a hypothesis is correct (Agyei & Voogt 2015; Muijs, 2011; Parsad, 2003). The disadvantage of a non-experimental design is that it only uncovers a relationship, but does not provide a conclusive reason for why there's a relationship. A correlative finding does not reveal which variable influences the other (Bordens & Abbott, 2002). The non-experimental research methodology was used in the study where the natural setting provided an opportunity to collect data within a naturally existing attribute.

There were various other research strategies considered for the study (i.e., experimental design, descriptive study, quasi-experimental design). Experimental designs involve the manipulation of predictors. However, utilizing an experimental design, in a community college setting where the results could place some students at a disadvantage provides an ethical challenge (Bordens & Abbott, 2002). The use of a descriptive research method would provide a way to questions that could not be examined with experimental procedures, but it cannot control events to isolate cause and effect (Finlay, 2009; Ulrich & Ozhan, 2012). The use of quasi-experimental designs provides greater validity, and more feasibility than descriptive research method despite the time and logistical constraints, but the limited number of variables controlled provide less causal claims (Gozu, Anandarajan, & Simmers, 2015; Schoenfeld, 2013).

While there has not been a lot of empirical studies directed specifically at determining the impact on learning engagement of interactive whiteboard/smartboard research findings in community college math classrooms, there has been a significant amount of data focused on the impact of technology in post-secondary education. Therefore, a quantitative survey study with a non-experimental design was the best research method and design to measure community college math students' degree of learning engagement when Smartboards are used in the classroom because it is in a natural or authentic environment and provided the opportunity for generalizable data. The non-experimental research design study the phenomenon, people or situation in a natural setting without manipulating it, and consequently, the findings can be an applied to a wide audience (Radhakrishnan, 2013).

Population

According to the National Center for Education Statistics (2016), there are 17.3 million undergraduate students in the United States. The population defined in this study is limited to college students in the United States and are not inclusive of other countries whose organizational features and structures are different from the United States and would require utilizing different inquiry (National Center for Education Statistics, 2016).

The population defined in this study is further limited to community college students in the United States. According to the AACC (2016), approximately 7.3 million undergraduate students were enrolled in community college. However, as four-year institutions vary differently in mission than those of community college students, the population of this study has been limited to United States community college students.

Additionally, while all United States higher education institutions maintain universal delivery standards, the high levels of diversity present particularly in community colleges, further limit the population in this study. The different culture and values present in diverse student populations may also impact learning engagement (National Center for Education Statistics, 2016).

Sample

The convenience sample used in the study was approximately n=120 math students collapsed into two groups, Math 100 and Math 119, in four classrooms. The Math 100 course is a degree required a course and prerequisite course in Math 199 which is based on the student's major. The two groups of students were taught in math classes not equipped with an interactive whiteboard for four weeks and then later taken to the classroom lab equipped with interactive whiteboard technology. The two groups were taught by four instructors as the college does not allow instructors to teach more than one course in the summer session. The method of recruitment used for the study was to provide the students of the four math classrooms with an invitation to participate in the study and verifying a sufficient number of participants, comprising a suitable sample fitting within the parameters of the study as the majority of community college math students have experience with Smartboard technology in their classroom (American Mathematical Association of Two-Year Colleges, 2007). The sufficient sample size was generated conducting a power analysis assuring an adequate sample size for the study.

Materials/Instrumentation

An adaptation of 13 questions from a Smartboard student survey (Smartboard Student Survey, 2010) was used for this study along with three demographic questions added. The survey, delivered through Qualtrics, provided the ability to collect data focused on the research questions. The online survey instrument was a 4-point Likert-scale: strongly agree, agree, disagree, and strongly disagree, rating the students' perceptions of their degree of learning engagement in math classes equipped with Smartboard technology (see Appendix A). The demographics section provides the ability determine the gender, age, and race of the participants of the study. This way study conclusions included specific subgroups if applicable and demographic trends within the data if any can be found, would ensure the results are not generalized beyond the parameters of the sample from which they were drawn (Teclaw, Price, & Osatuke, 2012).

Operational Definitions of Variables

The dependent variable consisted of the specific math classes used for the study who participated in the study of Smartboard technology. The independent variable is the student's degree of learning engagement as measured by the Smartboard Survey. Also, the dependent variable

Learning engagement. Learning engagement is an ordinal, predictor variable that will be measured using 13-item survey with a 4-point Likert type scale ranging from strongly agree to strongly disagree and three demographic questions.. In this study student engagement was operationalized as "the degree of student engagement" and measured using a thirteen survey instrument (see Appendix A). Learning engagement will be coded as: 1 = strongly agree, 2 = agree, 3 = disagree and 4 = strongly disagree.

Data Collection, Processing, and Analysis

After receiving Northcentral University IRB, community college study site, and math professor approvals, students in four math classrooms at the community college study site were invited to participate in the study. The researcher visited each class at 10 minutes before the end of the class to tell the students about the research study and passed out an invitation to participate. The invite contained the URL of the online informed consent and was also written on the Smartboard. The URL was the informed consent pre-page of the Qualtrics Smartboard Survey on the Smartboard. Students were able to access it immediately or later on their Smartphones or personal commuters and read the informed consent. To participate, they clicked the link at the end of the informed consent that takes them to the Smartboard survey. Clicking the link indicated they consented to participate in the study. Those who completed the survey were asked if they would like to enter a drawing for four $20 gift cards as a thank you for participating in the study, click a link at the end of the survey that takes them to a separate website page to sign up to be entered into the thank you drawing. Completion of the drawing entries was maintained separately from the data collection further protecting the anonymity of the participants.

