Spring 2019

Building Faculty Competence and Self-Efficacy for Using Z Space Virtual Reality (VR) Software in the Classroom

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Submitted as Partial Fulfillment for the Doctor of Nursing Practice Degree

Regis University

April 26, 2019

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Executive Summary

Building Faculty Competence and Self-Efficacy for Using Z Space Virtual Reality (VR) Software in the Classroom

Problem: The environments of teaching and learning are changing as educational needs and technology advancements evolve. It is imperative faculty know best practices for the use of technology in their curriculum and the versatility of technology to meet the needs of both the faculty and students to ultimately better prepare nurses of the future where the use of technology is and will continue to be part of their everyday work life.

Purpose: The purpose of this project was to investigate if participation in a learning model would increase pre-licensure nursing faculty members' confidence and self-efficacy in the use of Z Space Virtual Reality (VR) to enhance student learning.

Goal: The goal of this project was to measure the impact of an educational program designed to increase competency and self-efficacy of pre-licensure nursing faculty in the use of Z Space VR software.

Plan: An online educational module was designed, based on cognitive learning theory, to teach pre-licensure nursing faculty how to maximize the use of Z space VR in the classroom. A self-report instrument was designed and validated for face validity to measure participants' self-efficacy and competency using VR pre and post intervention. Reliability was .695 for pre-test and .876 for the post-test using Cronbach Alpha.

Outcomes: Although the data was collected at nominal level using a Likert Scale, treated as interval level data. A paired t-test and split paired t-test analysis demonstrated a statistically significant ($N=13$, $p>0.05$) change in faculty competence and self-efficacy after the educational intervention. The Cohen's d results were a large effect, (1.83), further supporting the efficacy of the intervention to increase competency and self-efficacy in using the Z Space software.

Acknowledgments

First and foremost, I need to acknowledge my husband, sons, and daughters-in-law whose constant support and encouragement was second to none. My husband, Mark, has been there on every part of my educational journey, from my pre-licensure program through this degree. His patience and support have made this journey possible. He has now attended four of my college graduations. He is my rock. My sons, Joseph, Scott, and Chris, whom I love with all my heart, had encouraged me when I no longer believed in myself. Their constant words of encouragement motivated me to continue to pursue my dream. I am amazed at how much I have learned from them. They are indeed my greatest accomplishment. Alison, Samantha, and Melissa, the women in their lives, were always spurring me forward with kind words of encouragement. My grandsons, Oscar, Teddy and Johnny, were there with hugs and comedic relief when I needed it most. My dad, sisters, and brothers thank you for understanding when I could not attend an event or had to leave early to do homework. Thank you for always asking how it was going? It meant a lot.

My DNP chair, Dr. Lynn Wimett, for her unfailing words of encouragement, support, and guidance. I would not be here without it. To all the instructors at Regis University, I have so enjoyed this journey because of your knowledge and talents that you have shared with me.

I would also like to thank the Joliet Junior College nursing faculty who participated in my project. I appreciate them volunteering their time to assist in my DNP project. They were always there with kind words of encouragement and support. And finally, I want to thank Professor Julio Santiago who was my partner in this educational journey. He was always there to calm me down and offer encouragement when things became overwhelming. I am so thankful you were my partner on this journey.

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Problem Recognition and Definition

Project Purpose

The purpose of this project was to investigate if participation in a learning model would increase pre-licensure nursing faculty members' competence and self-efficacy in the use of Z Space software. The scope of this project was limited to nursing faculty at Joliet Junior College and will not generalize beyond the study population. However, the outcome may influence other nursing colleges to design and provide a similar learning module.

The Problem

The environments of teaching and learning are changing as educational needs and technology advancements evolve. In 2015, the National League for Nursing stated that it is essential for students to use and interact with technology during their education. Furthermore, the common traditional classroom setting of passive learning is no longer meeting educational needs. Active learning is critical to retention (Aglen, 2016; Boctor, 2013; Henderson, Harrison, Rowe, Edwards, Barnes, Henderson, Henderson, 2018; Hoke & Robbins, 2005; Murray, 2016) and can easily be enhanced with technology (Affordable Care Act, 2010; The Institute of Medicine (IOM), 2011).

Additionally, today's highly diverse and technology-savvy students grew-up with technology as part of daily life and lead to student demand for technology in the classroom (Mazer & Hess, 2016). In 2017, the United States Department of Education stated that technology supports teaching and learning, increases student engagement, and motivation, and accelerates learning. Furthermore, it allows individualized learning both in and outside the

classroom and provides greater students ownership for their learning. Mazer and Hess (2016) also stated that the use of technology in the classroom enhances the skills and knowledge needed to compete in tomorrow's technology-driven global work environment. Of course, in order for faculty to embed active learning through technology in their course, they need to know how to maximize its use. It is imperative faculty know best practices for the use of technology in their curriculum and the versatility of technology to meet the needs of both the faculty and students to ultimately better prepare nurses of the future where the use of technology is and will continue to be part of their everyday work life.

Although cost was a barrier to achieving this goal in the past, technology has blossomed over the last several decades and is becoming more accessible and affordable to educational institutions (Ferguson, Davidson, Scott, Jackson and Hickman, 2015; and Walker, McMahon, Rosenblatt, 2017). Two of the newest technologies gaining momentum in healthcare education is virtual reality and augmented reality. Both are very similar and will be referred to as virtual reality (VR) throughout this proposal.

VR provides increased active learning opportunities by providing active (physical) interaction (Zhu, Hadadgar, Masiello, and Zary, 2014, p. 469) but, as above, in order for faculty to capitalize on the advantages of using VR technology to enhance active learning, they must know what VR is available and develop confidence that they can use VR and that using it will enhance learning. Both lack of knowledge and lack of self-efficacy or belief in the ability to use technology to facilitate learning were recognized as barriers to its use by multiple authors (Ireland, 2016; Kowitiawakul, Chan, Wang, Wang, 2014; Lilly, Fitzpatrick, Madigan, 2015; Marzilli, Delello, Marmion, McWhorter, Roberts, Marzilli, 2014 and Roney, Westrick, Acri, Aronson, Rebeschi, 2017). As self-efficacy builds so does the ability to organize and execute

action (Artino Jr., 2012; Cherry, Flora, 2016; Garner, Killingsworth, Bradshaw, Raj, Johnson, Abijah, Parimala, Victor, 2018; Gonen, Dganit, Lilac, 2016; Roney, Westrick, Acri, Aronson, Rebeschi, 2017). The research strongly suggested one solution to the lack of knowledge, and limited self-efficacy or confidence in using technology to meet student expectations and enhance learning is continuing education (Dennis, 2017; Kowitiawakul, Chan, Wang, Wang, 2014; Lilly, Fitzpatrick, Madigan, 2015; Marzilli, Delello, Marmion, McWhorter, Roberts, Marzilli, 2014 and Roney, Westrick, Acri, Aronson, Rebeschi, 2017).

