2022

Effect of Simulation Learning on Graduate Student Attitudes Toward Interprofessional Teams and the Team Approach to Care

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This is to certify that the doctoral dissertation by

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has been found to be complete and satisfactory in all respects,
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Walden University
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Abstract

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MPhil, Walden University, 2021

DPT, Temple University, 2007

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

According to health care reports, more than 250,000 deaths annually are attributed to medical error, prompting interprofessional education (IPE) initiatives as one way to improve healthcare delivery. The problem is that little is known about the effect of simulation learning with standardized patients on occupational therapy (OT) and physical therapy (PT) students' attitudes toward IPE. The purpose of this causal-comparative study using a pretest–posttest nonequivalent control group design was to investigate the difference in posttest scores on the Students' Perceptions of Interprofessional Clinical Education—Version 2 (SPICE-R2) between first-term graduate OT and PT students who participated in a simulation and those who did not, while controlling for pretest SPICE-R2 scores. The SPICE-R2 generates a total score as well as three subscores for teamwork, roles, and outcomes. The theoretical frameworks were Kolb's experiential learning and Pardue's framework for IPE. Data from 25 students in a control group and a random sample of 25 students from 217 students in a simulation group were used in a one-way analysis of covariance. Results indicated no statistically significant difference between the control and simulation groups in posttest scores with a pretest covariate. This study contributes to positive social change by furthering the investigation of simulation effectiveness and provides a foundation for future studies related to different timing, length, outcome alignment, and frequency of simulation. This study contributes understanding regarding the preparation of OT and PT students to be part of a collaborative practice-ready workforce designed to reduce medical error and patient death.

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Dedication

I dedicate my dissertation work to my dad, Danilo Panag Belleza. How I wish you were able to see me reach this milestone. Your love for your family, great sacrifice to provide for everyone, and unconditional love, humor, and dedicated work ethic has resonated in the hearts of all you touched. Your influence and life's work has carried across lands and seas. We miss you every day, dad. To my mom, Esther Cadiz Beleza, thank you for always believing in me, inspiring my passions, cultivating and investing in my talents, and for loving sacrifices to allow better opportunities for us all. My life has been blessed with the love and sacrifices of my parents. I also dedicate this dissertation work to my brother Bobby, sister-in-law Lori, and niece Taylor. Thank you for always supporting me and for sharing in the greatest joys in life's peaks and valleys.

Finally, I would like to dedicate this dissertation work to my best friend, spouse, and most wonderful person, Chris Oswald. We both started ventures at the same time in 2017, and I am so happy to see us both on the other side of our respective journeys. Thank you for love, encouragement, unwavering support, and looking after the reflection of your heart (including Breck and Kona) through life's challenges and celebrations. Also thank you to your family for sharing in all our achievements and adventures.

To my best friends Amando and Scott, all my extended family, fellow USA faculty, and close friends, thank you for always cheering me on to cross this finish line. I hope that I am as much a wonderful and positive influence in your lives as you are to me. I will finish with a famous quote by the writer William Faulkner, “You cannot swim for new horizons until you have the courage to lose sight of the shore.”

Acknowledgments

There are times when words fail, where words cannot adequately communicate the heart-felt depth of gratitude and appreciation for the mentorship and guidance that one has received through the care and compassion of others. Such is the state in which I find myself as I acknowledge the unparalleled excellence in teaching and kindness of spirit afforded to me from my mentors and committee who have supported me in this journey. Thank you from the bottom of my heart to Dr. Darci J. Harland, Dr. Richard Hammett, Dr. Shereeza Mohammed, and Dr. Beate Baltes. To Dr. Harland, thank you for inspiring me from day one on my PhD journey. Pictures, images, and analogies helped light my path and gave me sure footing in every step of the dissertation process. Your passion, enthusiasm, inspiration, and care that has been given throughout this venture has touched my heart and soul. Thank you for celebrating my happiest and challenging moments in life.

To Dr. Richard Hammett, I learned years of knowledge in the time that you spent with me in tele-conferences and the carefully crafted feedback to improve my writing, thoughts, and perspectives. I cannot tell you how much trepidation I had even thinking about methodology and statistics. Masterfully, you guided me through the waters of statistical analysis, and once you showed me how to navigate, I was well on my way. Thank you for tremendous wisdom, kindness, and patience to help me learn and grow.

Thank you Dr. Shereeza Mohammed and Dr. Beate Baltes for providing the continued guidance to help see my prospectus, proposal, and final study to its completion. To all of you in my committee and to the Walden University family, thank you for

walking hand-in-hand with me to help me add my voice to the global chorus of scholar-practitioners. I look forward to continued growth to be a social change agent through the work that I do.

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Chapter 1: Introduction to the Study

Introduction

A World Health Organization (WHO, 2010) report found that medical error was one of the leading causes of mortality, which had a significant influence on the healthcare sector. Recent studies have continued to report that more than 250,000 deaths have been accounted for annually by medical error and have possibly been linked to areas such as poor team dynamics (Arth et al., 2018; Sibert, 2018). As a result of the WHO report, the Interprofessional Education Collaborative (IPEC) was formed from various member organizations to establish core competency standards for interprofessional education (IPE) in academics and clinical practice. Healthcare initiatives are targeted to achieve what is often referred to as the triple aim: (a) improvement of the patient care experience, (b) improvement of the health of populations, and (c) lowering healthcare costs (Boyers & Gold, 2018; IPEC, 2011; Johnson, 2017; Stockert & Ohtake, 2017). Interprofessional education (IPE) is defined as occurring when students from two or more professions learn with, from, and about one another to improve collaboration and health outcomes (IPEC, 2016; WHO, 2010). A review of the current literature revealed a plethora of IPE studies across the spectrum of healthcare disciplines, including medicine (Coggins et al., 2017; Rojas et al., 2016), nursing (Homeyer et al., 2018; Humbles et al., 2017; Nikendei et al., 2016), occupational and physical therapy (Bethea et al., 2019; Coppola et al., 2019; Pitout et al., 2016), pharmacy (Fusco & Foltz-Ramos, 2020; Gordon et al., 2017; Shaikh et al., 2020; Timmis et al., 2018), and other health providers. In addition, current studies have been conducted on the myriad of ways to deliver IPE, such as role-playing (Kirwin et al., 2017), case studies (Goreczny et al., 2016), lectures (Oxelmark et al., 2017), and simulation (Bethea et al., 2019; Carson & Harder, 2016; Costello et al., 2017; Fiona & Kay, 2019; Mills et al., 2020; Sabus & Macauley, 2016; van Wyk et al., 2020). This study explored the effect that simulation learning had on graduate occupational therapy (OT) and physical therapy (PT) students' attitudes toward interprofessional (IP) teams and the team approach to care.

This quantitative study could have implications for educational stakeholders, including students, faculty, administrators, and academic leadership. Armed with an understanding of simulation learning and its influence on their knowledge, skills, and attitudes, students can improve their collaboration and performance when they enter clinical practice (Hamson-Utley et al., 2021). IP simulation may allow students to learn from one another, be practice-ready clinicians, and be part of a collaborative workforce. Faculty consider different learning methods, pedagogy, and ways to deliver content and evaluate what is the best practice to achieve desired learning outcomes. Simulation may influence students' attitudes toward the IP team and the dynamics of IP collaboration. Faculty may consider integrating into their learning modules to improve IPE opportunities within the courses they teach. Administrators and academic leaders may use the information from this study to weigh the cost and benefits of investment in simulation learning resources to improve student IP attitudes. Then, they may assess whether there can be enhancement of skills and outcomes to prepare students better to enter the workforce. Those who implement IPE endeavors seek to improve healthcare delivery by enhancing the dynamics of IP team care. Hopefully, improved IP collaborations can meet the triple aim of improved patient experiences, improved outcomes, and decreased healthcare costs. My study explored the effect of simulation on student attitudes toward IP teams and the team approach to care and may contribute to positive social change. A better understanding of IP simulation's effect on students may help to improve learning opportunities for future students in preparation for real-world clinical practice. As IP practice-ready clinicians, students can enter the workforce as social change agents to improve healthcare delivery and the health of patient populations through IP approaches to teamwork and a team approach to care.

Chapter 1 begins with an overview of the themes of my study expanded upon in background literature. The research problem, the purpose of the study, and the research questions then follow. The chapter also addresses the nature of the study and definitions of major terminology. Chapter 1 concludes with discussions on the study's assumptions, scope and delimitations, and limitations, as well as the significance of the study's contribution to the field of education.

Background

The WHO (2010) defined IPE as involving students from two or more professions learning together to foster collaboration and improve health outcomes. In 2011, in response to a WHO report, IPEC was established to create a framework for IPE. In 2016, IPEC reconvened to update the IPE framework, and an increasing number of healthcare organizations, including OT and PT, joined the organization (IPEC, 2016). Within the academic disciplines of OT and PT education, studies have explored the importance of integrating IPE into programmatic and institutional learning outcomes (Hughes et al., 2019; Johnson, 2017; Moyers & Metzler, 2014; Palangas et al., 2015; Reeves et al., 2016; 2017). Educational accrediting bodies of all the respective healthcare disciplines have emphasized the importance of IPE, including accrediting bodies of OT and PT, with endorsements from the American Occupational Therapy Association (AOTA) and the American Physical Therapy Association (APTA), respectively (APTA, 2017; Commission on Accreditation in Physical Therapy Education [CAPTE], 2019; Johnson, 2017; Uhlig & Raboin, 2015). According to Hamson-Utley et al. (2021), when there is increased IP collaboration in healthcare settings, there is improvement in patient outcomes linked to efficient workflow and cooperative team dynamics. Integrating IPE in the academic training of healthcare students could usher in the needed changes recommended by the WHO, IPEC, and IP organizations and accrediting bodies. The introduction and assessment of students' attitudes linked to the IPEC core competencies could lay the groundwork for future learning and collaborative partnerships with other healthcare providers. This study used the Students' Perceptions of Interprofessional Clinical Education—Version 2 (SPICE-R2), a validated outcome measure derived from the IPEC core competencies. The SPICE-R2 consists of 10 questions that measure IPE attitudes in four areas, with the first being the overall tool and total score for students' IPE attitudes in IP teams and the team approach to care (Total SPICE-R2). In addition, the SPICE-R2 consists of three subscores that measure the following areas: (a) IP teamwork and team-based practice (Teamwork); (b) roles and responsibilities for collaborative practice (Roles); and (c) patient outcomes from collaborative practice (Outcomes). The effect that simulation learning has on OT and PT students' IPE attitudes can usher in desired changes proposed by the WHO, IPEC, IP organizations, and educational accreditors to improve the health of populations and communities.

This study may contribute new knowledge for IPE outcomes and incorporate desired accreditation standards set forth by the AOTA and APTA in OT and PT curricula. From the myriad of IP learning activities available, this study specifically focused on simulation and the influence that simulation had or did not have on students' IP attitudes. Wilson and Wittmann-Price (2015) defined simulation as a preplanned activity occurring within a specified space and time, allowing participants to interact with one another and technical artifacts within the environment. Additionally, the simulation of this study used a standardized patient (SP) for student interactions within the preplanned scenario. Simulation learning did not exist for the course where student archival data were used for this study. Therefore, simulation was an innovation for the course and curriculum in this study. Figure 1 illustrates a simulation with student participants interacting with a SP in a preplanned scenario and student observers viewing and listening in an observation room and behind a one-way glass mirror.

Figure 1

Simulation with a Standardized Patient

Note. From *Experiencing IPE: A Framework Integrating IPEC Standards in Multi-Disciplinary Education*, by N. C. Belleza & M. Johnson, 2020, Physical Therapy Collection SOAR at USA Scholarship and Open Access Repository (https://soar.usa.edu/pt/65/). Reprinted with permission of N. C. Belleza & M. Johnson.

This study uses the term *simulation learning* over the common terminology of *simulation* often used in the current literature. This is because of the focus on students' attitudes, as well as simulation learning's alignment with neuroscience and adult learning theories that describe the sensory processing, connections through association, and physical changes that occur in the brain when learning occurs (see Zull, 2006). Zull (2006) also expanded on the notion that learning occurs when students develop their representations instead of knowledge transferred to them for students to effect an attitudinal change. Furthermore, according to Zull, students should pass through stages of experience (i.e., simulation) to discern, compare, and form new wisdom and learning.