The invitation included the purpose of the study, statements of anonymity; highlight the conditions of their volunteer participation, ethical assurances and a document of informed consent. The surveys were collected by the researcher via Qualtrics to maintain the anonymity of the participants by giving each survey respondent an anonymous ID. The data were analyzed using statistical software, SPSS, to measure the degree of learning engagement. The participant's responses will be summed to allow for direct assessment of learning engagement in classrooms equipped with smartboards, as self-reported by community college math students. In addition to the findings generated from the data analysis, a follow-up analysis will be conducted comparing the findings from the two different math classes to identify trends demonstrated in the different math subjects.

Assumptions

There were three assumptions for the study. The first assumption was that the respondents would provide honest and candid answers, providing valuable feedback to the research questions. The second assumption was that using an online survey would provide the study with proposed sample size needed for meaningful analysis. The final assumption was that sample size selection would be sufficiently within the parameters of convenience sampling used in quantitative research (Saunders, Lewis, & Thornhill, 2012).

Limitations

One limitation of this research was that the population was drawn from community college students in an Eastern state, which may not be generalizable to all U.S. community colleges, due to differences in student demographics between the study site and other community colleges. Another limitation was that all of the data collected was self-reported so there was no guarantee that the participants' responses would not be skewed by their mood, perceptions of the institution or instructor or perceived anticipated preferable response (Christensen, Johnson, & Turner, 2011).

Delimitations

A delimitation of the study was the sample extracted from math students in classrooms equipped with smartboards. The scope of the study was specifically limited to math classes as the study is most focused on the learning engagement of math students. Another delimitation of the study was that using an online survey to provide students with an easy way of participating in the study on their own time and pace, rather than using a paper and pencil method that should be completed in the classroom. A final delimitation is the study was explained to the students in the class who would be able to answer any questions in person, so they may make an informed decision to, or not to, participate in the study.

Ethical Assurances

The researcher adhered to the guidelines of Northcentral University's Institutional Review Board throughout the study. Before any data collection was initiated, the researcher sought approval from Northcentral University's IRB, and the community college study site and the math professors to survey their classrooms. The ethical principles of beneficence, respect for persons and justice as outlined by the Belmont Report (Greaney et al., 2012; Horner & Minifie, 2011) will be used when conducting the research study. Each of the study participants was given an informed consent providing sufficient detailed information on the study which included the purpose, expected duration, procedures, and information on their right to decline or withdraw and the benefits and risks of the study. The non-experimental research design and the survey methodology minimized the risk to the study participants.

Summary

The purpose of this quantitative survey study was to gather data on community college math students' degree of learning engagement when smartboards are used in the classroom. A non-experimental research design was utilized in the study. The data collected is the self-reported impressions of the respondents related to their perceptions of the impact instructional technology has on learning engagement in a math classroom.

The population from which the sample was generated was community college students in the United States. The sample included 100 community college students in four different math classes equipped with smart board technology at a community college in an Eastern state. The data were collected through the administration of an anonymous survey comprised of previously published analytics using a 4-point Likert-type scale. Additionally, a follow-up analysis was conducted reviewing the data to identify any emerging trends related to the demographics of the participants.

The data collected from the surveys were analyzed utilizing SPSS software. The survey measured the self-reported degree of learning engagement in classrooms equipped with Smartboard technology. The independent variable was learning engagement, and the dependent variable was classrooms equipped with Smartboard technology. The findings provided insight into the degree of learning engagement in math classes equipped with Smartboard technology. The results of the study contributed to the body of knowledge focused on the relationship between student engagement and classroom instructional technology.

Chapter 4: Findings

The chapter presents the findings of the study. The purpose of this non-experimental study was to investigate community college math students' degree of learning engagement when interactive whiteboards are used in the classroom. The non-experimental design was high on realism and low in control of the variables. The descriptive-type study did not require any experimental approaches. The chapter includes a description of the study, a detailed description of the research questions and which analysis was used to obtain results, detailed demographics of the survey participant group, description of the Quadrics survey, and data collection process. The study was conducted utilizing a non-experimental survey research methodology with a single variable to gather evidence and conclusions about the research question and hypotheses. The study consisted of 110 participants. The demographic information collected from the study consisted of the respondent's age, gender and race/ethnicity

Validity and Reliability of the Data

Validity and reliability are important consideration to generate credible results in a research study and were important considerations in the survey research study (Sullivan, 2011).. The approach to inquiry used in this study was survey research. The survey research method was used in this study because it provided the opportunity to provide a quantitative description of trends, attitudes and opinions of the respondents (Babbie, 1990).

Validity. The validity of the study was established by achieving the hypothesized value expected for the study. The biometric soundness of the study was established in several ways. The survey questions were in direct relation to the study's hypothesis that math instruction in community college settings equipped with interactive whiteboards has higher levels of student learning engagement. Also, the survey used in this study was previously used and had been verified and tested (Smart Resources, 2010). The study had been designed for research studies aimed at determining the efficacy of interactive whiteboard in promoting student engagement. The two-year study had similar goals as this current study, and the instrument was successful in generating important data supporting the hypothesis related to its impact on student engagement.

The incremental validity of the study was increased by the research study findings which are focused on the use of instructional technology in community college math classroom. There is extensive research on the subject of technologies impact on student engagement in higher education (Gunic & Kuzu, 2014; Han & Fiklestein, 2013; Parkin, Hepplestone, Holden, Irwin & Thorpe, 2012; and Wankel, 2013). However, the research is limited to community college instruction (AMATYC, 2007). The study findings contribute to the current research on instructional technology and its impact on student engagement.