Project Question

Would an organized, structured, comprehensive continuing educational module designed to teach how to maximize the use of Z Space VR to enhance learning improve the participating nursing faculty's competency of how and when to use Z Space VR and their self-efficacy in use of Z Space VR?

PICO Statements

Population. Pre-licensure nursing faculty at a small Midwestern Community College.

Intervention. A structured and comprehensive learning module focused on the use of VR software.

Comparison. Reporting and comparing nursing faculty's self-reports of self-efficacy and competency pre-participation in the intervention learning module and post-intervention.

Outcome. Nursing faculty self-reports improved self-efficacy and competency following participation in the learning module.

Project Significance, Scope, and Rationale

Best practices for VR in the classroom and beyond gives faculty a technology tool that may better prepare students to gain knowledge, attitudes, and skills needed to provide evidence-based, safe nursing care (Dalhem, Saleh, 2017; Doswell, Braxter, Dabbs, Nilsen, Klem, 2013; Kilmon, Brown, Shosh, Mikitiuk, 2010; and Warburton, 2009; Lieberman, 2018). Joliet Junior College purchased ten Z Space VR units in 2017; however, the department of nursing does not provide a structured, formal orientation on the use of Z Space VR for instruction, while the literature documented a clear need for education how to use VR in the classroom, before implementing its use. Considering the expense of technology, it is imperative that nursing faculty are educated to use technology in teaching.

The scope of the project was limited to nursing faculty at Joliet Junior College and will not generalize beyond the study population. However, the outcome may influence other nursing colleges to design and provide a similar learning module. The rationale for this project was the need to find if a barrier to utilizing Z Space VR software purchased by the college was lack of competency and self-efficacy in how best to use the software by measuring pre- and post-changes reported competency and self-efficacy following the education module intervention. Anticipated future research would measure if the increased competency and self-efficacy supported increased use of the software and if increased use enhanced learning. Both questions are beyond the scope of this project but are the long-term goals for future research.

Foundational Theories

Skill Acquisition in Nursing

Patricia Benner (1984) developed the Model of Skill Acquisition in Nursing. Benner's theory focused on the stages of clinical competence from novice to expert. These can be applied to nursing faculty continuing education as well. Benner discussed how nurses learn through "doing" and reflecting upon it. She further described practice growth through the application of learning in practical settings stating knowledge and skills can also be acquired from performance and practical application. When the clinician (nursing faculty) tests and refines propositions, hypotheses, and expectations in practical situation expertise develops in five stages: novice, advanced beginner, competent, proficient and expert (Benner, 1984). Dumchin (2010), applied Benner's model to an online learning environment emphasizing movement from a novice at the beginning of the course progressing to an understanding of the knowledge presented by completion of the course. Dumchin purposed integrating technology into a curriculum to assist nurses in a smooth transition to a high tech environment. Technology can enhance movement from a didactic concept to a hands-on experience.

Social Learning Theory

All humans strive to control events that affect their lives. This is rooted in the belief that influencing control assists in realizing desired outcomes and eliminating or minimizing undesired consequences (Hughes, 2008). Social learning theories were grounded in the belief that new behaviors can be learned by observing and imitating others when the outcome of observed behavior is desired (Abrams and Niaura, 1987; Bandura, 1977; Krohn, Lanza-Kaduce and Radosevich, 1979; Mischel, 1973).

Bandura (1977) took social learning theory another step when he examined why even when something was desired, some people would attain the goal, and some would not. He found motivation and belief in one's ability to achieve the desired goal made the difference. His extensive research resulted in a fundamental philosophy summarized as is if a person thinks he/she can and wishes to, he/she will succeed. If a person thinks he/she cannot even if he/she want to but continue to try, he/she will eventually succeed. Conversely, if a person wants to but believes he/she cannot achieve the goal, the person will stop at first challenge or barrier. The construct of self-efficacy continued to be explored in education and found an individual's motivation for learning and achievement was dynamically influenced by self-efficacy (Bandura, 1997; Multon, Brown & Leni, 1991; Pajares, 1997; Stajkovic & Luthans, 1998).

Social Cognitive Theory (SGT)

The social cognitive theory was grounded in the fact that humans are their change agents, (Bandura, 2011). They are in charge of their actions and can consciously choose their battles. Bandura further believed that anyone, regardless of life challenges, can strengthen their self-efficacy. People acquire self-efficacy beliefs from past performance, observing others perform, verbal persuasion and physiological clues (Ajzen, 2002; Bandura, 1977; Conrad & Munro, 2008; Hill, Smith, & Mann, 1987); although, Bandura identified behaviors, environment, and personal/cognitive factors having most significant influence on self-efficacy.

Self-efficacy of faculty affects the environment of the instructional method (Conrad, Munro, 2008; Dogru, 2014; Flammer, 2001; Kent, Giles, 2017; Schunk, 2001) and there is clear evidence that the level of technology used in a classroom is dependent on the instructor (Jimoyiannis, Komis, 2006; Kent, Giles 2017).

Change Model

Prochaska and Velicer (1997) identified the Transtheoretical Model of Health Behavior Change (TTM). The model consists of six stages of change: pre-contemplation, contemplation, preparation, action, maintenance, and termination. TTM is a model of intentional change and focuses on the decision-making of the individual. While most of the research for this model has been based on addiction/high-risk behaviors, it contains cognitive, affective and evaluative processes which can be applied to learning new knowledge and skills (DiClemente, Prochaska, 1998; Nidecker, DiClemente, Bennett, Bellack, 2008; Prochaska, Redding, Harlow, Rossi, Velicer, 1994). Progression through the steps included: pre-contemplation stage defined for this study as unaware of how to use VR to enhance learning; contemplation where faculty will show interest in participating in the learning and preparation; where faculty will review the module. The action and maintenance stages of change are outside the scope of this project, but the vision is for faculty to move toward action in utilizing VR to enhance learning, seek out other learning opportunities for VR use and expand VR use.

Roger's Experiential Learning Theory

Carl Rogers's (1942) experiential learning theory was chosen as the basis for the development of the learning modules. His theory was based upon making learning significant for the learner by providing an environment where the learner gain knowledge that can be applied to real-life scenarios (Aliakbari, F., Parvin, N., Heidari, M. & Haghani, F., 2015). Roger's believed all human beings have a natural ability to learn; however, it is the role of the teacher to facilitate that learning. That facilitation includes:

1. Student immersed in the learning process and allowed control over nature and direction.
2. A direct encounter with real-life practical application, including social, personal and research problems.
3. Assessment of success is through self-evaluation.

The online learning module will include each facilitation step. A pre-survey will be used to define the appropriate learning path, the module will be visually organized and contain relevant and applicable content, and the cognitive flow will be based on pre-existing skill sets and limited to small chunks of content.