One of the significant considerations of simulation is using the type of patient based on the desired learning and activities. Low-fidelity mannequins or high-fidelity mannequins have improved student performance in team dynamics and providing care (Kunst et al., 2017; Roberts & Cooper, 2019; Sherwood & Francis, 2018; Weiss et al., 2016). The world of virtual learning encompasses many environments and innovations in delivering simulation. Among the virtual learning environments are virtual worlds with patients portrayed in a digital environment (Englund, 2017; Winkler et al., 2017), augmented reality (Carlson & Gagnon, 2016), serious games (Hooran et al., 2019; Tubal et al., 2019), virtual SPs (Tandy et al., 2016; Taylor et al., 2017a), and virtual reality (Forgione & Guraya, 2017; Hsieh & Lee, 2017). The SP is defined as a trained person to simulate patients with conditions and portray scenarios designed by the simulation author (Palangas et al., 2015). The literature has many disciplines that use the SP in simulation learning in athletic training (Kinslow et al., 2019), medicine (Jerant et al., 2017), nursing (Byrne, 2020), OT (Johnson, 2017), and PT (Phillips et al., 2017). There is a gap in the literature exploring the effect of simulation learning with a SP among OT and PT students. There is also a lack of experimental studies that use a control group not participating in simulation versus participating in simulation to compare differences among those variables. The methodology of this study used a control group and a simulation with a SP group. This study's research method and design fill a gap in the literature exploring the effects of simulation learning with a control group.

Simulation can be further categorized in ways that address improvements in technical skills and nontechnical skills. Technical skills are defined as hands-on skills needed to provide and administer care to the patient. Respiratory therapists and medical students have been studied in delivering ventilator care (Rojas et al., 2016), medical students managing anaphylaxis, shock, and myocardial infarction (Coggins et al., 2017), and nursing, medical students, and PT managing myocardial infarction and diabetes (Nikendei et al., 2016). Most IP simulation studies are dedicated to improving nontechnical skills such as knowledge, teamwork, collaboration, and communication (Gordon et al., 2017). Conducting a literature review yielded numerous qualitative and quantitative studies on nontechnical skills and IP simulation. In a qualitative study, Pitout et al. (2016) improved social skills and confidence in providing care among a team of medical, OT, and PT students in an outpatient clinical setting. Quantitative studies among PT and nursing students found improved nontechnical skills in shared learning, teamwork, professional identity, roles and responsibility (Cunningham et al., 2018), and socialization and valuing scales (Karnish et al., 2019). There is limited research on the effects of IPE among OT and PT students (Stockert & Ohtake, 2017) or controlling for simulation with a control group.

This study contributes knowledge and fills the gap of what is known or not known about the effect that simulation learning with a SP has among OT and PT students. Additionally, using a standardized and validated outcome measure helps establish best practices using a battery of tests or tools in healthcare educational curricula. Improving IPE has social implications by fostering IP teams and the team approach to care to prepare students as practice-ready clinicians. Students entering the workforce with IP experiences and skillsets have the potential to improve healthcare delivery as IP collaborative healthcare providers. This study was needed to contribute to the gap of knowledge on the effect that simulation has on OT and PT IPE attitude scores on the Total SPICE-R2, Teamwork, Roles, and Outcomes.

Problem Statement

The problem related to this study addresses the troubling healthcare report findings that medical error is one of the leading causes of death, with more than 250,000 deaths per year (Arth et al., 2018; Sibert, 2018; WHO, 2010). To improve the delivery of healthcare, the IPEC (2011) instituted an IPE framework of core competencies to improve the health of populations, improve the experience of care, and lower healthcare costs (Boyers & Gold, 2018; Johnson, 2017; Stockert & Ohtake, 2017). Educators and clinicians have used various teaching methods to integrate IPE in academia and clinical practice. The use of simulation is one innovation that can facilitate IPE (Brennan et al., 2021; Goreczny et al., 2016; Kirwin et al., 2017; MacKenzie et al., 2017; Paige et al., 2017; Wellmon et al., 2017). Incorporating IP experiences in academia and clinical practice aims to mitigate medical errors and facilitate a team approach to care that fosters collaboration, communication, and interdisciplinary and multidisciplinary healthcare.

This research was relevant and was current with a body of research related to improving healthcare delivery and outcomes across many disciplines, including medicine, nursing, pharmacy, and social work, as well as across the spectrum of healthcare. Previous studies in IPE and simulation framed the problem addressed in this study. In the current literature, numerous studies have explored simulation, notably in nursing and medicine (Oxelmark et al., 2017). However, simulation has not been well studied in OT and PT education (Johnson, 2017; Sabus & Macauley, 2016; Stockert & Ohtake, 2017). Chown and Horn (2017) described how simulation could create IP learning experiences, but the authors did not measure student outcomes. Studies have found positive IPE outcomes in simulation with a high-fidelity mannequin (Wellmon et al., 2017), whereas other studies have explored additional teaching methods such as simulation, case conferencing, and developing comprehensive treatment plans (Bethea et al., 2019; Costello et al., 2017; Kirwin et al., 2017; MacKenzie et al., 2017; Mills et al., 2020). A quasi-experimental study by Nichols et al. (2019) examined the influence that simulation had on pretest–posttest measures of the SPICE-R2 among psychology, social work, athletic training, OT, and PT students. However, Nichols et al. did not use a control group, and likewise a control group was not used in other IPE studies or simulation studies.

There remains a gap in the literature focusing on the interactions between OT and PT students and how IPE activities such as simulation influenced changes in student learning outcomes. IPE and simulation studies in the current literature have varied outcome measures or have used tools developed by the researcher. Further, recent studies have been limited in findings because changes in IP attitudes have been measured pretest–posttest with no comparison or control group (Bethea et al., 2019; Mills et al., 2020; Nichols et al., 2019). This study addressed these gaps in the literature and further contributes to the body of knowledge. Therefore, the problem investigated in this study was whether simulation learning affected OT and PT students' IPE attitude scores on the Total SPICE-R2 and subscores of Teamwork, Roles, and Outcomes.

A pseudonym, Healthcare University (HU), was created for the institution where this study was conducted. This study's results may interest educational stakeholders, including students, faculty, academic leaders, and administrators. Simulation integrated into healthcare curricula can improve students' knowledge and attitudes toward IP collaborative teams (Sabus & Macauley, 2016; Stockert & Ohtake, 2017). The study is also significant to the discipline of higher education, particularly in rehabilitation and health science education in the training of healthcare providers. Simulation can be a new learning innovation in some educational programs and would constitute new pedagogical approaches for instruction not used in existing curricula. Therefore, the effect that simulation learning has on IPE speaks to facilitating change in the academic specialization of learning, instruction, and innovation. The study expanded on what is understood regarding the effect that simulation with a SP had on student IPE outcomes.

Purpose of the Study

The purpose of this causal-comparative study using a pretest–posttest nonequivalent control group design was to investigate the difference in first-term graduate OT and PT students' IPE attitudes posttest scores on the Total SPICE-R2, Teamwork, Roles, and Outcomes between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate. Archival data consisted of SPICE-R2 scores from students who did not participate in the simulation and another group of students who did participate in the simulation. The independent variable (IV) was participation in the simulation with the two categories participated in the simulation or did not participate in the simulation. The dependent variable (DV) was students' posttest data on the SPICE-R2 outcome measure. The covariate was students' pretest data on the SPICE-R2 outcome measure. Both the DV and the covariate each consisted of four scores, including the total SPICE-R2 and the three subscores of Teamwork, Roles, and Outcomes indicating students' attitudes in the four measured areas of IPE.

Research Questions and Hypotheses

To address the problem and purpose of this study, research questions (RQs) were developed for each of the scores on the SPICE-R2 and were used to guide the study.

RQ1: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Total SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0 1$: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Total SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1 1$: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Total SPICE-R2 between those who participated in simulation with a SP and those

who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

RQ2: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Teamwork SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0$2: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Teamwork SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$2: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Teamwork SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

RQ3: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Roles SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0$3: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Roles SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$3: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Roles SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

RQ4: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Outcomes SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0$4: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Outcomes SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$4: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Outcomes SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

Theoretical Framework for the Study

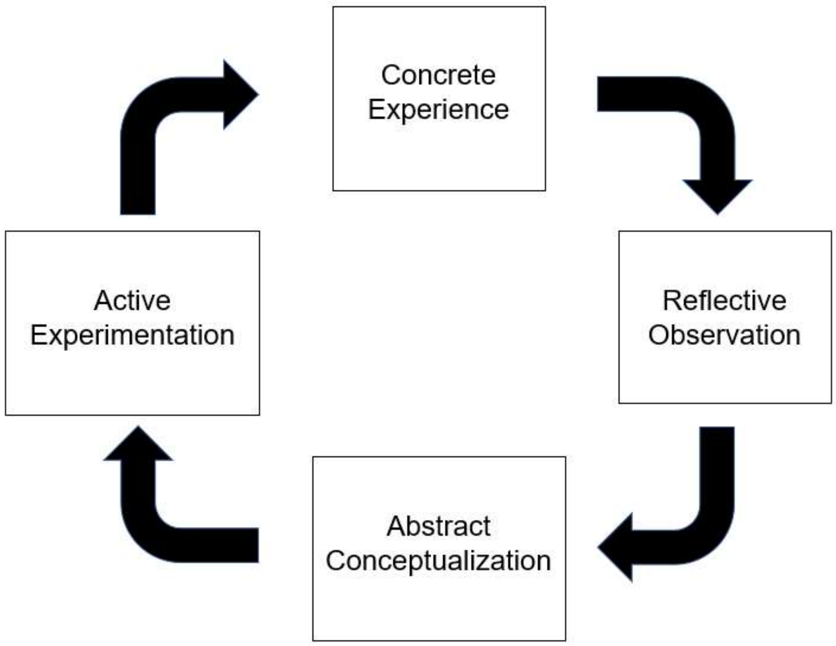
The combination of Kolb's (1984) experiential learning theory (ELT) and Pardue's (2015) framework for IPE provided the structural support and perspective for this study. Kolb (1984) described learning as an ongoing process beginning with engagement with new experiences and ending with the application of newly formed information from experience. Kolb theorized that learning occurs over four stages: (a) concrete experience, (b) reflective observation, (c) abstract conceptualization, and (d) active experimentation. Figure 2 illustrates how Kolb's theory provided an operational model to describe simulation and student learning.

Simulation aligns with Kolb's concrete experience and provided opportunities for students to engage in real-life clinical practice scenarios. After their simulation experience, students gained insights into their attitudes toward IPE through Kolb's reflective observation. Kolb's theory was used in this study during the data analysis to interpret the study results, with a more detailed explanation of this theory provided further in Chapter 2.

The second part of this study's theoretical framework utilized Pardue's (2015) framework for IPE. See Figure 3.

Figure 2

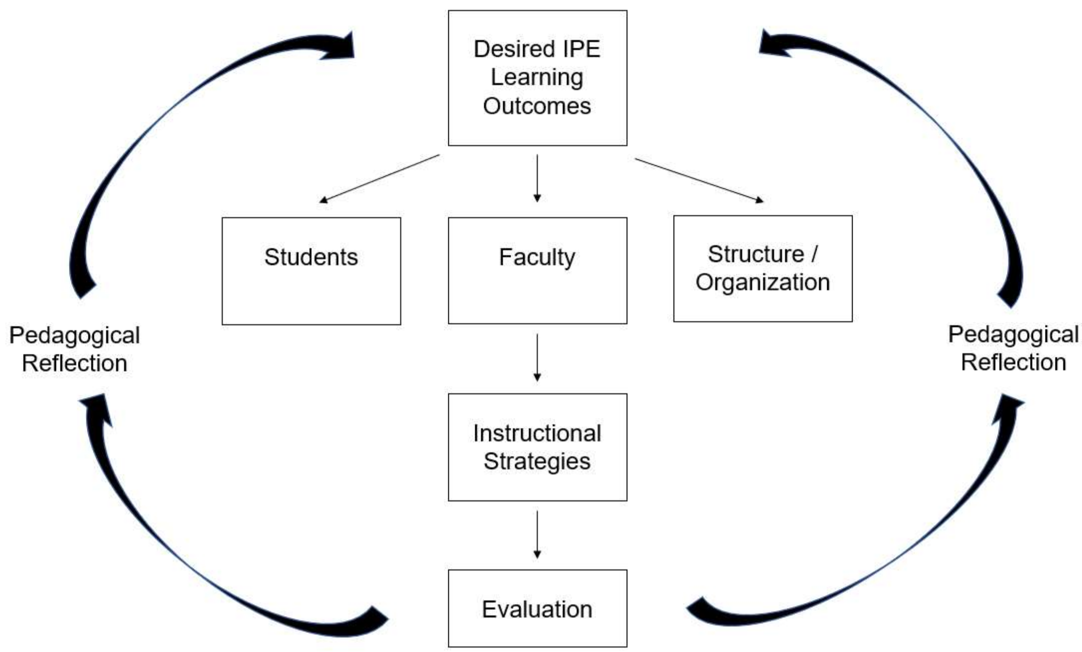
Kolb's Experiential Learning Theory



Note. From "Kolb's Experiential Learning Theory as a Theoretical Underpinning for Interprofessional Education," by L. Fewster-Theuente & T. J. Batteson, 2018, *Journal of Allied Health, 47*(1), p. 3. Copyright 2018 by Association of Schools of Allied Health Professions. Reprinted with permission of L. Fewster-Thuente.