Reliability. High-quality tests are important to evaluate the reliability of data supplied in an examination or a research study. Tavakol and Dennick (2011) describe Alpha as an important concept in the evaluation of assessments and questionnaires and mandatory for the researcher when estimating quantity and to increasing validity and accuracy of the interpretation of their findings. The Cronbach's Alpha test is a most common measure of internal consistency or reliability in survey research where multiple Likert questions are posed to the respondents (Cronbach, 1951; Nunnally, Bernstein, 1994). The Cronbach's alpha test provides researchers with an overall reliability coefficient for a set of variables. A Cronbach's Alpha test was conducted on the study findings to measure internal consistency. The Cronbach's Alpha test not only averages the correlation between every possible combination of split halves but also allows multi-level responses (Tavakol & Dennick, 2011). Also, the test also considers the size of the sample and the number of potential responses. The reliability statistics demonstrated a

Cronbach's alpha as .952, which indicates a high level of internal consistency with the study sample (Cronbach, 1951; Nunnally, 1978).

Results

The results section of this chapter will provide answers to the research study and introduce the data collection. First, the demographic data collected in the study will be presented. The demographic information was collected to help answer the research question by getting a better description of the sample.

After the demographic data is provided, the results of the descriptive analysis will be presented to demonstrate the responses to the survey questions as they related to the research questions. The data responses of the sample will be provided in individual charts reporting the significant findings of each survey questions as they related to the research questions. The next section will provide the results of the independent samples t-test. The study involved data collection from two independent samples which demonstrate the comparison of means and the equality of variance of the two separate groups. Finally, the evaluation of the study findings will be presented as related to the two research questions and the subsequent hypothesis of the study.

Demographics of the Study Participants. The study consisted of 110 participants. The demographic information collected from the study consisted of the respondent's age, gender and race/ethnicity. The demographic information was collected to demonstrate the representative sample of target population for generalization purposes.

The survey respondents were all adults. The age range of the participants is displayed in Table 1.

Table 1

Age Range of Study Participants (n=110)

Response	*f*	%
18-20	39	35.1
21-29	38	34.2
30-39	13	11.7
40-49	16	14.4
50+	5	4.9
Total	111	100.0

The gender of the survey respondents was analyzed from the study responses. The results are shown in Table 2. The findings indicated that 2/3 of the respondents were female.

Table 2

Gender of Study Participants (n=110)

Response	*f*	%
Female	64	57.7
Male	44	39.6
Other	3	2.7
Total	111	100.0

The race/ethnicity of the survey respondents was analyzed from the study responses. The results are shown in Table 3.

Table 3

Race/Ethnicity of Study Participants (n=110)

Response	*f*	%
African-American (Black)	73	65.8
Asian-American	4	3.6
Caucasian (White)	6	5.4
Hispanic/Latino	21	18.9
Native Hawaiian or other Pacific Islander	1	.9
Other Ethnicity or Mixed Race	6	5.4
Total	111	100.0

Research Question 1/hypothesis

The first research questions sought to determine whether community college math students self-report higher than average degrees of learning engagement when an interactive whiteboard is used in the classroom. The hypothesis proposed that community college math students' do not self-report a significantly higher degree of learning engagement when interactive whiteboards are used in the classroom. The representative sample consisted of a total of 110 community college math students consisting of four different classrooms, two different professors and two different math courses (math 100 and math 119). The entire representative sample of student responded to the survey with no missing responses. The survey instrument consisted of thirteen questions, three demographic questions and ten questions related to the research study inquiry. The questions about the degree of learning engagement experienced by community college math students in classrooms equipped with interactive whiteboard technology were subjected to statistical analysis. The results provided interesting observations using frequency analysis.

In adherence to the research questions, the survey consisted of questions focused on generating the respondent's perceptions about the impact classrooms equipped with interactive whiteboards had on their learning engagement. One of the survey questions sought to determine the overall respondents perspective about their experience with interactive whiteboards. Consequently, the respondents were asked whether they enjoyed having interactive whiteboards in their classroom. The frequency analysis revealed that in total 59.1% of the respondents strongly agreed and 39.1% agreed they enjoyed having interactive whiteboards in their classroom. As seen in table 4, only 1.8% of the respondents did not enjoy interactive whiteboards in their classroom.

Table 4

Enjoyed Smart Boards in the Classroom

Response	*f*	%
Strongly Agree	65	59.1
Agree	43	39.1
Strongly Disagree	0	0
Disagree	2	1.8
Total	110	100.

The respondents were asked whether lessons on the interactive whiteboard held their attention. The responses were as follows: 54.5% of the respondents strongly agreed, and 44.5 respondents agreed that the use of interactive whiteboards in their classrooms held their attention in the classrooms. One out of 110 respondents disagreed and believed interactive whiteboards did not hold their attention at higher rates. These results can be seen in table 5.

Table 5

Attention held by Interactive White Boards

Response	*f*	%
Strongly Agree	60	54.5
Agree	49	44.5
Strongly Disagree	0	0
Disagree	1	.9
Total	110	100.

The researcher's sought to determine whether the respondent's value of the interactive whiteboard on their learning. The respondents were asked whether they believe all classrooms should have interactive whiteboard technology.

Table 6

Classrooms should be equipped with interactive whiteboard

Response	*f*	%
Strongly Agree	73	66.4
Agree	28	25.5
Strongly Disagree	0	0
Disagree	8	7.3
Total	110	100.

Table 6 shows that 66.4% of the respondents strongly agreed and 25.5% of the respondents agreed that math classrooms should be equipped with interactive whiteboards. In contrast, 7.3% of the respondents disagreed that math classrooms should be equipped with interactive smart boards and .9% strongly disagreed.

The study sought to investigate how the participants self-reported their engagement in a classroom equipped with interactive whiteboard technology to determine their learning engagement. The respondents were asked whether they were more willing to discuss and participate in lessons that include interactive whiteboard technology. The results of the survey analysis demonstrated that 53.6% of the respondents strongly agreed and 40.9% agreed that they were more willing to discuss and participate in lessons that include interactive whiteboard technology. Only six of the participants (5.5%) disagreed that they were more willing to discuss and participate in lessons that include interactive whiteboard technology. The results are displayed in table 7.