Literature Selection

Systematic Process

Peer-reviewed studies on the integration of technology into the pre-licensure nursing curriculum were identified. Search engines used were: Ovid, MEDLINE, CINAHL, PubMed, and Google Scholar and keywords technology in the classroom, novice nursing faculty, preparing technology savvy nurses, technology in patient care, open educational resources for educators, IT education, virtual reality, augmented reality, best practices of virtual reality in the classroom, use of technology by pre-licensure nursing faculty, cost of technology, future care providers, technology, and barriers to implementing technology in education. The first search yielded 397 articles. To narrow the search, exclusions included duplicate articles, non-English articles, and publication dates prior to 1999. Keywords were narrowed to medical teaching with VR, collaborative learning, interactive learning environments, virtual patients, eLearning, and self-confidence in teaching with technology. The search resulted in 258 articles which were further narrowed down to 35 articles by excluding articles that were too narrow to add to the project, focused on research on nursing practice rather than nursing

education or were exclusively on simulation or did not include final keywords nursing faculty, technology use, VR, or self-efficacy.

Level of Evidence Supporting Project

Using the seven levels of evidence as defined by Houser and Oman (2011), eight articles met level one criteria; seven met level two; six met level four; seven met level five; five met level six, and two were at level seven.

Seven-Tiered Level of Evidence: Levels of Research	**Research Design**	**Number of Articles**
I	**Systematic Review or Evidence-Based Practice Guidelines**	8
II	**Randomized Control Trial**	7
III	**Quasi-experimental Studies**	0
IV	**Case-Control**	6

V	**Systematic Review of Descriptive or Qualitative Studies**	7
VI	**Single Descriptive or Qualitative Study**	5
VII	**Expert Opinion, Regulatory Opinions or Committee Reports**	2

Background of the Problem

The impact of technology on self-efficacy towards teaching addresses several challenges faculty encounter (Garner, Killingsworth, Bradshaw, Raj, Johnson, Abiljah, Parimala, Victor, 2018; Skiba, Connors, Jeffries, 2008; Tacy, Northam, Wieck, Lynn, 2016; Urick, 2016). These challenges include teaching multigenerational students, decrease enrollment in healthcare education and the impact of healthcare technology on patient care.

The Problem

Technology continues to evolve and enhance every part of society, including higher education (Arnold, Sangra, 2018; Castaneda, Selwyn, 2018; Lundin, Rensfeldt, Hillman, Lantz-Andersson, Peterson, 2018). Technology has become so much a part of society, including higher education, it becomes essential for educators to understand how technology can facilitate active learning and learn how to best take advantage of its use in preparing the nurse for the 21st century. As early as 2016, the National League for Nursing emphasized the

importance of nursing students interacting with technology as it would become a part of their everyday work life following graduation. The facts presented a problem for many nursing programs since not only was technology expensive, many faculty were digital immigrants not having a pivotal role of technology in their education

Multigenerational students have different expectations of the use and value of technology. The oldest generation, baby boomers, are digital immigrants. Technology did not have a pivotal role in their early education (Anderson and Jiang, 2018). However, their adoption of technology continues to grow (Anderson and Jiang, 2018). The youngest generation is called millennials. They grew up using technology both socially and educationally. Millennials are described as being digital natives (Mazer and Hess, 2016). Millennials want to consume and use content from multiple sources (Friedman, 2018). Educators must address the technology needs of all generations. Each generation will bring its uniqueness and challenges to education. Several strategies have been identified to address these challenges, they include offering a variety of technology options for learning, a mixture of technology enabled and formal education, and measurable educational outcomes of technology use (Joshi, Dencker, Franz, 2011; Kapp, 2012; Lyons, Urick, Kuron, Schweitzer, 2015; Urick, Hollensbe, Masterson & Lyons, 2016). The faculty are challenged to become competent in using technology to address multigenerational learning needs.

Technology accommodates the needs of a broad range of students. Technology can change how education is delivered. This delivery allows access to higher education for larger groups of students while providing more flexibility and lower costs (Culatta, 2014). Competence with technology use is one avenue to attract and retain students in healthcare

education (Al-Hariri, Al-Hattami, 2016; Piscotty, Kalisch, Gracey-Thomas, 2015; Schwartz, Mauger, 2010).

Technology will continue to shape the future of healthcare and nursing. Technology is integrated into every dimension of healthcare from concern for patient safety to providing coordinated care to improve patient outcomes (Berkow, Virkstis, Stewart, Aronson, Donohue, 2011; Burrell, 2014; Fero, Wisberger, Wesmiller, Zullo, Hoffman, 2009; Swart, 2016). Technology exposure and use need to be an integral part of nursing education. The integration of technology will assist the nursing student to safely visualize and provide care for patients in a learning environment that has no real patient who could be harmed. Technology will enhance learning by emphasizing individual learning styles, mastery of concepts, flexibility, and accessibility. It is essential for faculty to be competent and confident in the use of technology. It is imperative that faculty stay at the forefront of technology to educate the future care provider in navigating patient care (Aglen, 2015; Murray, 2016; Skiba, Connors, Jeffries, 2008; Tacy, Northam, Wieck, Lynn, 2016).

Project Plan and Evaluation

Market/Risk Analyses

When faculty were asked their preferred methodology for VR education, 75% stated they favored independent learning modules, accessible information available twenty-four hours a day every day, hands-on experience and strong technology support (Bhattacherjee, Hikmet, 2008; Fiedler, Giddens, North, 2014; Georgina, Olson, 2008; Huang, Deggs, Jabor, Machtmes, 2011). It was reported that participants who were taught academic content with technology had higher levels of retention than those with just didactic delivery (Roney, Westrick, Acri, Aronson, Rebeschi, 2017).

An online learning module on the use of Z Space VR benefits the faculty at Joliet Junior College by allowing them to participate at their own pace. Participation in this learning module improves the knowledge and skill of the nursing faculty in VR use, and therefore incorporating VR into the classroom and meeting the technology expectations of the nursing students.

Strengths, Weaknesses, Opportunities, and Threats

The strengths of the project included access to twenty full-time faculty members; and current purchased virtual reality technology software which includes vendor mentors and support as well as a 24-hour support system which can be accessed via text or phone for the software and administrative support for the project. The Dean of Allied Sciences and the Nursing Chair are committed to using technology in healthcare education and supported that commitment through funding and space allocation. Also, the Information Technology department of the organization is committed to increasing faculty use of VR technology and has agreed to provide 24/7 support to all faculty and students. Finally, the acquisition of this technology is being used for marketing allied health programs to the community so maximizing how best to use the virtual reality software is critical.

Identified weakness include limited time for completion of the project, and faculty refusal to participate due to lack of time on their part to complete the module when it is available due to teaching schedules and other responsibilities. Another weakness of the project was the limited size of participants. The entire nursing faculty at Joliet Junior College consists of 20 faculty members.