Figure 3

Pardue Framework for Interprofessional Education



Note: From "A Framework for the Design, Implementation, and Evaluation of Interprofessional Education," by K. T. Pardue, 2015, *Nurse Educator, 40*(1), p. 11. Copyright 2014 by Walters Kluwer Health Lippincott Williams & Wilkins. Reprinted with permission of K. T. Pardue.

Pardue described a theoretical framework for IPE linked to the IPEC core competency standards of roles and responsibilities for collaborative practice, IP communication, values and ethics for IP practice, and teams and teamwork. Pardue described how the design and development of IPE should use backwards design (McTighe, 2014), beginning with the end in mind first and starting with desired learning outcomes. This end-in-mind design philosophy is illustrated in Figure 3 through design elements that include (a) desired IPE learning outcomes, (b) students, (c) instructional strategies, (d) evaluation, and (e) pedagogical reflection. Pardue's structural framework, particularly the evaluation stage, aligned well with the survey instrument selected for this study. A detailed explanation of how this study used this framework is provided in Chapter 2.

Nature of the Study

This study used a quasi-experimental causal-comparative research paradigm with a pretest–posttest nonequivalent control design. Justification for this approach is based on several reasons. One reason was the alignment of the methodology as described in Chapter 3 and the purpose of my research. There is wide use of nonequivalent control designs in education, field research, healthcare, and social sciences (Campbell & Stanley, 2015; Reichardt, 2019). Pretest–posttest designs in IPE, commonly used in healthcare educational programs, measure changes in IPE among students or clinicians after an intervention (Kirwin et al., 2017; MacKenzie et al., 2017; Nichols et al., 2019). Archival data existed in IPE outcomes as part of HU's educational assessment and programmatic evaluation aligned with accreditation standards for the curriculum and institutional, programmatic, and course outcomes. OT and PT students entering HU were admitted as first-professional students and into an entry-level program for their profession. This meant that they would be entering for the first time as new clinicians (either OT or PT) upon program completion. Also, the students' archival data were from an introductory patient-care management course in the first academic term of their program. Thus, this study was on first-term graduate students. Archival data consisted of pretest and posttest measures from students before and after participation in simulation with SP.

Additionally, a group consisting of OT students in a new program in the curriculum had IPE data collected for programmatic assessment. The faculty in this new course in the program did not receive simulation training, and therefore, the data served as a control group. Available archival data justified the study to explore simulation's influence on outcome measures by comparing students with simulation and no simulation. The pretest scores in both groups allowed for a covariate that compared variance for differences among the groups, if they did or did not exist, in prior experiences or attitudes toward IPE.

The key variables of this study consisted of an IV categorized and coded into archival data sets of two groups of students who participated in simulation and students who did not participate in the simulation. The DV of my study was posttest measures of the SPICE-R2. The covariate of my research was pretest measures of the SPICE-R2. There may have been differences between the two groups of students who participated in the simulation and those who did not. Students may vary in their IPE attitudes due to prior work or life experiences (see Laureate Education, 2017c, 2017h; see Warner, 2013). Therefore, the pretest SPICE-R2 measures controlled for students' previous experiences.

Archival data in this study aligned with the methodology for a quantitative quasi-experimental causal-comparative analysis using a pretest–posttest nonequivalent control design. The number of students in the sample could not change because the data were archival; thus, the study was nonequivalent in nature with differing numbers in the data groups. Moreover, this study was nonequivalent because of potential variance of the groups due to differing work or life experiences. Therefore, the use of a covariate pretest measure was useful in my study. There was nonequivalence between the control and simulation groups by both criteria. After completing the Institutional Review Board (IRB) process and being granted proper permissions, I collected data from archival records. The platforms storing archival data for the course were on Survey Monkey or the Blackboard learning management system. Once the pertinent data were gathered for this study, data were inputted for the IVs, DVs, and covariates into SPSS to prepare for the one-way analysis of covariance (ANCOVA) data analysis.

Definitions

Debriefing: Where an experienced or trained facilitator leads in a time of guided discussion after a simulation, allowing for participants to reflect and openly discuss observations of interventions, observed performance, and participant interactions (Palangas et al., 2015).

Interprofessional education: Where two or more professionals learn about, from, and with one another to facilitate team collaboration and improve the health of patients and patient outcomes (WHO, 2010).

Simulation: A preplanned event or scenario that occurs within a defined space and time to accomplish one or more purposes and where participants interact with each other in a goal-oriented manner with technical artifacts and with the environment (Wilson & Wittmann-Price, 2015).

Standardized patient: A carefully coached person who simulates patient factors such as patient history, physical attributes, emotions, and personality such that a skilled clinician cannot detect the simulation (Palangas et al., 2015).

Interprofessional collaborative practice: When multiple healthcare providers from various professional backgrounds work together with patients, families, and the community to deliver the highest quality of care (IPEC, 2016; WHO, 2010).

Assumptions

This study was based on several assumptions. OT and PT students from both the control group of no simulation and the group participating in a simulation responded to a survey regarding their attitudes toward IP teams and the team approach to care. The underlying assumption was that students were open and honest about their attitudes when completing the pretest and posttest surveys. Because students in this study were from across the academic calendar year of 2020, the course was offered during the spring, summer, and fall trimesters. There was the assumption that the student simulation experiences were similar for the cohorts participating in the simulation. Additionally, there was the assumption that the course content was like the residential program and the flex program. Standardized curricula and course modules within the learning management system mitigated any issues with the assumption of similarity of courses between the two programs. Therefore, the content was consistent in the residential and flex course offerings; however, the timing of the course schedule of labs was different. Students in the residential program attended labs weekly, whereas students in the flex program attended labs during extended weekends each month. At the time of this study, it was assumed that saturation of the literature was reached in relation to this area and explored in the literature review.

Scope and Delimitations

Certain study boundaries were based on the scope of this study. One boundary was the purpose of the quantitative study that explored differences among OT and PT students' IPE attitudes. This study compared outcome measures from pretest–posttest data of OT and PT students after participating in simulation with a SP and pretest–posttest data from OT and PT students who did not join in the simulation. The application of Kolb's ELT served as a framework for IPE learning for students in academia and in clinical applications (Brown & Bostic, 2016; Fewster-Thuente & Batteson, 2018). The simulation provided concrete experiences according to the ELT framework, and then students continued in simulation debriefing during reflective observation. The latter stages of abstract conceptualization and active experimentation continued after simulation during future academic training and entry into clinical practice. Related to my study, Nichols et al. (2019) utilized the SPICE-R2 to measure changes in student IPE attitudes on IP teams and the team approach to care. Another boundary was the geographic campus location of HU and the offered introductory patient care management used in the study. The course offering was from one local campus at HU in the western part of the United States. The type of simulation studied defined another boundary of this study. Simulation can occur with a SP, with a low-fidelity mannequin, with a high-fidelity mannequin, and in virtual environments. This study focused on simulation with a SP.

The delimitations of this study involved the use of student archival data, with an emphasis on student personal input based on their level of agreement or attitudes toward

IPE, and the quantitative approaches of this research. This study only used data from OT and PT students from one campus and one course in their first trimester of graduate studies. A variety of prior experiences and backgrounds prior to starting their academic coursework may influence students' IPE attitudes. For example, some students may have had previous experience working in various healthcare settings. This research focused on the role that simulation had in attitudes toward IPE. While prior individual student experiences might have had value in this research, the use of archival data did not allow for the gathering of these data points, and therefore, the quantitative survey responses from students bound this study. The generalizability of this study was bound to IVs of simulation and control and influence on OT and PT students early in the curriculum.

Limitations

The research design often creates limitations, and this study had limitations regarding internal and external validity. Internal validity exists with regression and regression to the mean in this research. According to Campbell and Stanley (2015), regression and regression to the mean are when there are differences in test scores between a treatment group and intervention. For instance, the control group may not have a specific diagnosis, while the treatment could have a medical diagnosis such as depression. Between these two groups, there may be differences in pretest scores. On the other hand, outliers or extreme scores due to lack of presence of a diagnosis can inflate the influence of intervention among the two groups, creating a regression to the mean (Campbell & Stanley, 2015; Creswell & Creswell, 2018). For this study, the statistical test of an ANCOVA utilized a covariate that may have identified differences between the two groups by having a pretest score between the control group and the simulation group. External validity issues existed in this study regarding selection and treatment. Campbell and Stanley defined selection as the potential for bias when selecting participants for control and intervention. This research potentially addressed this issue as students were enrolled into the control or intervention group outside of the parameters of the research study. OT and PT students gained admittance into either the residential or flexible program based on their preference for the length of the program and delivery format. Additional internal and external validity limitations and how these were addressed are further discussed in in Chapter 3.

The use of archival data in this research limited the ability to select and recruit participants. In addition, the number of participants was predetermined in an archival data set. Therefore, the statistical power analysis was determined and calculated by the minimal effect size that would be statistically significant with a given alpha and sample size. The study parameters of simulation with a SP among OT and PT students bounded the generalizability of this study. Students from other healthcare disciplines and simulation with a SP bounded the generalizability and represented the last limitation of this study. The parameters of this study expanded the current research on what is known about the effectiveness of simulation and its effect on IPE outcomes in the training of healthcare students.

Significance

The significance of a study may reside in its potential to advance knowledge and fill a gap in the current literature. This study has the potential to advance knowledge of the effect of simulation learning in the rehabilitation education training of OT and PT students who participated in a simulation as an intervention in comparison to a control group that did not participate in the simulation. Simulation in this study served the educational specialization of learning, instruction, and innovation. Integrating simulation into the curriculum was an innovation because it did not previously exist in the educational training of students at HU. Understanding the influence of simulation with a SP on students' IPE attitudes is essential for several reasons. Academic leaders such as program directors, IPE directors, or academic officers can better understand how students perceive their attitudes toward IPE competencies. In addition, understanding the influence of simulation can guide faculty and educational leaders about programmatic or course changes to frame IPE activities and learning methodology so that students understand the value of their course experiences.

This study was also significant because of the contributions that the study may make to advance practice or policy. Faculty may consider whether to use or not use simulation as part of their coursework to achieve desired learning outcomes. Administrators and academic leaders may use the information from this study to weigh the cost and benefits of investment in simulation learning resources to improve student IPE attitudes that may potentially bridge to improve students' IP nontechnical skills and technical skills.

Last, this study has potential implications for positive social change. Improved IPE attitudes may lay the groundwork for future learning that can improve communication, teamwork, and hands-on skills. As students prepare to enter the workforce, simulation challenges them to be in real-world situations and to think about working with other healthcare providers. The overall goal of IPE is to meet the triple aim of (a) improving patient care, (b) improving the health of populations, and (c) lowering healthcare costs (IPEC, 2011, 2016). Emphasizing IPE early in the educational training of future healthcare providers prepares the way for an IP collaborative practice-ready workforce. This may lead to improving healthcare delivery and decreasing medical error while ushering in the necessary positive social change to improve the outcomes and health of patients and healthcare providers.

Summary

Chapter 1 introduced the main themes of the study and included descriptions of this quantitative research study and the overall problem addressed in it. In the background section, I provided an overview of the current literature that supported my study. My problem and purpose statements indicated the focus within my research on changes in students' attitudes toward IP teams and the team approach to care from pretest–posttest scores after participating in simulation with a SP. In describing the development of the RQs, I addressed the Total SPICE-R2 and subcompetency scores within the tool. In addressing the study's theoretical framework, I described the use of Kolb's ELT and Pardue's framework that supported the scope and nature of the study. In the nature of the study section, I highlighted the rationale for using a causal-comparative and pretest–posttest nonequivalent control design. I then provided definitions to clarify keywords and terminology in the context of this study. The assumptions, scope and delimitations, and limitations sections described the boundaries and limits of my study and provided the potential ways that my study would mitigate limitations. Chapter 1 concluded with an explanation of my study's significance and potential influence on rehabilitation education. In Chapter 2, I will describe the strategies for the literature search, expand on the details of the theoretical framework, and provide an in-depth review of the current literature pertaining to my study.