Table 7

More likely to Discuss and Participate in Technology Equipped Classrooms

Response	*f*	%
Strongly Agree	53.6	59.1
Agree	40.9	39.1
Strongly Disagree	0	0
Disagree	6	5.5
Total	110	1

The survey respondents were asked whether the interactive whiteboard makes learning more fun in their community college math course. The results are displayed in Table 8

Table 8

Learning Made Easy in Classroom Equipped with Interactive Whiteboard Technology

Response	*f*	%
Strongly Agree	56.4	59.1
Agree	39,1	39.1
Strongly Disagree	0	0
Disagree	5	4,5
Total	110	100.

Table 8 shows that 56.4% of the respondents strongly agreed and 39.1 % of the respondents agreed that learning is made easier in classrooms equipped with interactive whiteboards. Only five of the respondents (4.5%) disagreed that learning is made easier in classrooms equipped with interactive whiteboards.

The study sought to measure the respondent's self-reported perceptions regarding the use of interactive whiteboard technology and its impact on their learning engagement. The respondents were asked whether they find it easier to learn when an example is shown on an interactive whiteboard first. The results are shown in Table 9.

Table 9

Learning made easier when examples are shown on interactive whiteboards

Response	*f*	%
Strongly Agree	53.6	53.6
Agree	40.9	40.9
Strongly Disagree	0	0
Disagree	6	5.5
Total	110	100.

Table 9 shows that 53.6% of the respondents strongly agreed and 40.9% of the respondents agreed that learning in math class is made easier when examples are displayed on the interactive whiteboard. However, 5.5% of the respondents disagreed that examples on the interactive whiteboard made learning easier.

The respondents were asked whether or not they find it easier to learn when they can touch and move things around on the interactive whiteboard during a lesson. The results are shown in table 10.

Table 10

Touching and Moving Things on Interactive White Board makes learning easier

Response	*f*	%

Strongly Agree	64	59.1
Agree	40	36.4
Strongly Disagree	0	0
Disagree	6	1.8
Total	110	100.

Table 10 shows that 59.1% of the respondents strongly agreed and 36.4% agreed that touching and moving things around on the interactive whiteboard makes learning easier. In contrast, 6% of the respondents disagreed that touching and moving things around on the interactive whiteboard makes learning easier.

The respondents were asked if they focused better during class when interactive whiteboard is used. The results are displayed in table 11.

Table 11

Focus is better in classes equipped with interactive whiteboard technology

Response	*f*	%
Strongly Agree	57	51.8
Agree	44	40.
Strongly Disagree	0	0
Disagree	9	8.2
Total	110	100.

Table 11 shows that 51.8% of the respondents strongly agreed and 40% of the students agreed that their focus is better in math classes equipped with interactive whiteboard technology. However, 8.2% of the respondents disagreed that the classes equipped with interactive whiteboard technology improved their focus.

The respondents were asked if they remember and better understand lessons, units or themes that have been taught with interactive whiteboards. The results are displayed in table 12.

Table 12

Interactive whiteboards improve memory and understanding (n=110)

Response	*f*	%
Strongly Agree	59	53.6
Agree	43	39.1
Strongly Disagree	0	0
Disagree	8	7.3
Total	110	100.

Table 12 shows that 53.6% of the respondents strongly agree and 39.1% of the students agree that interactive whiteboards in their math classroom improve their memory and understanding of the lesson, units, and themes. In contrast, 7.3% of the respondents disagreed that use of the interactive whiteboards in their math classrooms improves their memory and understanding of lessons, themes, and units.

Also, respondents were asked whether interactive whiteboards response quizzes helped them to prepare for exams. The student's responses are displayed in table 13.

Table 13

Interactive Whiteboards helps students to prepare for exams

Response	*f*	%
Strongly Agree	59	53.6
Agree	44	40.0
Strongly Disagree	0	0
Disagree	7	6.4
Total	110	100.

Table 13 shows that 53.6% of the students strongly agree and 40% of the students agree that interactive whiteboards help students to prepare for exams. In contrast, 6.4% of the respondents disagreed that interactive whiteboards help them to prepare for exams.

Research Question 2/Hypothesis

The second research question investigated the comparison between how if any community college students in Math 100 are self-reported a higher degree of learning engagement in comparison when interactive whiteboards are used in the classroom compared to Math 119 when interactive whiteboards are used in the classroom. The null hypothesis for this research question was that the mean number of community college math students in Group 1 who self-report higher degree of learning engagement enrolled in classrooms equipped with interactive whiteboard technology = - mean number of community college math students in Group 2 who self-report higher degree of learning engagement enrolled in classrooms equipped with interactive whiteboard technology. The alternative hypothesis is that the mean number of community college math students in Group 1 who self-report higher degree of learning engagement enrolled in classrooms equipped with interactive whiteboard technology ± - a mean number of community college math students in Group 2 who self-report higher degree of learning engagement enrolled in classrooms equipped with interactive whiteboard technology.

The representative sample of 110 students used for the study was drawn from a pool of 120 students in two different math subjects with 55 students in each subject participating in the study. The four groups of students were collapsed into two separate groups of students in Math 110 and Math 119 for analysis. The results provided interesting observations using statistical analysis of means and standard deviation to the study findings of the hypothesis of the study.

In adherence to research question 2, community college students in two separate math subjects completed the survey after receiving math instruction with and without the interactive whiteboard. The two samples were compared to make inference about possible differences if any existed. Several tests were used in the study understand better the comparison of the two independent samples. A descriptive statistical analysis was conducted to get an output analysis that would be decisive in seeking knowledge about the research questions. The T-Test was performed to compare the two means generated in the study from the two separate math subjects.

Table 14 presents the overall descriptive statistics, whereas 110 students participated in the study and displayed the means and standard deviation for study. The data collected from the entire representative sample is displayed demonstrating that many of the participants were favorable to the use of interactive smart boards in their classroom and believed that it provided indications of improving learning engagement.