Joliet Junior College, where the project will take place, recently was awarded a $20,000 grant to purchase five immersive VR units and software but without needed training in the use of

VR, these units and software may go unused or not used to the maximum benefit of the students. This project has the potential to increase faculty's competence and self-efficacy in the integration of VR technology and thus maximize the use of the purchased software and conduct research on best practices for this technology.

Additionally, there are opportunities to attract more students to the college and faculty becoming subject matter experts (SME) in VR. Becoming SMEs would allow them opportunities to present at conferences, support local hospitals for skills verification and thus increase the reputation of the college

A possible threat to the participation in the project would be other colleges or vendors providing the same education for faculty at different times or the software becoming outdated and no longer supported by the vendor or desired by faculty. Another possible threat includes research not showing specific best practices for VR implementation did not include this software.

Driving and Restraining Forces

There is significant research supporting how VR can complement nursing education by allowing nursing students to practice care for virtual patients in a safe, virtual environment where error becomes a learning event rather than a potential adverse event. Furthermore, the rapid development of technology and cheaper costs have made VR more accessible to nursing faculty than ever before (Christensen, 2002; Rizov, Rizova, 2015; Urick, 2016;) and with renewed emphasis on active versus passive learning, and today's multigenerational students growing up with technology and now demanding its use be part of their learning tools (Boctor, 2012; Ferguson, Davidson, Scott, Jackson, and Hickman; 2015; Hoke, Robbins, 2005; Walker, McMahon, Rosenblatt, and Arner, 2017) faculty are now, more than ever, being challenged to implement technology including VR experiences into the curriculum (Martin-Gutierrez,

Millennials (defined as people born between 1981 and 1996) grew up in the digital age and expect technology in the classroom (Mareco, 2017). Millennials are exposed to VR technology in gaming, mobile applications, and entertainment. In 2016, VR revenue was predicted at $4.4 billion; the actual revenue reported was only $2.7 billion (Merel, 2017). This surge in revenue was caused by the success of Pokémon Go, which is a free mobile application using virtual reality technology. Statista (2016) reported that 46% of 18-29 years old individuals played Pokémon Go. As a result of digital consumption, nursing students are coming to class expecting interactive technology use (Button, Harrington, and Belan, 2013; Clark, Glazer, Edwards and Pryse, 2016; Hoke and Robbins, 2005; Urick, 2016).

Bandura (1997) stated, "the major goal of formal education should be to equip students with the intellectual tools, efficacy beliefs, and intrinsic interests needed to educate themselves (p. #1)." For nursing faculty to become competent and confident in the use of VR, they need to view the education as worthwhile, obtainable, current and will benefit the student and profession (Bandura, 1997; Bilings, Halstead, 2012; Elsaadani, 2013; Moule, Ward, Lockyer, 2011; Roney, Westrick, Acri, Aronson, Rebeschi, 2017; Urick, 2016).

Finally, faculty have a strong desire to learn and integrate VR technology into the nursing curriculum but report lack of a vehicle for doing this independently (Dalhem, Saleh, 2017; Doswell, Braxter, Dabbs, Nilsen, Klem, 2013; Jeffers, Mariani, 2017; McNeil, Elfrink, Bickford, Pierce, Beyea, Averill, Klappenbach, 2003; Sorcinelli, 2007). Several articles emphasized the need for faculty education for implementation of interactive technology into the nursing curriculum (Buttton, Harrington, and Belan, 2013; Day-Black, Merrill, Konzelman, Williams, and Hart, 2015; Clark, Glazer, Edwards, and Pryse, 2016; Sargent and Miles, 2016). Included in driving forces were faculty desire to implement VR into the

classroom, student demand for technology in education and technology use in healthcare. Restraining forces included faculty time constraints, nursing faculty lack of participation, and faculty's resistance to change. Faculty availability for training, motivation to complete the training, their level of comfort with self-directed learning and fears they may have of change and perhaps of not being needed with the new technology replacing them are restraining forces which will be minimized by administration and nursing support for faculty involvement, time module is available to faculty use, faculty may progress at own pace, availability of hardware for "hands-on" experience and education on how technology compliments faculty instruction.

Faculty previous experience with VR technology may also be a restraining force. At this Midwestern community college, nursing faculty have had limited access to the VR technology, mainly due to the recent purchase of equipment. Another restraining force is the time required by the faculty to complete the learning module. As the semester progresses, it becomes difficult to add another time commitment.

Need, Resources and Sustainability

Resources. Resources available included a course management system all faculty had experienced with, VR equipment housed in the nursing building, and the computer lab assistant(s) are well versed with the equipment, and available whenever the nursing building is open. Access to information technology support will be available both on and offline.

Sustainability. The learning module was created in the course management system. This information will continue to be available to all faculty all the time regardless of participation in the study or not. Adjustments may be made to the module based on feedback from the study and will be updated as new technology is purchased for nursing faculty use. The project developer is responsible for these updates until reassigned by the administration.

Stakeholders. The stakeholders for this project include nursing faculty, nursing students, administrator at the college, the software engineers, ITS and potentially hospitals that use the technology for a skill competency evaluation, patients the graduates serve and insurance companies

Project Team. The project team included the investigator, the Capstone advisor at Regis University, Dr. Lynn Wimett, and project mentor. Additional services for Information Technology support, Mr. Jim Serr, and Instructional Design Assistance, Dr. Chris Ostwinkle, were included in the team. Dr. Mary Beth Luna, Chair of the Nursing Department, provided administrative support.

Cost-benefit Analysis

The total cost of this project was $13,810.00 (Z Space equipment and LMS available at institution), however, if replicated would be approximately $39,985.00 (see Table 1).

Table 1

Market and Risk Analysis Projected

Item	Cost
Time spent learning best practices for VR use	$50/hour x 40 hours = $2,000.00
Time to develop module	$50/hour x 40 hours = $2,000.00
Faculty time to complete the module	Average faculty salary is $100,000/year $48/hour x 6 hours=$288.00/faculty 20 faculty x $288.00=$5,760.00
Technology Support (IT) (if not supported in house)	$85.00 per unit times 5 units $425.00

Principal Investigator time to complete project	$4,000.00
Printing costs-FAQ SHEET	$50.00
Laptops and VR software	5 Units at $5,000/each $25,000.00
Mounting carts and cables	5 Carts at $150/each $750.00
Total	$39,985.00

The total cost of the investigators time, participants' time, IT support, printing costs, hardware-laptops, carts and cables, and VR software would be approximately $39,985.00. There would be no cost for a subscription to survey monkey and the college provides free access to the course management system. Dennis (2017) states that integration of technology into educational systems has great impact worldwide higher education. VR allows students to experience dynamic learning in the classroom and create high-tech learning environments (Grajek, 2018; Piatt, 2017; Kimball, 2017). The real benefit is that more technology will be used in the classroom resulting in active learning, safe student environment, student expectations, and safer patient care. While these are benefits, there is no way to quantify the price. The better-prepared nurses provide better patient outcomes which is not quantifiable and is beyond the scope of this study but is part of the vision.