Chapter 2: Literature Review

Introduction

The purpose of this causal-comparative study using a pretest–posttest nonequivalent control group design was to investigate the difference in first-term graduate OT and PT students' IPE attitudes posttest scores on the Total SPICE-R2, Teamwork, Roles, and Outcomes, between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate. Specifically, this study focused on the Total SPICE-R2, Teamwork, Roles, and Outcomes (IPEC, 2011; WHO, 2010). Researchers have demonstrated that simulation could improve student IP skills (Coppola et al., 2019; Pitout et al., 2016). However, current literature has not controlled for simulation as a variable in studies among OT and PT students. Further, limited numbers of studies from the current literature have used a consistent or validated outcome to measure changes in student IPE attitudes. This study examined first-term OT and PT students at the start of their respective programs. Then, a validated outcome tool was used to measure to what extent simulation did or did not have on students' attitudes toward IPE on the Total SPICE-R2, and the subscores of Teamwork, Roles, and Outcomes.

Chapter 2 begins with the literature search strategy and the theoretical foundations of the study. In the literature review sections, I outline concepts and findings from the current literature related to this study's problem statement and purpose. First, I describe why the WHO recommended IPE for improving healthcare delivery and how the IPEC provided a working framework for competency domains within IPE. Next, I describe simulation utilization in healthcare education. Additionally, I discuss how simulation uses SPs, low-fidelity mannequins, and high-fidelity mannequins, and I explore the various uses of virtual reality in simulation. Finally, I describe studies investigating how simulation can improve clinicians' technical and nontechnical skills. Following this discussion, I describe the current literature as it pertains to students in OT and PT.

Literature Search Strategy

Various scholarly resources were used in the literature review. These sources included books, reports and publications, and peer-reviewed and empirical research articles. Databases accessed included Academic Search Complete, CINAHL Plus with full text, Cochrane Database of Systematic Reviews, ERIC, Education Source, Google Scholar, MEDLINE with full text, and ProQuest Health and Medical Collection. Filters were used to focus on relevant documents from the past 5 years. Several key themes for this research study emerged as I sought to present an overview of the current literature. These key terms and themes included the following: *augmented reality*; *experiential learning theory*; *healthcare and IPE*; *healthcare outcomes*; *high-fidelity mannequins*; *IPE and OT*; *interprofessional education* or *IPE* or *interdisciplinary education*; *interprofessional education collaborative*; *Kolb's learning theory*; *mannequins*; *Pardue theoretical framewor*k; *serious games*; *simulation and communication and OT or occupational therapy*; *simulation and communication and physical therapy or physiotherapy*; *simulation and IPE and OT communication*; *simulation and value or ethics and physical therapy or physiotherapy*; *simulation and value or ethics and OT or occupational therapy*; *standardized patient*; *virtual reality*; and *World Health*

Organization. A literature review matrix and template were used to organize relevant resources categorized by theoretical framework, purpose statement, problem statement, research methodology, and findings related to the level headings that organized Chapter 2. As the literature review continued, key terms and authors were used to expand the literature search. Saturation of the literature was achieved when the same authors and studies repeatedly showed up and no further ideas emerged relating to this study.

Theoretical Foundation

The theoretical framework utilized in this study was a combination of Kolb's (1984) ELT and Pardue's (2015) framework for IPE. Kolb's ELT derived from the work of predecessors in educational theory, including Dewey and Piaget. Collectively, these theorists postulated cognition and learning as a continuous process influenced by interactions of people, experiences, and environments (Kolb, 1984). The origin of Pardue's IPE framework stemmed from the need for a new pedagogical approach for the development, implementation, and assessment of collaborative learning based on a theoretically grounded framework (Pardue, 2015). I further describe how these theories link together in the following sections.

Theoretical Propositions, Applications, and Prior Studies Using Kolb's Theory

Kolb (1984) described learning as an ongoing process beginning with engagement with new experiences and applying newly formed information from experience. Kolb theorized that learning occurs over four stages: (a) concrete experience, (b) reflective observation, (c) abstract conceptualization, and (d) active experimentation. These proposed four stages provided the framework for learning when students engaged in simulation. See Figure 2.

The first stage of Kolb's ELT is to gain concrete experience; in this stage, students learn through doing and feeling (Fewster-Thuente & Batteson, 2018; Kolb, 1984). According to Kolb (1984), knowledge comes from grasping experiences and transforming them. Students perceive concrete experiences in two ways. Prehension describes students relying on interpretation and symbolic representation, whereas comprehension depends on what they feel immediately from experience (Kolb, 1984). Described further, the concrete stage of ELT is participation in real-life events providing an opportunity for students' reactions effectively to work situations and environments in everyday life (Atkinson & Murrell, 1988). Kolb's ELT has been cited frequently in learning theory across disciplines, professions, and vocations.

Efforts to apply ELT outside of healthcare have included agriculture students being engaged in concrete experiences by designing wind turbine blades (Baker & Robinson, 2016). In comparison, students in geography have learned about lived experiences by reading novels describing aspects of living in the suburbs of various regions (Healy & Jenkins, 2000). Healthcare studies have applied Kolb's concrete experiences in nursing by providing simulated IP learning experiences (Poore et al., 2014) and running tests in the clinical laboratory for IP exchange of patient information (Brown & Bostic, 2016). In my study, when students engaged in experiential learning using simulation, they entered Kolb's concrete experience. Educators can design simulation learning experiences to offer hands-on activities, lab practice, or other experiential methods. By engaging in a physical practice, environment, or setting, students immerse themselves in the learning process (Fewster-Thuente & Batteson, 2018; Kolb, 1984). Students engaged in a new experience of a planned simulation learning event where educators planned specific learning and embedded them in the activity.

Kolb described the second reflective observation stage as watching and formulating insights through structured, focused, and organized approaches (Fewster-Thuente & Batteson, 2018; Kolb, 1984). Like students' prehension or comprehension experience, there are ranges of how students process the concrete experience and transform their reflections into new meaning as part of the reflective observation stage. Kolb described the concept of intention, where students reflect internally to formulate new learning or understanding. In contrast, the idea of extension involves students actively manipulating the external environment (Kolb, 1984). In a prior study of counseling students, Atkinson and Murrell (1988) described Kolb's reflective observation in activities such as clients meeting in small groups to discuss reactions to occupations that they studied; discussing skills and personal qualities needed for daily routines; or describing how the observed employees felt about their work. In an engineering study by Chan (2012), a group of students traveled to a primary school destroyed by a devastating earthquake. Students participated in reflective observation in this study by carefully observing their work outcomes and discussing them with peers and teachers. Applied to my research, the debriefing process after a simulation event was a critical step. The debriefing facilitator, often led by faculty, asked students to share observations, what was going through their minds, or what led to the behavior observed during the simulation.

Reflective observations allowed students to ponder their experiences further to formulate emerging learning based on their observations (Johns et al., 2017; Morse, 2012). Additionally, applied to my study, there were two student groups in simulation. The first consisted of students who were not directly involved in the simulation as active participants but played a role as participant observers. The second consisted of active participants, often described in the literature as being in the "hot seat," who were actively hands-on and involved in the immersive simulation scenario (Bong et al., 2017; Reime et al., 2017). Regardless of the two roles, students took part in the ELT component of reflective observation together. According to the recent studies of Bong et al. (2017), O'Regan et al. (2016), and Reime et al. (2017), both observers and active participants equally benefited from the learning of simulation even if there was no direct hands-on experience. These results highlight the importance of effective debriefing and guided discussions to improve cognition during the reflective observation process, benefitting all students participating in a simulation.

Kolb described abstract conceptualization as the third step, in which students move away from sharing direct observations from the simulation and what occurred and take the additional actions of thinking about why something happened, considering what students might have done differently, and explaining their clinical reasoning and rationale (Johns et al., 2017; Kolb, 1984). Students demonstrate a preference for learning activities categorized as divergent knowledge, assimilative knowledge, convergent knowledge, and accommodative knowledge (Kolb, 1984; Sudria et al., 2018). In a study of chemistry students, Sudria et al. (2018) found students using convergent and assimilative knowledge for abstract conceptualization. When students used convergent or assimilative knowledge, this indicated the application of more theoretical concepts using varying degrees of intention and extension in cognitive thought processes. In my study, faculty led students in debriefing right after the simulation to encourage students' work through the abstract conceptualization phase. Additionally, students may engage in abstract conceptualization well after the simulation experience and in time beyond the event as they contemplate the scenario, challenges, and observed interactions. If students reach abstract conceptualization, they should gain new knowledge, have new insights, or modify pre-existing knowledge or perspectives based on the simulation experience. In similar studies, Morse (2012) found that when engaging in abstract conceptualization, students learned to consider the relevance of IPE experiences, stimulate new thoughts, and consider if they would have done something differently while in the simulation. In the time after the simulation and moving forward, student metacognition continued to shape and form student learning from the experience as students progressed to Kolb's final stage of active experimentation.

In Kolb's (1984) fourth and final stage of active experimentation, students create knowledge by transforming learning experiences into new perspectives. As a result of the continuous cycle of the stages of Kolb's ELT, the development of the individual is a result of the interaction of internal characteristics, external circumstances, personal knowledge, and social knowledge. Learning occurs across cultural and social systems (Kolb, 1984). Therefore, because of active experimentation, Kolb indicated that students' reflection and processing of experiences, or engagement in new concepts or theories, are weighed against previous experiences or knowledge. The examination and application of the new perspectives allow students to actively experiment based on these new experiences and discoveries, allowing for further acquisition of skills and knowledge (Atkinson & Murrell, 1988; Kolb, 1984). When applied to this study, educators design simulations to expose students to circumstances in real-world practice that they can apply in future coursework or clinical practice. Similar studies cited this stage of Kolb's ELT. They stated that students apply what they learned through active experimentation in future simulations, other courses in the curriculum, clinical internships, or different work experiences (Brown & Bostic, 2016; Morse, 2012; Poore et al., 2014). To continue the final stage of active experimentation as applied to this study, postexperience instruments using various IP outcome measures would provide the backdrop of cognitive reflection for the final stage of experiential learning in simulation.

Theoretical Propositions, Applications, and Prior Studies Using Pardue's Theory

Pardue (2015) described IPE development using backward design (McTighe, 2014), beginning with the end in mind and starting with desired learning outcomes. The parts of Pardue's framework include the following elements: (a) desired IPE learning outcomes, (b) students, (c) instructional strategies, (d) evaluation, and (e) pedagogical reflection. After reviewing the literature, I found no current studies that used Pardue's framework for IPE; however, various authors recommended using this framework for future work (Jones & Phillips, 2016; Oermann, 2015). IPE, simulation, outcome measures, and the IPEC core competency practice domains aligned well with the tenets of Pardue's framework for IPE for this study. Jones and Phillips (2016) and Oermann

(2015) noted that Pardue's framework for IPE education was a helpful model for training healthcare students. Educators may consider using the IP collaborative core practice domains set forth by the IPEC (2016) report and Pardue's framework as a foundation for learner outcomes when planning curriculum. See Figure 3.

Pardue's first theoretical framework started with identifying desired learning outcomes. This study used the IPEC (2011) core competency domains of Values/Ethics for IP Practice, Roles and Responsibilities for Collaborative Practice, IP Communication Practices, and IP Teamwork and Team-Based Practice as the target outcomes. In addition, other studies could explore using the subcompetencies for each of the four primary core domains as desired learning outcomes (IPEC, 2011, 2016). Following the backward design model of McTighe (2014), starting with the end in mind first allows for the development, planning, and design of learning activities for IPE content and curriculum.

The following steps of Pardue's framework consider students and instructional strategies in the design, implementation, and evaluation of IPE. Pardue (2015) recommended starting small to promote success and high-quality IPE and not trying to include all health professions in the initial learning events. Additionally, Pardue suggested that beginning with two different professional cohorts would be most effective for intentional and thoughtful planning (Pardue, 2015). In an earlier study, Pardue (2013) highlighted scaffolded learning activities to introduce skills, acquire technical and nontechnical practice, and then apply the knowledge and skills gained in subsequent courses. IPE learning activities could occur across many modalities, including problem-based learning, group work, lecture, role-playing, and case studies (Pardue, 2015). The integration of simulation was the primary learning method development examined in this study.