Table 14

Descriptive Statistic

	N	Mean	Std. Deviation
I enjoy having an Interactive Whiteboard in my classroom	110	1.50	.502
Lessons on the Interactive Whiteboard that are interactive hold my attention.	110	1.43	.533
I believe all classrooms should have an Interactive Whiteboard.	110	1.46	.519
I am more willing to discuss and participate in lessons that include the Interactive Whiteboard.	110	1.43	.670
Learning with the Interactive Whiteboard makes learning more fun.	110	1.52	.602
I find it easier to learn when I see an example on the Interactive Whiteboard first.	110	1.48	.586
I focus better during class when the Interactive Whiteboard is used.	110	1.47	.601
I have remembered and better-understood lessons, units or themes that have been taught with the Interactive Whiteboard.	110	1.56	.643
Interactive Whiteboard Response quizzes helped me prepare for exams.	110	1.54	.631

Table 15 includes the independent-sample t-test for the scores on the 1-4 scale of community colleges students in math class 100 with community college students in math class 119, where 1 = Strongly Agree and 4 = Strongly Disagree. No significant differences were found. The comparison of the two math classes did not demonstrate any measurable differences thereby supporting the null hypothesis.

Table 15

Independent Samples Using t-test for Comparison of Means

	Class	No.	Mean	Std. Deviation	Std Error Means
I focus better during class when the Interactive Whiteboard is used	Math 110 Math 119	55 55	1.51 1.44	.605 .601	.082 .081
Lessons on the Interactive Whiteboard that are interactive hold my attention.	Math 110 Math 119	55 55	1.47 1.38	.539 .527	.073 .073
I believe all classrooms should have an Interactive Whiteboard	Math 110 Math 119	55 55	1.51 1.40	.539 .494	.073 .067
I am more willing to discuss and participate in lessons that include the Interactive Whiteboard.	Math 110 Math 119	55 55	1.51 1.35	.663 .673	.089 091
I find it easier to learn when I see an example on the Interactive Whiteboard first.	Math 110 Math 119	55 55	1.53 1.44	.573 .601	.077 .081
Interactive Whiteboard Response quizzes helped me prepare for exams.	Math 110 Math 119	55 55	1.65 1.47	.700 .573	.094 .077

Note: Math 110 = Group 1 and Math 119 = Group 2

The null hypothesis is further supported by statistical test to measure the equality of variances. Table 16 shows the Levene's Test for Equality of Variances, where no significant variation was noted in the two independent samples.

Table 16

T-test for equality of variance and means

		f	Sig.	t	df	Sig. (2-tailed)
Lessons on the Interactive Whiteboard that are interactive hold my attention.	Equal variances assumed	2.817	.096	1.290	108	.200
	Equal variances not assumed			1.290	107.193	.200
I am more willing to discuss and participate in lessons that include the Interactive Whiteboard.	Equal variances assumed	.006	.940	.791	108	.431
	Equal variances not assumed			.791	107.998	.431
I find it easier to learn when I see an example on the Interactive Whiteboard first.	Equal variances assumed	.907	.343	.791	108	.431
	Equal variances not assumed			.791	106.987	.431
I focus better during class when the Interactive Whiteboard is used.	Equal variances assumed	2.940	.089	1.491	108	.139
	Equal variances not assumed			1.491	103.938	.139
I have remembered and better-understood lessons, units or themes that have been taught with the Interactive Whiteboard.	Equal variances assumed	.605	.438	1.366	108	.175
	Equal variances not assumed			1.366	107.339	.175
Interactive Whiteboard Response quizzes helped me prepare for exams.	Equal variances assumed	4.470	.037	2.203	108	.030
	Equal variances not assumed			2.203	102.437	.030

Note f = frequency, t –independent sample, Sig = significant difference df = degree of freedom, Sig tailed

Evaluation of the Findings

The analysis of the survey findings revealed the respondent's self-reported learning engagement was enhanced in classrooms equipped with interactive whiteboard technology, specifically in relation to their enjoyment, retention, and performance. The results of the analysis were aligned with the literature findings on the subject, where researchers reported the positive impact of interactive whiteboards on learning engagement (Eyyam and Yaratan, 2014; Jarvis, Lavicza, and Buteau, 2014; Zientek et al., 2015).

In addition, the research findings correlated with the theoretical, conceptual framework (engagement theory and situated cognition theory) underpinning the study. The theoretical framework of the study proposed students are more engaged and have higher retention in classrooms equipped with instructional technology and provided a strong research base for answering the research question (Brown, Collins & Duguid, 1989; Kearsley & Schneiderman, 1999).

Question 1. The hypothesis of research question 1 proposed that self-reported learning engagement was increased with the use of interactive whiteboard technology in math classroom instruction in a community college environment. Analysis of the data collected from the survey research found the self-reported perceptions of the project participants indicated higher learning engagement in math classrooms where interactive whiteboards are used for instructions.

The research literature is limited in the areas the use of instructional technology in community college math environments ((Blair, 2012; AMATYC, 2007), but is extensive in regard to the impact of instructional technology (Alarcia & Bravo, 2012; Ellwein et al., 2014) and math education and technology and higher education (Jarvis, Lavicza, & Buteau, 2014; Foshee, Elliott, & Atkinson, 2016). The initiation of the study was related to the researcher's perspectives in the learning advantages of instructional technology in math classes. The findings of the study corroborate the study's hypothesis that learning engagement in increased in classes equipped with interactive smart board and is aligned with the current research on the subject.

Question 2. The hypothesis of research question 2 proposed there would be no significant differences in the self-reported perceptions of the community college students in two different math classes. The decision to investigate the research questions using two separate math courses was made in an attempt to strengthen the conclusion of the study. The statistical comparison of the findings of the two groups revealed that both groups reported increased learning engagement in classes equipped with interactive whiteboard concurring with the hypothesis.