Future benefits may include increasing use of VR in the classroom and clinical setting, increase clinical reasoning by students, better patient outcomes and increased enrollment in nursing courses, decreased dependence on outside agency clinical space.

Mission

The mission for this project was to test if an organized, structured, comprehensive continuing educational module designed to teach faculty how to maximize the use of Z Space VR software increased faculty competence and self-efficacy in maximizing the use of this software.

Vision

The vision for this project continues to be to maximize preparation of 21st century nursing students to provide enhanced evidenced based nursing care through increased use of technology to not only enhance student learning but to remain on the cutting edge of best educational practice, attract technology-savvy faculty and students to the college, and potentially support local hospitals in using virtual reality software to update competency and skill set of their nursing staff.

Project Goals and Objective

The goal for this project was to increase self-efficacy and competency of nursing faculty in the use of virtual reality software. Although beyond the scope of this project, a long-term goal would include increase implementation of technology in the classroom or online to maximize applications for VR use in nursing courses designed to facilitate student learning and application to practice as RNs. The objective of this project was to develop a teaching module that facilitates increased competence and self-efficacy of study participants in the use of Z Space software as measured by differences in pre-and post-tests.

Methodology

This quality improvement study used a pretest-posttest design to evaluate the effectiveness of a learning module designed to increase participants competency and self-efficacy on how to effectively use Z Space software to enhance student learning. Although the data collected was ordinal level as a five-point Likert scale, Likert scales may be used as interval level data for descriptive studies comparing testing results since the sum of Likert-type items can be a reasonable approximation of an interval data point (Polit 2010, p 90). A paired sample t-test was conducted to compare the mean competency and self-efficacy in VR use before and after participating in the educational module.

Population

A purposive convenience sampling included full-time nursing faculty members currently employed at Joliet Junior College that had access to the Z Space software and permission to use it in their courses when appropriate. Some faculty may have chosen not to participate based on workload, experience with VR or time constraints.

Intervention

The teaching module was created using Roger's cognitive theory for experiential learning. Cognitive components of the module focused on how to access VR software, best practices for using that software that was provided by the vendor (Z Space Central), and included active learning exercises for participants to develop activities with the software within the module. In theory, this helped participants to be physically engaged with the software and practice its use within the module where step-by-step directions were available (See Appendix D).

Measurement Instrument

An online self-report, forced choice, five-point Likert scale survey tool was designed to measure participants competence and self-efficacy of using the VR software Z Space pre-intervention and post-intervention. The tool included a unique code to pair results pre-intervention with the results post-intervention confidentially. No names were attached to either the pre or post self-report instrument. Face validity was established by eight subject matter experts in the field of VR use in education outside of Joliet Junior College. Reliability, using Cronbach alpha was measured at 0.695 (N=5) for the pretest and 0.876 (N=5) for the post-test. (See Appendix E for a copy of the survey tool).

Project Findings and Analysis

Population

Eighteen members of the faculty that met inclusion criteria agreed to participate in the study; however, only 13 faculty completed the pre-test survey and only 12 completed the post-test survey. Reasons faculty chose not to complete the study was not documented; however, it was postulated that the time required to participate in the study might have been prohibitive for some faculty that were overwhelmed with other demands on their time or simply a lack of interest in the VR software use. A power analysis showed that a sample size of 25 was needed to minimize a type I or type II error. Not reaching power was a limitation of the study. Additional descriptive demographic data was not collected to help prevent data identifying a specific participant.

Results

A paired sample t-test was conducted with SPSS software to compare the difference between the pre- and posttest questions. The paired sample t-test demonstrated a difference in

scores between the pretest (N=60, M=2.33, SD=1.084) when compared to the posttest (N=60, M=3.93, SD-.660, t = -9.798). These findings demonstrated that the educational intervention resulted in a difference between the two group's mean; however, since all questions were grouped, it was impossible to determine if the variability was caused by an increase in competency, self-efficacy, or both (See Appendix I). The decision was made to separate the question themes and run a paired split sample t-test to extract the results of the two competency questions from the three self-efficacy questions.

When the questions were separated into those measuring self-efficacy and those measuring competency, the paired split t-test found both competency and self-efficacy survey scores improved post intervention. The competency pretest (N=24, M=2.00, SD-.978) compared with the competency post-test (N=24, M=3.92, SD=.584) was significant with a t score equal to minus 6.678 ($p<0.05$). Self-efficacy paired split t-test results for pretest (N=36, M=2.56, SD. 1.107) and posttest (N=24, M=3.92, SD=.584) were also significant (t-test = -7.523, $p<0.05$) (See Appendix G).

The paired split sample t-test identified significant variability ($p=>0.05$) between the pre-intervention test scores and the post-intervention tests for both competency and self-efficacy; but the sample size was very small and this may have impacted the results. A Cohen's d is not influenced by small sample size. When it was performed to measure the effect size based on the distance between the means of the groups, it demonstrated a large effect (1.83), further supporting the efficacy of the intervention to increase competency and self-efficacy in using the Z Space software (See Appendix H).

Limitations, Recommendations, Implications for Change

Limitations

The small number (N=13) of participants was a limitation of the study as was the short timeline for the study and that it conducted during a hectic time for potential subjects which may have limited participation or time participants could spend in the learning module. Other limitations included the use of a self-reported force-choice instrument, the same pretest, and posttest given within three months of each other, having only five questions on the test (two competency questions and three self-efficacy questions), and only establishing face validity for the test. Using ordinal level data as interval level data for statistical analysis, and the fact that all participants knew the project investigator also limited the validity of the results. Knowing the investigator may have skewed the results for some participants that wanted to please the researcher. The lack of demographic data and forced choice responses without opportunity for participants to make comments did not allow the capture of any qualitative data. These limitations with small sample size, made it beyond the scope of the study to judge the effect of extraneous variables such as pre-requisite knowledge of using VR software, teaching experience in general or to measure external validity of the study.

Recommendations

It is recommended that future studies be conducted with a larger and more heterogeneous sample and with a measurement tool that allows capture of qualitative data and controls for some extraneous variables to generalize the above findings to other populations. It is also recommended to continually assess what faculty believe they need to feel competent and motivated to use Z Space software and update the learning module based on assessment findings and evaluation of the current module. Finally, continued research to evaluate if

gaining competence and self-efficacy results in the greater use of the software and if greater use does enhance student learning.