The evaluation stage of Pardue's framework emphasized the importance of assessing IPE effectiveness. Overall, the goal of the IPE curriculum is to change students' knowledge, skills, and attitudes (Hamson-Utley et al., 2021; Pardue, 2015; WHO, 2010). The endeavor of implementing IPE curricula requires an assessment of program efficacy. Various efficacy measures demonstrate program success, including student self-assessments, instructor rating tools, and other developed questionnaires, surveys, and instruments (Hamson-Utley et al., 2021). This study examined how simulation affects students' IPE attitudes toward IPE using a validated tool based on the IPEC core competency domains.

The final stage of Pardue's framework is pedagogical reflection, where students contemplate and process learning, analyze against previously learned experiences, and synthesize new behaviors, skills, and perspectives (Pardue, 2015). Kolb's ELT (1984) and Pardue's IPE framework (2015) overlap in concepts in this final framework stage. Similarly, Kolb's abstract conceptualization and active experimentation stages align with Pardue's final stage. At this stage for Pardue, new learning could shape student behavior in future courses, simulations, clinical experiences, or real-world practice. Students reflect on their evaluation of their performance. They weigh their knowledge and understanding related to the desired learning outcomes from the IPEC core competency domains.

The Rationale for Selecting Kolb and Pardue and Relationship to Current Study

This study used Kolb's ELT (1984) to describe student learning, and the rationale was justified for several reasons. First, the experiential nature of the simulation aligned well with Kolb's ELT. Well-designed simulation is an immersive experiential environment where students are directly involved in playing the active role in the hot seat within the simulation, or they are directly observing the students within the simulation from behind a one-way mirror. Student can also view simulations live with video cameras and television monitors. Other studies have used Kolb's ELT to explain learning that occurs after engaging in simulation to improve technical, nontechnical skills, as well as IP competencies such as teamwork and roles and responsibilities (Brown & Bostic, 2016; Fewster-Thuente & Batteson, 2018; O'Neil-Pirozzi et al., 2019; Paige et al., 2017; Poore et al., 2014).

Another reason both Kolb's ELT (1984) and Pardue's IPE framework were justified for this study was because they aligned well with the RQs and purpose, which was to explore the effect simulation had on students' attitudes toward IPE. As per Kolb, the simulation provided the immersive environment inherent in ELT. As per Pardue, the evaluation stage was examined through the student self-assessment using a standardized outcome measure. Over the past few years, educators have developed various outcome tools to measure various aspects of IP behaviors. Recent studies measured the affect simulation had on technical skills such as specific interventions and medical techniques (Brown & Bostic, 2016; O'Neil-Pirozzi et al., 2019). Other studies noted the influence simulation had on nontechnical skills such as communication and teamwork (Oxelmark et al., 2017; Paige et al., 2017; Wellmon et al., 2017). This study used the outcome measure of the SPICE-R2. The RQs and hypotheses aligned with the variables of IP collaborative practice domains established by the IPEC report (2016) and the variables as measured by the SPICE-R2 tool. Using an instrument aligned to the IPEC framework made this study's data link directly to Pardue's (2015) framework. By placing the SPICE-R2 strategically within the evaluation stage, the effects of the simulation on student attitudes allowed for students' pedagogical reflection back toward the IP competency domains. The SPICE-R2 instrument also leads back to the desired outcomes of IP competencies and lays the foundation for future application, new learning, and perspectives towards IP collaboration. Pardue developed the IPE framework with the IPEC core competencies in mind by purposefully aligning IPE learning outcomes as the starting point for student learning. Pardue's original intent was to create a framework for a new pedagogical approach to develop, implement, and assess IP learning based on a grounded theory. The purposeful alignment of Pardue's framework with IPEC competency domains allows healthcare educators to readily adapt the pedagogy of learning by linking the outcomes, students, instructional activities, and evaluation, then reflecting on the desired IPE outcomes. Educators can use the IPEC competency categories such as values and ethics or IP communication practices as primary objectives for planned learning activities. Therefore, students experience a combination of Kolb's ELT and Pardue's framework for IP learning. The simulation in this study bridged between Kolb and Pardue, where students learned based on desired learning outcomes established in the IPEC core competency standards with potential influence on their IPE experience. The learning, instruction, and innovation of integrating well-established learning theories such as Kolb (1984) and bridging to combine contemporary frameworks such as Pardue (2015) have the potential to extend and contribute to the body of knowledge of educational research.

Interprofessional Education

Improving health care delivery is a common topic in local, state, national, and global initiatives. Modern U.S. healthcare operates in a fragmented structure that struggles to meet the increasingly complex needs of patients and populations (IPEC, 2011; WHO, 2010.) The WHO has recommended IP collaborative practice (IPCP) to improve healthcare delivery and patient outcomes. Instituting IPCP requires the preparation of a collaborative, practice-ready workforce comprised of healthcare teams that provide comprehensive services across the continuum of care (WHO, 2010). To meet goals for IPCP-ready clinicians, students need IPE training in healthcare settings. Therefore, the formation of IPEC established standards for IPE in the academic training of students and IPCP for the continued development of practicing clinicians.

Interprofessional Education Collaborative

IPE is defined as “students from two or more professions learn about, from, and with each other to enable effective collaboration and improve health outcomes” (WHO, 2010, p. 1). In response to the WHO recommendations for enhanced IPE to address shortcomings in the current healthcare system, healthcare organizations formed IPEC. Additionally, other entities sought to establish criteria for IPE, including the Health Professions Accreditors Collaborative, the National Center for IP Practice, the American

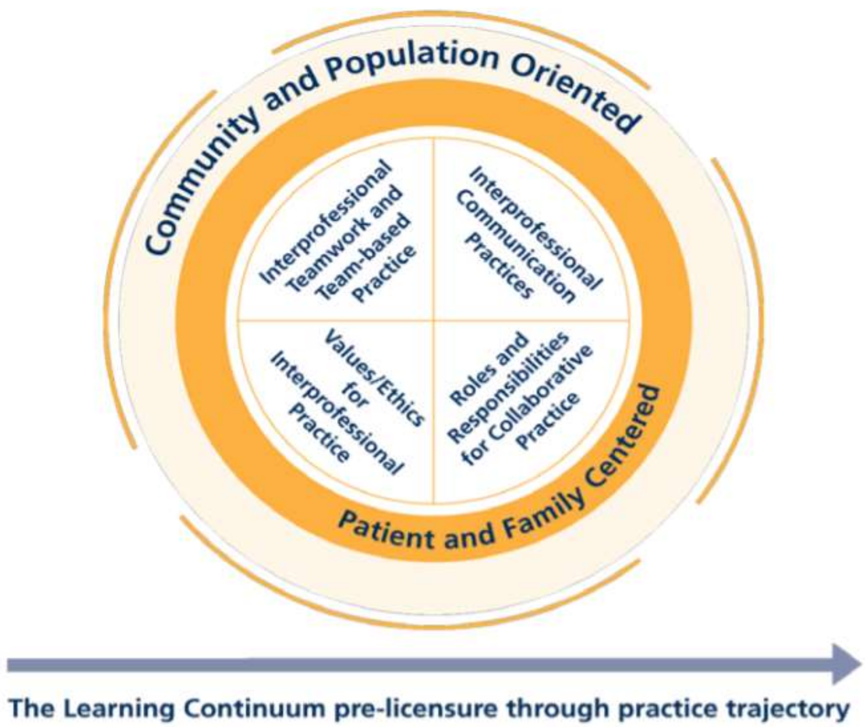
IP Health Collaborative, and the National Center for IP Practice and Education, among others (Hamson-Utley et al., 2021). IPEC emerged as one of the more recognized authorities, and subsequent IPE studies cited them more often in the literature. The first IPEC meeting took place in 2010 with the formation of an expert panel consisting of members from the professions of nursing, osteopathic medicine, pharmacy, dentistry, medicine, and public health (IPEC, 2011; Wilson & Wittmann-Price, 2015). The primary objective was to establish individual levels of core IP competencies and bring together literature from the United States and across the globe (Hamson-Utley et al., 2021; Palangas et al., 2015). The core competencies created a template of standards to direct curricular development in health professional programs, including accreditation criteria, pedagogical structure, outcomes, and assessments (IPEC, 2011). As a result, common competencies converged in four areas of collaborative practice competency domains. The IPEC 2011 report established four domains:

1. Values/ethics for IP practice
2. Roles and responsibilities for collaborative practice
3. IP communication practices
4. IP teamwork and team-based practice

How these four domains interact and affect patient outcomes, and ultimately, the health of communities and populations, is illustrated in Figure 4. The culminating report has served as one of the primary guiding documents for IPE throughout the United States and globally (Arth et al., 2018; Palangas et al., 2015; Stockert & Ohtake, 2017). Consequent to the findings of the IPEC expert panel, the core competencies have provided a foundational structure for educational development and research studies to further efforts to build outcome measures, assessment, and curricular development to advance IPE.

Figure 4

Interprofessional Collaboration Competency Domain



Note. From *Core Competencies for Interprofessional Collaborative Practice: 2016 Update* (p. 9), by Interprofessional Education Collaborative, 2016 (https://www.ipecollaborative.org/resources.html). Copyright 2016 by IPEC. Reprinted with permission.

The landmark report released by IPEC in 2011, and the creation of a common framework of competency standards, paved the way for research and guided the development of educational content and curriculum. In 2016, growing interest in IPE prompted continued refinement of the original work of IPEC from 2011. One of the significant shifts was to use the continuum of the collaborative practice competency domains to influence the patient, community, and population outcomes. Health outcomes would span the IPE trajectory of student learners and practicing clinicians (IPEC, 2016). IPEC highlighted the “triple aim,” which comprises three aims to improve the patient’s experience of care, improve the health of populations, and reduce medical costs in the revised IPEC model (Brandt et al., 2014; IPEC, 2016). The number of professional organizations represented grew. The IPEC welcomed new institutional members from podiatry, PT, OT, psychology, veterinary medicine, optometry, allied health professions, social work, and physician assistants (IPEC, 2016). Since IPEC’s original report in 2011, the expert panel found more than 550 citations in the peer-reviewed literature from May 2011 to December 2015, further solidifying the importance of their work and efforts (IPEC, 2016). The IPEC and IPCP domains continue in the literature as featured frameworks for IPE curricula and research.

Collaborative Practice Competency Domains

One of the primary barriers for IPE is to shed the notion that learning IP skills occurs automatically when students of different professions merely practice in the same room or on the same team (IPEC, 2011; WHO, 2010). IPE does not occur in these instances but rather is deliberate practice. Students develop an integrative approach to address the needs of a patient or population and reflect on the interactions of one’s profession and that of others. This approach includes sharing of one’s knowledge and active participation with the patient and family members (Wilson & Wittmann-Price, 2015). The IPEC expert panel members described subsets of specific competencies within each domain to further define IPE.

Interprofessional Teamwork and Team-Based Practice

Modern U.S. healthcare delivery often follows a siloed approach, where each professional visits a patient individually. To illustrate a siloed model, a typical day during a hospital stay may include nursing providing care within their scope of practice in a one-on-one patient encounter (Johnson, 2017). The nurse may dispense medications and assess the patient's current vital signs. Once nursing completes care, another provider, such as an OT, comes to provide an assessment of a patient's daily occupational tasks. Each service rendered generates separate bills, codes, and reimbursement based on the individual disciplines. There is little interaction among providers, and if issues arise within each discipline, the providers rarely convey problems encountered to one another. The entire model forces a disjointed and fragmented system of care (Johnson, 2017). Hean et al. (2018) reviewed instances of compromised patient care and found that healthcare providers had difficulty figuring out how to work in teams. Healthcare disciplines have become increasingly specialized, and providers recognize that although team practice needs to occur, healthcare settings rarely incorporate IP care in clinics or educational settings (Palangas et al., 2015). IP teamwork and team-based care address shortfalls in fragmented and siloed care. Fostering an environment that encourages teams of providers to collaborate can help meet the many healthcare needs of the patient.