The research literature supports the hypothesis proposing no significant difference in the impact of instructional technology in one class more than another. The advent of technology of higher education continues to normalize itself in the delivery systems for courses across the board (Delialioglu, 2012; Hora & Ferrare, 2013; Pittman & Edmond, 2016 Further, the literature demonstrated the application of instructional technology in higher learning in a diversity of courses, including physics, biology, etc. ((Hodges & Prater, 2014; Hora & Holden, 2013; Reiser & Dempsey, 2012; Stevens & Kirst, 2015).

Summary

The study findings indicated an overall agreement that learning engagement is increased in classroom instruction supported by interactive whiteboard technology. These findings were indicated in response to the questions focused on the impact of interactive whiteboards on classroom focus, knowledge retention, and performance on quizzes and test. In addition, the comparison of data collected from students in two different math subjects revealed similar findings indicated the positive impact interactive whiteboards have on student learning engagement.

The study results concurred with the research literature and the theoretical framework supporting the study (Eyyam and Yaratan, 2014; Jarvis, Lavicza, and Buteau, 2014; Zientek et al., 2015). The survey data generated responses related to the overall enjoyment of learning with interactive smart board technology, its impact on, as well as the respondent's perception of its value in promoting their learning engagement and are supported in the research literature

The research questions and the study hypotheses were investigated in the study and revealed significant evidence based on the study findings that the self-reported perceptions of community college math student are that learning engagement is increased in classrooms where instructional technology is being used.

Chapter 5: Implications, Recommendations, and Conclusions

Chapter 5 is organized into three sections: (a) implications, (b) recommendations, and (c) conclusion. The primary findings of the research questions and their implications will be discussed in the first section. In addition, the section will consider and compare the findings with the research literature related to the subject. The second section will make recommendations related to instructional technology as a means to increase learning engagement. The third section will be a conclusion of the research study summarizing the main points of the dissertation.

Implications

The problem addressed in this study is despite the fact that technology is becoming an important teaching tool in mathematics impacting student learning engagement (Blair, 2012), the integration of technology as a teaching tool in community college math classrooms has not yet been fully embraced and funded (AMATYC, 2007). The purpose of this quantitative study was to investigate community college math students' degree of learning engagement when interactive whiteboards are used in the classroom. The research methodology used in the study was an exploratory quantitative study using single variable survey.

One limitation of this research was that the population was drawn from community college students in an Eastern state, which may not be generalizable to all U.S. community colleges, due to differences in student demographics between the study site and other community colleges. In addition, the data collected was self-reported, so there was no guarantee that the participants' responses would not be skewed by their mood, perceptions of the institution or instructor or perceived response. The findings of this study show that the learning engagement of community college math students is increased in a classroom equipped with interactive whiteboard technology. It also answers the question of "to what extent if any, do community college math students self-report higher than average degrees of learning engagement in Math 100 as compared to Math 119 when interactive whiteboards are used in the classroom".

The use of interactive whiteboards in the classroom is reported to increase learning and improve student engagement, which results in higher achievement (Eyyam and Yaratan, 2014; Jarvis, Lavicza, and Buteau, 2014; Zientek et al., 2015). Through the research lens of an exploratory study using a quantitative approach, the study was conducted to investigate how community college math student self-report the impact of interactive whiteboards on their learning engagement. The data used to support the research questions were obtained from an anonymous survey utilizing previously published analytics.

This study as conducted with adherence to important ethical principles conducted with careful adherence to important ethical principles which included academic integrity, risk assessment, informed consent, privacy and confidentiality, data handling and reporting, working with a mentor, and adherence to institutional review board guidelines. Adherence to these principles in this study helped to elevate the role of the human participants while adhering to the highest quality of ethical practice in the pursuit of knowledge.

Research question 1 and the subsequent hypothesis were focused specifically on whether learning engagement was increased with the use of interactive whiteboard technology. The hypotheses related to question one was that: "community college math students' do self-report a significantly higher degree of learning engagement when interactive whiteboards are used in the classroom? This study was conducted to explore the self-reported perceptions of the study participants about the impact on learning engagement in classroom equipped with interactive whiteboards

Research question 2 and its subsequent hypothesis was focused on whether students from two different math classes reported higher learning engagement in classes equipped with interactive whiteboard technology. The literature research findings reported the increase in learning engagement and comprehension in a wide variety of subjects where interactive whiteboard technology was used in instruction (Jarvis, Lavicza, and Buteau, 2014).

Situated cognition is a theoretical approach to human learning supporting the notion that learning takes place when a person is doing something in both real and virtual world whereby social, cultural and physical contexts are important (Brown, Collins & Duguid,1989; Clancey, 1997 and Wilson & Myers, 2000). The main argument of the situated cognitive theory is that all knowledge acquired by a learner is embedded within the activities that are social, physically or culturally based (Brown, Collins & Duguid, 1989). The theory supports the hypothesis of the study that math instruction with interactive whiteboard technology results in a higher level of learning engagement than the traditional classroom where instructional technology is not used. The respondents indicated high levels of learning engagement as demonstrated by enjoyment, higher comprehension, and higher test scores as a result of the use of instructional technology.

The literature findings along with the theoretical frameworks indicate that emerging new technology has become a standard part of the teaching process. Engagement theory as posited by Kearley and Shneiderman (1998) proposed learning in technology-based environments is accomplished by three primary means: (1) its emphasis on collaborative efforts, (2) its project-based instruction, and (3) its non-academic focus.

The students in each classroom received instruction for four weeks where interactive smart board technology was not available and then received instruction for an additional four weeks where the interactive smart board was available. The students were asked to consider their experience in both circumstances and self-report their perceptions. The students were asked to respond to several inquiries: 1) how much they enjoyed and recommended interactive smartboard technology, 2) how much interactive whiteboards command their attention, increase their knowledge retention and improve their enjoyment of lessons, 2) how well interactive smartboard commanded their attention, increased their focus, encouraged their participation and increased their learning, and 3) whether it increased their performance on quizzes and exams.