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Appendix A

Systematic Review

Article/Journal	Integrating information technology's competencies into academic nursing education-an action study. *Cogent Education*	A multidisciplinary team approach to faculty development in technology. *Poster Presentation at Brightspace Minnesota Connection*
Author/Year	Gonen, A., Sharon, D. & Lev-Ari, L. (2016)	Pierce, T. (2016)
Database/Keywords	PubMed: educators, nursing students, information technology, competencies, curriculum change	PubMed: nursing faculty, technology, faculty development, informatics, technology in the classroom
Research Design	Qualitative study involving an action research process. A meta-analysis method	Qualitative study involving a defined cohort. Meta-analysis method
Level of Evidence	Level VI: Evidence from a single descriptive or qualitative studies (met-synthesis)	Level IV: Evidence from well-designed case control or cohort studies
Study Aim/Purpose	The purpose of this study is to advance the information technology knowledge and competencies to the population of nursing students and educators. In this study the target aim is to be achieved by making changes that will encourage nurses to use technology to enrich their knowledge and care of patients.	The purpose of the study was to determine if the use of a multidisciplinary support team increased faculty adoption of technology when compared to self-initiated learning.
Population/Sample size Criteria/Power	59, first and second year nursing students participated in a pencil and paper survey to ensure that using a computer would not post a threat or hindrance to compliance. All younger than 30 years of age. The cohort was evenly split between Jews and Muslims. 58% had not participated in a basic computer course and 71.2% had less than 4 years of computer experience. 52.5% had access to computers at home. 3 nursing educators and 3 recent nursing graduates were interviewed to represent faculty.	A faculty technology survey was sent to all faculty related use on iPad use, development and preferences. 13 full time faculty were invited to attend the workshops/seminars. No demographics regarding this population was provided. At the completion of the seminars, a post evaluation survey was sent out to all who attended. 5 workshops were held and all faculty invited, topics focused on using the iPad in the classroom and collaboration with the learning management system.
Methods/Study Appraisal Synthesis Methods	The study involved interviews with faculty members and recent nurse graduates employed in the	Emails were sent to each faculty pre and post workshops. 10 workshops were held, 5 topics

	hospital. A needs and attitudes assessment survey aimed at nursing students. To assess student's attitude and their knowledge and competencies in IT, descriptive statistics were used. Content analysis was used to assess interview results.	covered, 2 different times for each. The post project survey gathered anecdotal information and determine change in iPad use. Pre and post questionaries' were used to assess the effectiveness of the intervention (workshops). All questionnaires were scored using SPSS Wilcoxon Pairs Test.
Primary Outcome Measures/Results	The study identified the necessity of integrating informatics into the nursing curriculum. Due to interview's data, significant consideration was given to prioritization-incorporation of new and accessible modes of teaching, including situated learning/technology. The study also identified that information technology knowledge and experience can contribute to the student's positive attitudes towards working with technology and becoming competent with it. Also, the study identified the need for nursing faculty to be educated on technology and its' use in the classroom/clinical setting.	The study identified participants reported an increase in confidence following the training sessions (z value-3.937). The post survey 11 out of 12 faculty responded. The faculty rated (6) small group sessions and 1:1 assistance from the multiple disciplines as most beneficial, access to IT and content experts was rated most beneficial by 2 and 4 rated follow up sessions as most beneficial. 5 respondents reported using the iPad in the classroom/clinical setting several times (more than 3) and 5 respondents have not used the iPad as of yet. All respondents (n=11), reported that the timing of the trainings was the primary reason for low/no attendance.
Conclusions/Implications	Conclusion: Positive correlation with nursing student's attitudes towards computers and student's reported self-efficacy. The overall theme from this research demonstrated the need for innovation to be integrated within the larger body of the nursing curriculum.	Conclusions: This research demonstrated the need for faculty education on how best to implement technology into the classroom. The use of small group sessions with hands on learning and 1: assistance was well received by faculty and should be considered vital in faculty technology development. The data analyzed suggest that faculty confidence is increased by using a multidisciplinary team approach.
Strengths/Limitations	The strengths included support for the implementation of technology on a larger scale to educate the future care providers. Also, the need for new nurses to feel confident with technology use in the clinical setting. The limitations included: a small	The strengths of this study was a well-developed action plan to address their research question. The pre and post survey allowed for the collection of data to be analyzed for future revisions. Sustainability of the study is included in the development. The

	sample size, only 3 nursing faculty participated and no demographics were reported on this group.	limitations included a small sample size with no identifying demographics. Development of these sessions could be time (and cost) consuming for replicating the study.
Funding Source	None reported	None reported
Comments	This study supported the need for increasing technology in nursing education. And that faculty are key to this goal.	This study underlines the need for nursing faculty to have access to technology and education of that technology. Access to experts to assist them with learning and implementing is definitely a plus.

STUDENT NAME: ___Kathleen Wolz_____Systematic Review Evidence Table Format [adapted with permission from Thompson, C. (2011). Evidence table format for a systematic review. In J. Houser & K. S. Oman (Eds.), Evidence-based practice: An implementation guide for healthcare organizations (p. 155). Sudbury, MA: Jones and Bartlett