The primary goal for IP teamwork and team-based practice, as defined by IPEC (2016), is to apply relationship-building values and team dynamics for planning, delivering, and evaluating patients and populations in a safe, timely, efficient, equitable, and effective manner (IPEC, 2016). The IPEC (2016) report expanded sub-competencies based on the original four competency domains established in 2011. Within the realm of IP teamwork, the expanded criteria included the following: (a) developing consensus on ethical principles to guide team care, (b) applying leadership practices to support collaborative team effectiveness, and (c) sharing accountability among patients, communities, and professions for outcomes in healthcare and prevention (IPEC, 2016). Eleven sub-competencies comprise the IP teams and teamwork within the IPEC framework. Descriptors within this domain set parameters to measure the effectiveness of IP teamwork and team-based practice.

Roles and Responsibilities for Collaborative Practice

A member of a healthcare discipline must understand their professional role coupled with knowledge of the roles and responsibilities, which is critical in providing comprehensive patient-centered care. When delivering care, healthcare providers identify the patient's needs within a professional's scope of practice. Scope of practice defines the legal parameters that a provider operates under, as delineated by the practice environment, location, and region (IPEC, 2011). When there are issues outside of a member's expertise, providers must recognize who is the appropriate team member for whom to refer. The IP team interacts in a way where each member knows the roles and responsibilities of others to provide quality care (Wilson & Wittmann-Price, 2015). The continuity of care and the exchange of vital information flows more readily when each member of the healthcare team, armed with the knowledge of their specific contributions to a patient, adds to the comprehensive care of patients with other providers.

In terms of roles and responsibilities for IP practice, the primary approach for each member is to use their knowledge of their discipline and that of others to assess patients appropriately and advance the health and wellness of populations (IPEC, 2016). The IPEC (2016) report expanded the sub-competencies based on the original four competency domains established in 2011. Within the realm of roles and responsibilities, the expanded criteria included the following three: (a) forging inter-dependent relationships with other professions, (b) engaging diverse professionals that complement a member's professional expertise, and (c) each member recognizing their limitations in knowledge, skills, and abilities (IPEC, 2016). Ten sub-competencies comprise IP roles and responsibilities within the IPEC framework. Descriptors within this domain set parameters to measure the effectiveness of roles and responsibilities for collaborative practice.

Outcomes From Collaborative Practice

Medical error establishes the critical need for IPE using root-cause analysis of negative occurrences and patient outcomes research. According to the 2008 Joint Commission report, breaches in the healthcare quality stemmed most often because of poor communication among healthcare providers. Improved communication became a focus of subsequent actions to address the shortfalls noted in the healthcare quality. Therefore, Bodenheimer and Sinsky (2014) made a significant contribution and expanded the triple aim to include one more integral factor by adding the clinician experience. Thus, the “quadruple aim” is to improve the clinician experience and mitigate burnout among healthcare providers because this negatively influences patient satisfaction. A systematic review of the literature assessed organizational practices and showed that 78% of studies reported positive patient health outcomes when clinical settings changed assessments to include IPE outcome measures (Reeves et al., 2016; 2017). According to Hamson-Utley et al. (2021), the current literature on IPE focuses on specific patient populations and primarily includes only physicians and nurses and does not include other relevant healthcare disciplines. The lack of rigorous studies of other healthcare professions opens the door for future research to explore IPCP with various patient populations and other healthcare providers. To add, Hamson-Utley et al. (2021) found a gap in needed research where the emphasis was on undergraduate and graduate healthcare education. There is a need for more studies to bridge the gap between academia and clinical practice. The influence IPE has on healthcare delivery and the patient and population outcomes demonstrate systematic vulnerabilities in our current healthcare system. Therefore, two fronts are emerging for continued research: the expansion of studies of IPE to include a range of various disciplines and the influence that IPCP has on patient outcomes and the health of communities and populations.

Educational Accreditors Adopt Interprofessional Education

Preparing for a future practice-ready collaborative workforce would require that IPE be adopted by various health care disciplines’ representative academic accrediting bodies. There is increasing acceptance that IPE contributes to greater access to care, improved safety, and higher quality patient experiences and outcomes (IPEC, 2016; WHO, 2010). According to Wise et al. (2015), PT education has been involved in IPE but did not require its use or integration as part of accreditation standards. Increasing research and continued interest in IPE prompted further review and consideration of IPE for the profession of PT. As a result, the American Physical Therapy Association (APTA), and the American Council for Academic Physical Therapy (ACAPT), formalized a position of support for the IPEC core competencies. ACAPT required IPE integration as part of PT educational curricula (APTA, 2017). In 2017, with the formal recognition of APTA and ACAPT, the Commission on Accreditation in Physical Therapy Education (CAPTE) added the requirement that IPE is part of the formal training in PT education. Within the CAPTE accreditation standards, it states the following: “The didactic and clinical curriculum includes IPE; learning activities are directed toward the development of IP competencies including, but not limited to, values and ethics, communication, professional roles and responsibilities, and teamwork” (CAPTE, 2019, p. 20). CAPTE accreditation standards require the presence of IPE criteria in the PT curriculum with the four IPEC competency domains clearly identified within the standard requirements.

Like the APTA, the AOTA formally incorporated IPE as part of the formal educational training of OT students. Moyers and Metzler (2014) suggested that OT practitioners need to learn how to partner with other providers and provide coordinated care to remain viable in a new value-based healthcare payment system. As a profession, OTs approach client and patient care from a holistic perspective, including performance skills and patterns. As part of a team, the OT can help others understand clients’ motor processes, social skills, personal habits, daily routines, and how roles and patient rituals can affect health outcomes (AOTA, 2014). In 2015, a recommendation to begin working towards collaborative care and fostering continued mutual respect with others on the healthcare team (Uhlig & Raboin, 2015). By 2016, the AOTA became one of the nine institutional members to join IPEC (Johnson, 2017). The Accreditation Council for Occupational Therapy Education (ACOTE) is the accrediting body for OT education. IPE standards in OT education state the following:

> Demonstrate knowledge of the principles of IP team dynamics to perform effectively in different team roles to plan, deliver, and evaluate patient and population-centered care as well as population health programs and policies that are safe, timely, efficient, effective, and equitable. (ACOTE, 2018, p. 33)

The commitment of ACOTE to adopt the IPE standards, as defined and described by the IPEC report, was readily evident. The language of the ACOTE IPE standard mirrored that of the IPEC standard, as stated when Teams and Teamwork and defined in the IPEC standards.

In the formative training of specific healthcare providers, exposing students to IPE experiences could change the healthcare landscape. Healthcare students, who constitute the future healthcare workforce, would learn how to work in teams, collaborate on care, and understand their contributions and others' contributions to patients' well-being. According to Hamson-Utley et al. (2021), healthcare settings with collaborative environments routinely improve patient outcomes because of efficient workflow and cooperative and synergizing work relationships. Implementing IPE throughout the healthcare education system could usher in the changes envisioned by the WHO, IPEC, and other IP organizations to improve the health of populations and communities.

Simulation Learning in Healthcare Education

Realism in simulation is essential for students to suspend disbelief and immerse themselves in real-world learning and interactions within the simulated environment (Wilson & Wittmann-Price, 2015). Realism also refers to the fidelity of the simulation experience. The definition of fidelity is when the exactness of duplication mirrors real-world clinical environments and situations (Issenburg et al., 2005; Wilson & Wittmann-Price, 2015). Fidelity in simulation includes physical fidelity, psychological fidelity, equipment fidelity, and environmental fidelity (Wilson & Wittmann-Price, 2015). The simulation creates believable environments within the scenario framework, and learners must be receptive to interchange that the situation represents actual patient care (Dieckmann et al., 2007). One of the crucial considerations in simulation is the use of the patient. Simulation uses various methods of portraying the patient role using high-fidelity mannequins having computer-operated voices or the voice of a person speaking through the mannequin. These high-fidelity mannequins can also simulate physiological responses such as breathing, heart sounds, pulses, and other real-life functions (Fiona & Kay, 2019; Sabus & Macauley, 2016). According to the simulation scenario, SPs can also portray patients, with SPs being trained persons with a script and cues (Palangas et al., 2015; Sabus & Macauley, 2016). Another emerging trend is the use of virtual reality or virtual environments allowing for patient interactions where students enter a virtual environment as an avatar or interact with SPs who speak through an avatar (Taylor et al., 2017b; Wilson & Wittmann-Price, 2015). The rest of this section discusses how simulation in healthcare education uses SPs, high-fidelity mannequins, and virtual reality as the primary means of interaction in developed scenarios.

Standardized Patient

A SP is a person trained to simulate patients with conditions and portray scenarios or situations designed by the educator or simulation author and commonly used in healthcare education (Palangas et al., 2015). A well-trained SP performs their role by embodying the history, body, language, physical findings, emotional, and personality characteristics. The SP is believable to the degree that even skilled clinicians cannot detect SPs from actual patients (Hamson-Utley et al., 2021). The typical simulation uses SPs, and many studies have explored the use of SPs in the literature. This literature review aimed to explore what is already known about SP's effects on patient outcomes and healthcare education programs.

The SP in simulation allows students to apply academic learning and bridge the classroom to real-world clinical practice (Palangas et al., 2015; Sabus & Macauley, 2016; Webster & Carlson, 2020; Wilson & Wittmann-Price, 2015). When students enter a simulation, encountering a SP creates a sense of realism, and they must suspend belief and use clinical and critical thinking skills (Palangas et al., 2015). The effect of SPs in educational curricula, highlighted by improved student learning outcomes, measures knowledge and skills performance. For example, Kinslow et al. (2019) studied 36 athletic training students comparing case-based learning and simulation with a SP to manage patients experiencing exertional heat illness. The authors found a statistically significant difference in both groups' knowledge, recognition, and management of patients experiencing exertional heat illness in both groups. However, the study lacked a control group for comparison purposes. Bush et al. (2019) also studied 17 athletic training students in a qualitative study and gathered student responses after participating in three simulations with SPs and a debriefing session. Results revealed that students engaged in self-reflection and were motivated to alter their approaches and perspectives toward patient-centered care. Results from Kinslow et al. (2019) as a qualitative study and Bush et al. (2019) as a quantitative study together showed a balance of perspectives in research to further define the influence of simulation on student learning. When students get motivated to alter their approach toward patient-centered care, as found by Kinslow et al., students can improve their clinical performance, as demonstrated by Bush et al. Combined, these study results indicate interactions with a SP improve student learning experiences. Future studies could explore these experiences' affect patient outcomes in real-world clinical practice.

In a similarly formatted study, Webster and Carlson (2020) further supported the conclusions found by Bush et al. (2019) in a mixed-methods study showing improved phenomenological empathy and a sense of coherence among 100 nursing students. The nursing students completed post-survey outcome measures and open-ended questions after evaluating three various acutely ill SPs. Results indicated 71.3% of nursing students positively declared the SP simulation event. Themes from the study's qualitative data of clarified that nursing students highly valued the SP event as means to deliver person-centered care and motivated cognitive and therapeutic connectivity with the SP. Webster and Carlson (2020) did not provide rigorous outcome measures using a standardized tool and based the data on student perceptions. However, the study findings provided insights into the nursing student experience and perspective and laid the groundwork for future studies.

Studies of athletic training students (Bush et al., 2019; Kinslow et al., 2019) and nursing students (Webster & Carlson, 2020) provided insights of the effect SP encounters had on student learning. Randomized controlled trials (RCT) added additional insights and clarified conclusions on the influence SP encounters as a controlled, isolated IV had on student outcomes and performance. Jerant et al. (2017) studied 50 physicians in a double-blinded RCT comparing groups receiving See It training and another group encountering SPs struggling with self-care behaviors. Data of both groups measured physicians' interviewing skills and behaviors. SP ratings were not significantly different from those receiving training. Results from Jerant et al. (2017) may indicate no significant differences in a RCT; however, the generalizability of the findings were limiting as the study was conducted in one geographical location of the United States and only attributed to physicians. Also, the coding system used to rate the interactions with SPs was limited because the coders may have introduced subjectivity in their rating of the SP encounters. Additional studies of other disciplines, regional variety, and a way to control for subjectivity of SP coding of scoring may present other findings on SP encounter effects on student learning.

In addition to studies focused on student performance outcomes and student experience and perspective, other authors explored the influence of SPs on educational outcomes, especially when considering social issues such as differing cultures or value systems. SPs portraying these types of situations expose students to the patients that they may potentially encounter in clinical practice. Unver et al. (2019) measured intercultural sensitivity scores of 34 nursing students before and after participation in a simulation with a SP. After simulation with a SP, the results did not show a statistically different change in pre–post-participation scores after simulation with a SP. However, there were limitations in the study, in that there was no control group to compare the findings against students participating in simulation with a SP. In another study, Byrne (2020) conducted a mixed-methods study from a convenience sample of 38 nursing students who participated in a lecture-only activity or a group participating in simulation with culturally diverse SPs. Both groups had statistically higher pre–post participation cultural competence scores after participating in the lecture-only activity or simulation with culturally diverse SPs. Qualitative analysis showed that students who worked with SPs were less nervous in patient-care activities.