The survey findings indicated that the students overall self-reported either strongly agreeing or agreeing that classrooms equipped with interactive whiteboard technology were more enjoyable, as well as having increased their learning engagement and performance. The findings were higher regarding the enjoyment of learning and the ability to capture their attention in classrooms equipped with interactive whiteboards. These findings corroborate the research hypothesis of the study where the respondents significantly report statistically high agreement that learning engagement was increased in an environment equipped with interactive whiteboard technology.

Researchers have explored active learning in environments with instructional technology and found learning increased in technology-fused learning environments (Delialioglu, 2012; Erbas, Ince and Kay, 2015). In addition, researchers have published findings proposing that interactive whiteboards help students focus their attention on the class content and permit them visualize the processes better, quicker, and making fewer mistakes (Akdemir & Yasaroglu, 2013, Ormanci, Cepni, Deveci, & Aydin., 2015) conducted a study comparing the use of traditional blackboards and the use of the interactive whiteboard confirming higher student success when the IWB was implemented in the classroom. Finally, several studies have identified the positive impact of instructional technology on student learning and engagement (Kahu, 2013; Hodges & Prater, 2014; Reiser & Dempsey, 2012; Stevens & Kirst, 2015).

Research question 2 asked: To what extent if any, do community college math students self-report higher than average degrees of learning engagement in Math 100 as compared to Math 119 when interactive whiteboards are used in the classroom? The hypotheses related to this research question was as follows: community college math students' statistically significantly do not self-report higher than average degree of learning engagement in one math class than the other math class where interactive whiteboards are used in both courses.

The integration of instructional technology, such as interactive whiteboards in math classrooms has opened a new field of research and found their efficacy by systematically and dynamically providing the scaffolding of key learning processes during learning (Cueli, González-Castro, Krawec & Núñez, 2016). The impact of interactive whiteboards on math classes was further investigated in more than one math subjects. The data analysis of this study included a t-test of independent samples (Math 100 and Math 119) comparing the student's experience in both classrooms to see if there were any significant differences in their self-assessment of learning engagement. While there was some slight deviation between the self-reported beliefs in the impact of interactive whiteboards on learning engagement, where students in Math 119 had a higher perception of the impact, both Math 100 and Math 119 students expressed similar beliefs in the benefits of interactive whiteboard on learning engagement.

One of the greatest challenges faced by university administrators regarding the implementation of instructional technology is the need for greater professional development. Professional development of staff is frequently ignored, or there is lack continuity. For the efficient and effective intervention of technology, new methods of pedagogy are required that support instructors to better understand the effective use of technology for teaching and learning. Another challenge faced by university administrators is funding, as expenditure for running a school takes priority over the instructional uses that are key in 21st-century education.

There is no denying that instructional technology is a growing standard in higher education. The emergence of technology and its integration in education has been written about extensively in the research literature (Mayes, Natividad & Spector, 2015). The rise of distance learning is an easily identifiable demonstration of the impact of technology in the educational ranks, but its emergence in community colleges has not been fully investigated (Blair, 2012; AMATYC, 2007; Sitomer et al., 2014).

Despite the evolution of higher education pedagogy, the impact it has on subjects, such as mathematics also calls for a greater investigation. The high number of community college students requiring foundational math (Wang, Wang, Wickersham, Sun & Chan, 2017) presents a real challenge for an educator that might benefit from the advances instructional technology brings to the math classroom and provides indications for further investigation).

The findings of this study, along with the findings in the literature regarding the challenges of implementing instructional technology in the classroom indicate the need for further research to investigate the research question.

Recommendations for Practice

The findings of this study show that the learning engagement of community college math students is increased in a classroom equipped with interactive whiteboard technology. It also answers the question of "to what extent if any, do community college math students self-report higher than average degrees of learning engagement in Math 100 as compared to Math 119 when interactive whiteboards are used in the classroom". Numerous studies have investigated the impact of instructional technology on learning engagement and report that educational delivery in classrooms using technology is improved and favored (Heemskerk, Kuiper, & Meijer, 2014; De Vita, Verschaffel, & Elen, 2014; and Bidaki and Mobasheri, 2013).

The components for learning engagement are predominantly described in the literature as (a) the behavioral perspective with the focus on student and institutional practice; (b) the psychological viewpoint, whereas engagement is viewed as a psycho-social process; (c) the socio-cultural perspective, which is focused on the critical role of socio-political context; and (d) the holistic perspective, a broader view of engagement (Kahu, 2013).

The use of instructional technology in educational delivery promotes learning engagement. Researchers have found the problem-solving based approach which involves the use of web-based support for students in mathematics or science is an advantage that promotes higher learning (Kay & Kletskin, 2012). In addition, the dynamic visualizations from the internet facilitated greater learning than in powerpoint lectures in math classroom (Kay & Kletskin, 2012). The use of interactive smart boards and computer-based graphing utility positively affected students' attitudes towards technology and mathematics and improved the reasoning and interpretation skills of the students (Erbas et al., 2015).

In addition, the value of interactive whiteboards in features, such as highlighting, screen-shaking, spotlighting, annotating, capturing, recording, handwriting recognition, zooming, network screen sharing, as well as helping students focus attention on the class content has been noted by researchers (Ormanci et al., 2015). Whiteboards also help students focus attention on the class content, permits them to visualize processes, more quickly identify mistakes, and promotes the sharing of knowledge through listening and talking. Finally, the immediate access to the Internet provides teachers direct access to a multitude of educational websites, videos, photos and textual materials that substantially enriches the classroom teaching environment. The study findings showed that interactive whiteboards provide benefits to teachers and students when implemented into the classroom (Ormanci et al., 2015).