Appendix B

Logic Model

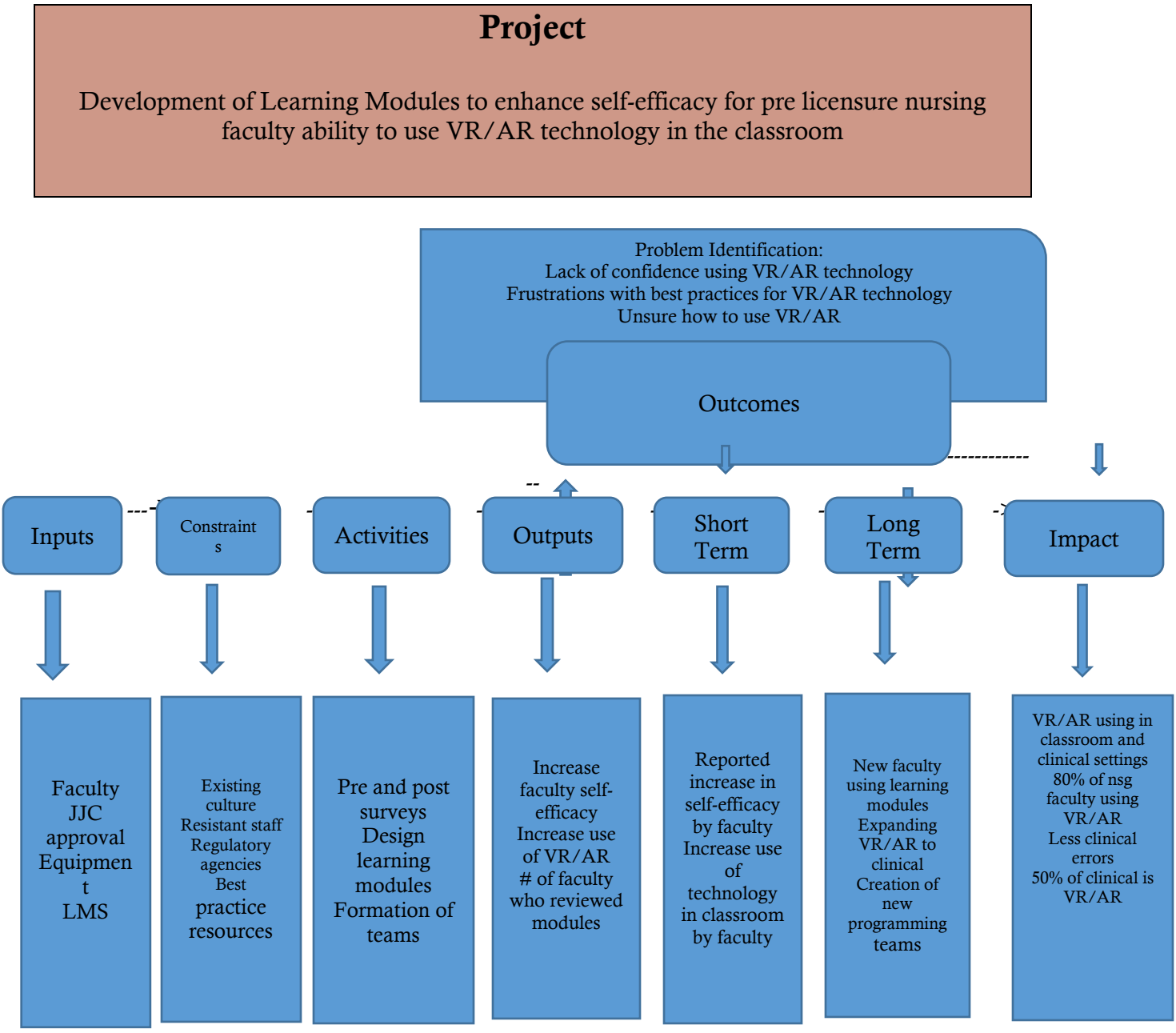
The Difference in Faculty Competence and self-efficacy in Z space use after Reviewing Learning Module

Resources	Constraints	Activities	Outputs	Short & Long Term Outcomes	Impact
Pre Licensure Nursing Faculty	Resistant pre licensure nursing faculty	Pre-survey to determine current confidence level of pre licensure nursing faculty using VR in the classroom	# of nursing faculty who report an increase in self-efficacy for VR use	Short term- Increase self-efficacy using VR in the classroom	Increase use of VR in both the classroom and clinical setting by 50%
Approval from Joliet Junior College Administration	Regulatory agencies (ACEN rules for classroom/clinical minutes and experiences	Design and implement module on educational use of VR in the classroom to include: 1. Procedure for reserving equipment 2. Setting up equipment 3. Best practices for use 4. Troubleshooting and problem identification and correction	# of nursing faculty who reviewed the learning modules	Short term- Increase implementation of technology in the classroom	The body of knowledge of best practices for VR in nursing education will increase by 100%
Faculty volunteers in the areas of computer programming and graphic arts	Lack of IT support	Develop a team of programmers and graphic artist	# of faculty using technology	Short term- New nursing faculty using learning modules	50 % of nursing faculty will continue to search to develop new uses for VR in the classroom/

					clinical setting
Access to VR equipment	Lack of resources on best practices for VR/AR	Post Survey for evaluation of learning modules		Long term-Expanding VR to clinical setting	Through use of VR in the clinical setting, nursing student omission/errors will be decreased by 99%
Access to LMS-Canvas	Existing culture			Long term-Increase updates to learning modules as new evidence becomes available	50% of clinical education will be provided in the VR setting.
				Long term-Creation by JJC team of new programs and applications of VR	VR education will be mandatory for all novice nursing educators

Appendix C

Project Flowchart



Appendix D

Z Space Virtual Reality Software Course

Course Description

This course is an online self-paced six session module designed to educate nursing faculty on the use of Z Space VR software in the classroom. This repository of information will assist you in your journey of using Z Space VR software to augment your teaching. Each session contains learning outcomes, videos, worksheets, and active learning methods.

Overall Goal

To increase competency and self-efficacy of nursing faculty in the use of virtual reality software

Example of Session Two

Topic: Creating animated power point presentations

Objectives: At the completion of this session, the participant will be able to:

1. Describe how to create specific theory content
2. Discuss how to embed VR content into theory presentation
3. Develop accompanying worksheets for presentation
4. Develop content using Z Space software

Video Lecture

Worksheet

Quiz

Appendix E

Pre/Post Test Instrument

Create unique identifier- will be used for both pre and posttest assessment					
	Strongly disagree **1** **(-75 to -95%)**	**Disagree** **2** **(-50 to -75%)**	**Neutral** **3** **(-25 to 25%)**	**Agree** **4** **(50 to 75%)**	**Strongly agree** **5** **(75 to 95%)**
I am confident to create content using Z space					
I am competent in setting up Z space in the classroom					
I am competent in supporting students in the use of Z space					
I can use VR as an active learning teaching strategy					
I can include Z space activities designed for application to practice for my students to meet course objectives					

Appendix F

Paired Sample T-test

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	pre	2.33	60	1.084	.140
	post	3.93	60	.660	.085

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	pre & post	60	.008	.952

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	pre - post	-1.600	1.265	.163	-1.927	-1.273	-9.798	59	.000

Appendix G

Split Paired T-test

Paired Samples Statistics

QCorQSE			Mean	N	Std. Deviation	Std. Error Mean
10	Pair 1	pre2	2.56	36	1.107	.184
		post2	3.94	36	.715	.119
11	Pair 1	pre2	2.00	24	.978	.200
		post2	3.92	24	.584	.119