Based on the current literature, many studies cannot definitively isolate simulation effects with a SP alone on student outcomes. Few studies such as Jerant et al. (2017) in RCT studies isolated for SP activities, did not indicate a statistical difference between non-SP and SP-based learning. The study of Jerant et al. (2017) findings are limited to physicians practicing in clinical practice differing from effects on healthcare student learning outcomes. Results from the current body of evidence show numerous weaknesses in definitively conclusive findings due to the lack of controlling for the effect of simulation with a SP alone on educational outcomes. Other limitations include the absence other disciplines represented in studies, as most studies primarily focused on the medical and nursing fields. Therefore, there is merit for further investigation of the effectiveness of SPs on educational curricula and focusing on influences on OT and PT students. However, the mixed-method studies provided evidence of improved student learning through qualitative data on themes of positive student learning, indicating that students were less nervous working with patients (Byrne, 2020), and enhanced perspectives on patient-centered care (Bush et al., 2019). Future studies could focus on quantitative measures of students' nervousness or patient-centered care as a follow-up to the influence of simulation in these student-learning areas.

In reviewing the current body of literature, medicine and nursing are the most represented in IPE studies. Turning to the disciplines of OT and PT, relatively few studies examine the simulation results with a SP. Pritchard et al. (2016) conducted a systematic review synthesizing empirical studies and evaluating the effects of SPs in PT education. The study provided insights to guide current practice and future research. Pritchard et al. reached similar conclusions finding simulation with SPs as a beneficial resource for teaching and improving student outcomes in knowledge and skills. But most studies lack scientific rigor and have weaknesses in methodology to provide definitive conclusions about SPs' influence on educational research. The authors identified weaknesses due to the lack of control groups to isolate the effects of SP interactions, convenience sampling, or limited generalizability due to geography or only one healthcare discipline studied.

Macauley (2018) and Phillips et al. (2017) used experimental designs to study the influence of SPs on clinical reasoning and confidence in clinical preparation. Macauley analyzed 122 first- and second-year PT students and collected pre–post simulation with SPs. There was a statistical increase in scores compared to pre–post simulation results within the first-year group and second-year results. There were also statistically higher scores among second-year students scoring significantly higher than first-year students. The large sample size strengthened the study findings and proved that simulation improved students within the first year and second-year studies. Still, when comparing over time, students continued to have higher scores compared to first-year students. Year-over-year improvements indicated students were building on their previous experiences and attaining higher achievement in the measured performance areas. Phillips et al. examined the effects of SP interactions on 108 PT students for safety by measuring students' communication, confidence, and clinical preparedness using a self-perception scale. Students were placed in a control group engaging in classroom lectures, lab, and role-playing with one another or an experimental group working with SP in a simulated hospital setting. Results showed significant improvements in communication, confidence, perceived preparedness, and high satisfaction levels after SP simulation experiences compared to the control group. The use of student self-rating in this study did not measure student performance or faculty, supervisor, or preceptor assessment of student safety. However, improved self-rating provides insight that SP simulation provided student awareness of critical factors necessary for self-evaluation and reflection in preparation for clinical practice.

The literature review on OT education and the effects of SPs on student outcomes, like PT education, is limited in the number of studies available. In OT education, Fu et al.

(2017) studied the preferences of pediatric patients as SPs in practical testing. Fu et al. used a Likert scale to measure various choices such as working with children as SPs, participating in labs, parents' preferences for having chaperones present with children, coming back to join in the same SP activity, and preferring simulation with a SP over the written exam. The literature review yielded other studies involving OT students; however, the studies related to IPE outcomes are discussed further in the chapter.

Representation of OT and PT in studies investigating the effectiveness of SPs on student outcomes is limited in the literature. Current studies have various conclusions on the effects of SPs have on knowledge and skills acquisition. Still, the findings may be limited, or conclusions are not definitive due to limitations in the study design. This study examined the influence of simulation with a SP. This research methodology included a control group not receiving simulation learning with a SP and an experimental group with students receiving simulation learning with a SP.

High-Fidelity Mannequins

A high-fidelity mannequin (HFM) is another common tool used in the education of healthcare students. Fidelity and realism define how the simulation or simulator matches the actual environment the scenario is attempting to simulate (Wilson & Wittmann-Price, 2015). HFM can train specific tasks such as central line placement, CPR, and complex physiological responses to student actions or inactions (Wilson & Wittmann-Price, 2015). For this study, the use of HFMs is most relevant for investigating IPE skills such as communication, collaboration, and teamwork. Simple task-training mannequins do not offer complex medical scenarios or interactive communication with students. In contrast, HFMs can simulate medical complexities and non-verbal signs such as pupil dilation and engage in speech through robotics or hidden speakers to talk with students.

Other studies have compared the differences between simulation with a low-fidelity mannequin and a HFM and how interactions affect student outcomes. Konieczny (2016) studied 126 nursing students, comparing one group of students using a low-fidelity mannequin and using a HFM and knowledge and skills for medication calculation, dilution, and administration. Both groups had statistically significant higher scores after engaging in simulation. Students in the HFM group had a statistically higher significant score than those in the low-fidelity mannequin group. Weiss et al. (2016) studied 30 student respiratory therapists on knowledge and clinical skills for bag-mask ventilation, laryngeal mask airway placement, and endotracheal intubation. The study organized students into a low-fidelity mannequin or a HFM group. Data measured performance in both groups. There was no statistically significant difference in the knowledge or skills between the groups.

In a separate meta-analysis, Sherwood and Francis (2018) investigated the merits of studies using HFMs. There were limitations in Konieczny's (2016) and Weiss et al. (2016) studies, including the risk of bias due to funding sources and limited sampling with studies conducted in one facility. Using a mixed-methods research design, Kunst et al. (2017) investigated 112 nursing students. Students were randomly assigned to an intervention group working with a HFM, and other students were in a control group and did not participate in simulation with a HFM. Pre–posttest surveys and outcome measures showed that students in the simulation with the HFM reported significantly increased confidence, knowledge, and ability to complete care for acute emergency care in a mental health care facility. Students felt safe in the environment to practice clinical skills with complex clinical challenges. Results are mixed when comparing low-fidelity and HFMs, with no differences in outcomes and HFM having better outcomes than low-fidelity mannequins (Konieczny, 2016; Kunst et al., 2017; Sherwood & Francis, 2018; Weiss et al., 2016). The literature indicates mixed findings that improve student outcomes in knowledge and skills acquisition when interacting with HFMs. Continued studies could clarify the types of learning or skills needed to differentiate the use of low-fidelity mannequins or HFMs more suited depending on the desired performance or skills.

The current literature review revealed limited studies involving HFMs in OT and PT education. Roberts and Cooper (2019) initiated a meta-analysis of PT programs using HFMs in the educational curricula. Three RCTs and three quasi-experimental studies (n = 310) met the inclusion criteria. Only one of the three RCTs was considered high quality, while the other two were moderate quality. The authors concluded that there was no high-quality evidence that HFM interactions increase motor skill performance. The two moderate quality studies found improvement in students' perception of self-efficacy and no significant changes in communication skills. However, the authors noted that the lack of studies and limited variation in outcome measures prevented a proper meta-analysis. Ozelie and Both (2016) investigated the effect of simulation with a HFM on student performance on clinical internships before graduation. In their retrospective study, the authors analyzed 180 students to see if there were differences in fieldwork performance after participating in simulation with HFMs and compared to those who did not participate in simulation with HFMs. Results showed no statistically significant difference in students' clinical performance as measured by the OT fieldwork tool used to measure student performance at the respective clinical site when comparing students who participated in simulation with HFMs and those who did not. The OT fieldwork assessment rated students on a scale score of one to four and rates areas such as evaluation, screening, intervention, and communication. Though the study did not find significant differences and was retrospective, this study was unique from others as it provided insights into students completing didactic training and going on to clinical internships that are part of students' residency training of students before graduating. Future studies in this area would provide unique and valuable insights to students transitioning in their learning and bridging the gap between academic class training and adapting to clinical practice. The studies of Roberts and Cooper (2019) and Ozelie and Both (2016) underscore the importance and need for high-quality studies for OT and PT research to contribute to the body of knowledge and the efficacy of HFMs in improving educational outcomes.

Virtual Reality

VR can be used as an innovative learning strategy in the education of healthcare students as it is part of a larger category of what is called virtual learning (McGrath et al., 2018; Wilson & Wittmann-Price, 2015). The term VR is frequently misused, and educators could classify the actual activity in other categories within virtual learning (McGrath et al., 2018). Depending on the desired outcomes, the various categories of virtual learning would need to be matched based on the alignment with skills and the capabilities, practicality, realism, and direct application to clinical practice. The VR section was further organized by the current literature related to the use of virtual learning in healthcare education into five categories: (a) virtual simulation or virtual worlds, (b) augmented reality, (c) serious games, (d) virtual SPs (VSP), and (e) virtual reality. Current literature revealed several of the virtual technologies not yielding research for healthcare education; therefore, I described clinical applications and research to the areas to show emerging trends and use of the technology pertaining to patient care in the clinical setting with potential for application in academia.

Virtual Simulation or Virtual Worlds

Virtual simulation (VS) or virtual worlds (VW) is where a screen-based program provides an environment with sounds, navigation, and 3D graphic images (McGrath et al., 2018; Wilson & Wittmann-Price, 2015). The public uses of VS and VW for video gaming and entertainment. Current literature has few research studies linked to clinical research and healthcare education research since the application of these technologies continue to emerge and develop in these areas. Exploring VS or VW in real-world clinical practice reveals few studies because the application of these technologies in healthcare is a recent innovation for the benefit of patients. Taylor et al. (2017a) studied the application of VW with 94 patients with respiratory conditions. The study was a preliminary and exploratory study that surveyed if patients felt that they were likely to use VWs to engage with other patients worldwide. Younger patients were more likely to use this technology, with 14.5% indicating a preference and likelihood to use VWs. The study concluded that VWs should cater more to younger patient populations, and future studies should research the effectiveness of VWs with younger patients. Results from Taylor et al. showed that preferences of the younger population to use VW technology may be a learning environment that future healthcare students would be more willing to use in training. OT and PT clinicians studied VW as an educational tool to teach patients how to learn and manage their new prostheses. Winkler et al. (2017) conducted a qualitative study through interviews of nine participants and six clinicians and found positive responses to VS and VW applications showing how to perform rehabilitation exercises, simulating how to manage walking across varying terrains and stairs, and proper care of their prosthetic limbs. Qualitative research like Winkler et al. reveals insights into the positive effects of using VS and VW technologies. When used effectively, VS and VW environments convey patient education through different avenues and provide another form of active patient engagement. Educators can examine how VS and VWs benefit patients in clinical practice to help understand how the technologies can be taught and introduced in healthcare education.

A review of the current literature showed limited use of VS or VW applications in healthcare education due to it being an emerging innovation for teaching. VS or VW for healthcare education usually includes 3D depictions of a clinical setting or environment, immersing students in a representation of the reality of the setting or scenario. Students can visualize equipment or a patient encounter within these VW (McGrath et al., 2018; Wilson & Wittmann-Price, 2015). Immersion within the VW creates a sense of a student having presence created and feeling as if they were within the perceived environment.

Dang et al. (2020) researched students' believability in various environments by comparing three different learning activities: participation in face-to-face simulation, VR immersion, and VW observed through television monitors. Results showed that the virtual world format scored the lowest for presence among the eight nursing students compared to other learning formats after students completed a pre–post participation survey. Nursing students indicated that the VW created the lowest sense of presence when compared to face-to-face simulation or VR immersion. A potential reason for this finding is that the VW may create a representation of the environment, but the lack of ability to interact with a virtual reality patient or face-to-face patient is lacking.