Recommendations for Future Research

The results of this study provide insight into the perceptions of community college students and their perspectives on learning engagement in math classrooms. The findings to support the hypothesis of this study positing that learning engagement in math classes is higher in technology-enhanced learning environments. Further research is needed to investigate in broader terms the impact that instructional technology has on learning engagement in community college students. The research goal might yield interesting results that can be used by instructors in the delivery of math instruction. More specifically, research is needed that seeks to identify effective strategies dealing with the challenges related to proper professional development of faculty in the use of instructional technology, as well as the need for greater guidance to university administrators challenged by the financial difficulties related to technology transience

Further studies that include data from other community colleges should be undertaken. I only assessed one college in the northern United States. Future research that includes data collected from other community colleges across the United States could take into account variables such as academic versus applied career training institutes, public versus private, and urban versus rural/suburban colleges. In addition, much might be learned by comparing the demographic variables of the students in multiple colleges rather than looking only at one school.

The findings of this study have important implications for developing better strategies for the implementation of instructional technology in community colleges. If adult learners are reporting greater learning engagement in classes equipped with instructional technology but community college administrators and faculty are reporting challenges related to staff training and development and the integration of constantly changing technology, then these are the area's universities should focus on for funding and research.

Limitations. One of the limitations of the study is the self-reported method of data collection. There is limited research supporting the validity of student self-report as a measure of learning. The need to understand the systematic biases associated with self-report measures is a reasonable critique of survey research, particularly as the sole source of data collection (Aguinis, Dalton, Bosco, Pierce, & Dalton, 2011.; Brutus, Aquinas & Wessmer, 2013). In addition, the limitation of the quantitative study whereas there exists the opportunity of misrepresentation of the target population might hinder the study for achieving the desired goal and objective. The application of appropriate sampling plan representations is dependent upon the probability distribution of observed data and can provide miscalculation of probability distribution leading to falsity in the proposition.

Conclusions

The findings of this study revealed the study participants statistically higher perception of the improvement in learning engagement in community college math classes equipped with interactive whiteboards. In addition, the findings demonstrated that there was little statistical difference found in the perceptions of respondents in Math 100 and Math 119 classes.

The study findings demonstrate evidence of improved learning engagement using interactive whiteboard technology indicated in the responses to the various questions in the data collection tool. The respondents indicated their enjoyment and preference for math instruction delivered with interactive whiteboard technology. The responses related to focus, understanding and the retaining of knowledge also were highly indicative of the positive influence of smartboard technology on learning engagement.

The study revealed the following student descriptions: (a) students report they are better focused and are more attentive in math classrooms equipped with interactive whiteboard technology; (b) students report finding learning easier in math classes where they can see examples and physically interact with the lessons; (c) students enjoy learning better, perform better on tests and believe all classes should be delivered with the use of interactive whiteboard technology; and (d) there was no significant statistical difference in the perceptions of the high impact of interactive whiteboard on learning engagement in Math 100 and Math 119.

The study findings correlated and supported the study hypothesis. After receiving instruction in the same class by the same instructor, with and without interactive whiteboard usage, the majority of study participants reported higher student engagement in classes where interactive whiteboard was used in instruction. The findings correlate with the research literature proposing technology-equipped classrooms provide greater opportunities for learning engagement and richer educational delivery engagement (Eyyam and Yaratan, 2014; Jarvis, Lavicza, and Buteau, 2014; Zientek et al., 2015), and support indications for greater integration of instructional technology in community college classrooms.

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Appendices

Appendix A: Study Survey

Whiteboard Student Survey 2016

Part 1: Student Demographics

1. **What is your gender? Choose one.**

   Male, Female, Transgendered

2. **Select the age range that includes your age.**

   18-20

   21-29

   30-39

   40-49

   50+

3. **What is your race/ethnicity?**

   African-American (Black)

   Native American or Alaskan Native

   Asian-American

   Caucasian (White)

   Hispanic/Latino

   Native Hawaiian or other Pacific Islander

   Other Ethnicity or Mixed Race (fill in) _______________

Part 2 Interactive Whiteboard Survey

Motivation

1: I enjoy having an Interactive Whiteboard in my classroom.

1. Strongly Agree 2. Agree 3. Disagree 4. Strongly Disagree

Strongly Agree	Agree	Disagree	Strongly Disagree
4	3	2	1

2: Lessons on the Interactive Whiteboard that are interactive hold my attention.

1. Strongly Agree 2. Agree 3. Disagree 4. Strongly Disagree

3: I believe all classrooms should have an Interactive Whiteboard.

1. Strongly Agree 2. Agree 3. Disagree 4. Strongly Disagree

4: I am more willing to discuss and participate in lessons that include the Interactive Whiteboard.

1. Strongly Agree 2. Agree 3. Disagree 4. Strongly Disagree

Learning

5: The Interactive Whiteboard makes learning more fun.

1. Strongly Agree 2. Agree 3. Disagree 4. Strongly Disagree

6: I find it easier to learn when I see an example on the Interactive Whiteboard first.

1. Strongly Agree 2. Agree 3. Disagree 4. Strongly Disagree

7: I find it easier to learn when I can touch and move things on the Interactive Whiteboard during a lesson.

1. Strongly Agree 2. Agree 3. Disagree 4. Strongly Disagree

8: I focus better during class when the Interactive Whiteboard is used.

1. Strongly Agree 2. Agree 3. Disagree 4. Strongly Disagree

9: I have remembered and better-understood lessons, units or themes that have been taught with the Interactive Whiteboard.

1. Strongly Agree 2. Agree 3. Disagree 4. Strongly Disagree

10: Interactive Whiteboard Response quizzes helped me prepare for exams.

1. Strongly Agree 2. Agree 3. Disagree 4. Strongly Disagrees