Paired Samples Correlations

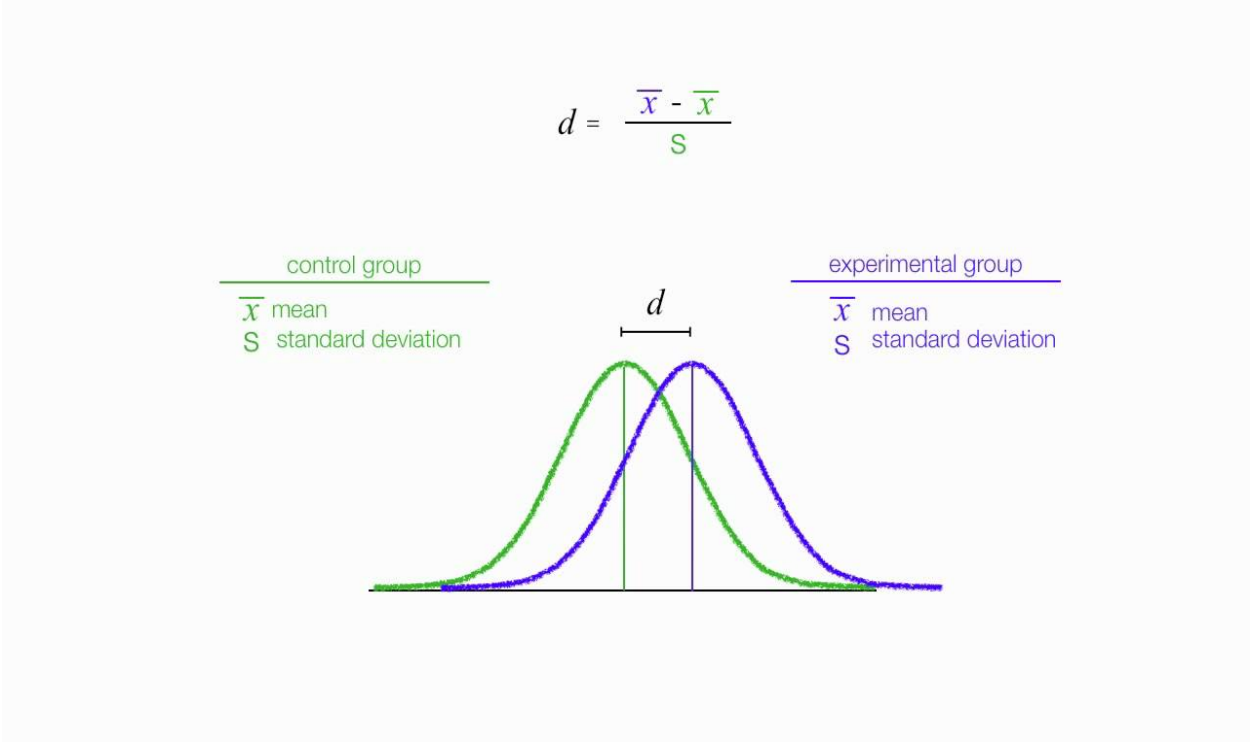
QCorQSE			N	Correlation	Sig.
10	Pair 1	pre2 & post2	36	.112	.514
11	Pair 1	pre2 & post2	24	-.229	.283

QCorQSE			Paired Differences					t	df	Sig. (2 tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
10	Pair 1	pre2 - post2	-1.389	1.248	.208	-1.811	-.966	-6.675	35	.000
11	Pair 1	pre2 - post2	-1.917	1.248	.255	-2.444	-1.390	-7.523	23	.000

Appendix H

Cohen's d

$$\frac{3.93 - 2.33}{0.872} = 1.83$$



D = greater than 0.8 is a large effect

https://www.youtube.com/watch?v=tTgouKMz-eI

Appendix I

IRB Exemption JJC

May 7, 2018

Dear Kathy,

This letter is to confirm that your IRB proposal for the Pre- and Post- Survey for Virtual Reality/Augmented Reality for Pre-Licensure Nursing Faculty conforms to relevant sections of 45 CFR §690; the Common Rule for the Protection of Human Subjects and 45 CFR §46; Public Welfare, Basic HHS Policy for Protection of Human Research Subjects. IRB review is not needed and the project is exempt. The research is exempt under the code of Federal Regulations. Any existing data utilized in the study, implementation and maintenance of this program is believed to be exempt from IRB approval per 46.101 of the code of Federal Regulations protecting human subjects as stated in 46.101(b)(4); Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. Should you require additional information regarding the project's IRB exemption, please don't hesitate to reach my office. Best of luck with your survey through this valuable research initiative. Please let me know if you have any questions or concerns.

Sincerely,

David Naze, PhD Dean of Academic Excellence and Support Chair,

JJC Institutional Review Board 815.280.2850

dnaze@jjc.edu

Appendix J

IRB Exemption Regis University

Please note that Regis University Human Subjects IRB has taken the following action on IRBNet:

Project Title: [1309974-1] Building Confidence and Self-Efficacy Using Z-Space Virtual Reality to Enhance Learning
Principal Investigator: Kathleen Wolz, MSN

Submission Type: New Project
Date Submitted: August 20, 2018

Action: APPROVED
Effective Date: September 10, 2018
Review Type: Exempt Review

Should you have any questions you may contact Alan Stark at astark@regis.edu.

Thank you,
The IRBNet Support Team

Appendix K

CITI Education

CITI PROGRAM

Completion Date 12-Feb-2018
Expiration Date 11-Feb-2021
Record ID 26166692

This is to certify that:

Kathleen Wolz

Has completed the following CITI Program course:

Human Research
Social Behavioral Research Investigators and Key Personnel
1 - Basic Course

(Curriculum Group)
(Course Learner Group)
(Stage)

Under requirements set by:

Regis University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w5dccc655-b0e4-4184-91ec-9ec498fcaf55-26166692

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI)
HUMAN RESEARCH CURRICULUM COMPLETION REPORT
Printed on 12/19/2013

LEARNER	Lynn Wimett (ID: 2059141)
DEPARTMENT	Nursing
EMAIL	lwimett@regis.edu
INSTITUTION	Regis University
EXPIRATION DATE	12/18/2016

BIOMEDICAL RESEARCH INVESTIGATORS AND KEY PERSONNEL

COURSE/STAGE:	Refresher Course/2
PASSED ON:	12/19/2013
REFERENCE ID:	11564757

REQUIRED MODULES	DATE COMPLETED
Biomed Refresher 1 - Instructions	12/19/13
Biomed Refresher 2 – History and Ethical Principles	12/19/13
Biomed Refresher 2 – Regulations and Process	12/19/13
Biomed Refresher 2 – Informed Consent	12/19/13
Biomed Refresher 2 – SBR Methodologies in Biomedical Research	12/19/13
Biomed Refresher 2 – Genetics Research	12/19/13
Biomed Refresher 2 – Records-Based Research	12/19/13
Biomed Refresher 2 – Research Involving Vulnerable Subjects	12/19/13
Biomed Refresher 2 – Vulnerable Subjects – Prisoners	12/19/13
Biomed Refresher 2 – Vulnerable Subjects – Children	12/19/13
Biomed Refresher 2 – Vulnerable Subjects – Pregnant Women, Human Fetuses, Neonates	12/19/13
Biomed Refresher 2 – FDA-Regulated Research	12/19/13
Biomed Refresher 2 – HIPAA and Human Subjects Research	12/19/13
Biomed Refresher 2 – Conflicts of Interest in Research Involving Human Subjects	12/19/13
How to Complete the CITI Refresher Course and Receive a Completion Report	12/19/13

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI Program participating institution or be a paid independent Learner. Falsified information and unauthorized use of the CITI Progam course site is unethical, and may be considered research misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Program Course Coordinator