Educators should use proper pedagogical approaches and implement well-developed VS or VW to benefit student learning. Englund (2017) completed a qualitative study using semi-structured interviews of four nursing and four pharmacy healthcare educators to establish the most effective theoretical and pedagogical approach for students in healthcare education. Though the sample size limited the study, the participants emphasized the importance of student-center approaches to improve student engagement to explore on their own and immerse in the VS or VW. Results showed that student-centered pedagogy would be more engaging than teacher-centered activities where teachers attempt to transmit knowledge or skills by watching the VS or VW activities. The study by Hack (2016) used a student-centered pedagogy model to measure the influence of VW on educational outcomes. Hack compared failure rates in a course where students did not participate in VW and a subsequent course that used VW. In the study, a BioSim platform created student-centered activities by allowing students to enter

VW to engage in problem-based learning, view poster displays, participate in social gatherings and discussions, and attend various seminars. The 12-week bioethics course enrolled approximately 100 post-graduate biomedical students each term. The same course was also offered without using VW and used more traditional teaching methods of lecture presentations and in-class discussions. The failure rate for the course not using VW content was approximately 11%, while the course using VW activities was approximately 5%. Hack (2016) also found that students performed better in virtual committees than students who did not participate in virtual committees.

Hack (2016) found that the use of VW activities decreased the failure rate of students in a bioethics course. Decreased failure rates are a positive outcome that benefits students in healthcare education when learning about ethics and general knowledge of healthcare-based content. However, when it comes to patient-based learning, such as Dang et al. (2020), the VW was not advantageous in providing a sense of presence in the clinical environment. Future studies should focus on the types of learning or content in health care education best suited for VS or VW applications. The studies of proper pedagogy (Englund, 2017) and successful implementation of VS or VW (Hack, 2016; Patel et al., 2013) are evidence that proper use of innovative educational technologies can benefit healthcare students. However, a literature search did not yield studies on the application of VS or VW in OT or PT educational curricula. This lack of current research provides further opportunities for studies to investigate the efficacy of VS or VW as an educational technology to improve healthcare education.

Augmented Reality

Augmented reality (AR) is where synthetic stimuli are superimposed on real-world objects, such as computer-generated images overlaid onto physical objects or places (McGrath et al., 2018). AR expands or enhances the real world, portraying its use in mainstream media. To give a better understanding of what AR looks like, movies like "Minority Report" or "Iron Man" uses digital images and animation overlaid on top of objects or projected into the air, are examples of AR. Users can manipulate the technology on surfaces or in open space using digital interfaces such as eye and earpieces (Hsieh & Lee, 2017). AR is innovative in virtual learning, and a growing number of studies are emerging in the current literature for its use in clinical and academic practice.

AR in clinical practice is emerging in healthcare to treat a range of patients and diagnoses. Examples of clinical applications include treating children with autism to recognize other people's emotions by projecting facial expressions onto individuals, (Chen et al., 2016; Voss et al., 2016); helping patients with phantom pain by digital renderings of amputated limbs (Dunn et al., 2017; Osumi et al., 2017; Rothgangel et al., 2018); enhancing or improving speech or motor control, cognition, learning, and hearing disabilities using AR through sensation in the skin, visual inputs, or audio cues (Assis et al., 2016; Cler et al., 2019; Corrêa et al., 2017; dos Santos et al., 2016); and teaching patients how to walk after a stroke by using digital projections, or audio cues while walking to adjust walking patterns (Hossain et al., 2016; Rossano & Terrier, 2016; Timmermans et al., 2016). Clinical application of AR in these studies in medicine and rehabilitation benefitted patients with various diagnoses. These clinical applications pave the way for AR for educators to train healthcare students and offer innovative treatments in a variety of settings, applications, and patient diagnoses. However, a literature search yielded few studies using AR in healthcare education.

For AR in healthcare education, Carlson and Gagnon (2016) surveyed 32 representatives of simulation technicians, simulation specialists, deans, and academic faculty to trial four nursing AR scenarios. The survey asked participants to rate areas if the experience was authentic, provided engaging interactions, enhanced learning, encouraged critical thinking and decision making, and assisted in understanding a concept or skill. The mean rating from the participants was 3.11 for favorability based on a 5-item Likert scale. Participants described that the study was an excellent start and looked forward to other iterations of scenarios using AR (Carlson & Gagnon, 2016). This study points towards interest in using AR in healthcare education and perceptions towards the use of AR. Future studies will need to explore AR's effect on student learning outcomes.

In nursing education, McCarthy and Uppot (2019) described AR application with students wearing specialized glasses to visualize projected images of human anatomy. The specialized eyewear utilized infrared technology to illuminate the circulatory system's arteries and veins, allowing students to trace the path of blood flow directly on skin surfaces of the body. Students felt more engaged and could apply the learning to techniques such as palpation of pulses and localizing where to draw blood or inject medications. The authors did not study the effect that this AR technology had on nursing student learning. However, the potential of how this enhances student performance could be an avenue for future research.

Carlson and Gagnon (2016) and McCarthy and Uppot (2019) looked at student preferences in using AR and the potential of applying AR to human anatomy. Other studies looked at the contribution that AR had on student learning. One study examined how AR may decrease anxiety as students transition from academic settings and to real-world practice. Ball and Hussey (2020) studied how AR decreased nursing student apprehension before entering clinical internship experiences. The study used a convenience sample of 47 junior and senior year students entered either into the control group with no AR experience or an experimental group participating in AR. Students in the AR group entered a photosphere environment mimicking the clinical setting in the hospital. Pre–post survey data measured student anxiety levels. The study did not show a statistically significant difference between the two groups in decreasing anxiety. However, Ball and Hussey concluded that the AR environments decreased time commitments to train students in the clinical setting, improved faculty productivity, and created standardized orientation procedures for students in the program. Although AR did not influence nursing students' anxiety, the study points to potential influence in other ways, such as improved faculty productivity and standard orientation. Researchers may further examine these benefits for students in future studies. This study illuminated AR's benefits on student performance or anxiety when transitioning from the classroom to the clinic. Concerning my study, the interests of my research was more in how students improved perceptions on the Total SPICE-R2, Teamwork, Roles, and Outcomes. There were no empirical studies performed with OT or PT students using AR in healthcare education. Future studies are needed to examine the influence of AR on student outcomes in OT and PT education.

Serious Games

Serious games (SG) are interactive computer applications simulating real-world events designed for education rather than entertainment (Hooran et al., 2019; McGrath et al., 2018; Wilson & Wittmann-Price, 2015). SG are applications created to impart knowledge and skills and incorporate an element of scoring to challenge students to meet particular goals and keep them engaged in learning (Wang et al., 2016). Gamification is another term used to describe the creation of game activities for teaching skills to students (Wilson & Wittmann-Price, 2015). Research has been conducted in the medical and nursing fields to study SG's effects on student learning (Hooran et al., 2019). The representation of other disciplines is less evident and demonstrates gaps in the literature for other healthcare education disciplines.

There are studies on SG's effects on nontechnical skills such as general knowledge, clinical decision-making, communication, teamwork, and collaboration, aligned to show the progression of medical student outcomes across various training points. Tubelo et al. (2019) studied the general knowledge of 27 undergraduate medical students in the early years of medical training for screening in the primary healthcare setting. Tubelo et al. randomly assigned students to an intervention group participating in a SG activity, or a control group of students received text-based learning materials. Results indicated a significant change in baseline tests scores among those in the gaming group after the experience and retained knowledge and scored significantly higher even four weeks later. Students in the control group did not show differences at any moment of the study. Students also described the SG-organized content clearly and favored increased engagement. In another medical study, Dankbaar et al. (2016) studied 61 medical students further along in their academic studies in SG, involving the interview of a VSP and performing a physical examination. Students participating in SG had a statistically significant difference compared to the control group. SG participation resulted in higher intrinsic and cognitive load, and students reported that they felt more engaged when compared to students in the control group. Students felt more engaged in the high-fidelity game but at the same time felt distraction from the game may have impeded learning.

In another medical study, Ward et al. (2019) examined the effects of SG called PlayDecide on junior medical students. Students of this study were further along on their academic trajectory and were in clinical internship training. Ward et al. studied student decision-making and the reporting on patient safety concerns at two different hospitals. Semi-structured interviews were conducted amongst 11 key hospital departments to examine medical students' knowledge to report patient safety concerns. The study showed a statistically significant difference in one hospital after participation in the SG over six months. In contrast, the other hospital did not significantly change the students' decision-making to report safety issues with patients. Overall, the studies of Tubelo et al. (2019), Dankbaar et al. (2016), and Ward et al. (2019) demonstrated improved outcomes at various points of medical student training. SG demonstrates effectiveness for improving "soft skills" or nontechnical skills that involve clinical reasoning, communication, and general knowledge.

The effectiveness of changing hands-on technical skills is varied among studies. Some improvements were noted in experimental studies, while others indicate no differences among intervention and non-intervention groups in SG. For example, developers created SG with the intent to enhance technical skills such as hand-to-eye coordination and hands-on skills. Harrington et al. (2018) studied 20 medical students' hand-eye coordination on a gaming platform to free robots stuck underground and guide them to the surface navigating various obstacles using a game controller. In the game, students experienced a simulated laparoscopic device in a 3D environment that mimicked the hand-eye coordination of grasping and clipping, cutting, and threading between different colored wires. The game group demonstrated significant improvements in 31 of the skills and metrics examined. Students in the control group, who did not experience the SG improved in only 14 measures, showing that SG may effectively improve medical school students' hand-eye coordination.

Authors of studies in SG found improved hands-on technical skills. Other studies show SGs are not as effective in teaching kinesthetic skills. For example, Drummond et al. (2017) studied 22 medical students and the effectiveness of an online learning module and SG titled "Staying Alive," a simulation in managing cardiac arrest. Students interacted with a VSP, and researchers examined students' behaviors and techniques to administer cardiopulmonary resuscitation. Results showed no statistically significant difference among students in the online course or SG in cardiac arrest management. The study results showed that students might only partially learn elements of resuscitation such as depth of compression in simulation-based training on mannequin task trainers.

In a similar study, Tan et al. (2017) studied the effectiveness of nursing students' knowledge and how students would complete the phases of administering a blood transfusion. The study randomly assigned 103 nursing students into a SG group or control group. The SG group had a statistically significant improvement in posttest knowledge of managing blood transfusions. However, there was no statistically significant difference in clinical performance between both groups. Current studies show mixed results on how SG benefits student learning with hands-on technical skills. These mixed results may be related to how the SG technology or tools are like the actual skill taught. For instance, in the study by Harrington et al. (2018), the controlling devices used by learners mirrored the fine motor skills used in laparoscopic surgery. On the other hand, studies such as chest compressions (Drummond et al., 2017) and blood transfusions (Tan et al., 2017) did not have technology to mimic skills these hands-on skills. Therefore, the SG had little significance or relation for students when applied to real-world practice.

The current literature review has well-described studies on the effects of SG on nontechnical and technical skills among students in nursing and medicine. However, when reviewing the literature in OT and PT practice, the current studies investigated how SG effects patient outcomes in clinical practice. SG studies improved patient outcomes in the clinical practice settings for OT and PT among patients with orthopedic diagnoses such as cervical disorders and after knee surgery (Morri et al., 2019; Velasco et al., 2017); neurological disorders such as stroke, cerebral palsy, Parkinson's disease, and traumatic brain injury (Foletto et al., 2017; Friedrich et al., 2015; Velasco et al., 2017); and detecting fall hazards at home (Money et al., 2019). There were no current studies on how SG affects student learning among OT and PT students. There is a gap in the literature studying the effects serious games have on students in OT and PT education.

Current studies in SG use only one discipline, such as nursing and medicine. There is potential to improve IPE using SG based on the studies available, but none have combined services or disciplines within a SG study. There are clinically based studies and applications in OT and PT practice. However, the current OT and PT literature has not researched SG and its effects on IPE in either of these disciplines.

Virtual Standardized Patients

VSPs are avatar-based representations of human SPs that can converse with students using natural language (McGrath et al., 2018). Applications such as “Second Life” create virtual learning experiences for learners using one-way VSPs and appear in studies in the current literature. In these types of experiences, students visualize themselves as an avatar or computer-generated image of themselves in the virtual environment. VSPs are computer-based interactive animations within the virtual environment. The experience can be live with an actual person speaking through the avatar, or they can also be pre-programmed with several decision-making pathways depending on what the students decide (Dang et al., 2020). Tandy et al. (2016) studied 20 social work students conducting virtual interviews with a VSP named Jenny. Survey results from the 20 social work students showed the intervention improved students’ understanding of how their interviewing errors influenced Jenny and what responses were most effective and successful. It gave students control over the interview process and provided repeated practice to take risks and make mistakes.

Challenges collaborating with actual patients in the clinical setting or ethical issues of SPs portraying patients with mental disorders are difficult to navigate due to patient safety or stereotyping behavior respectively (Washburn et al., 2020). Working with VSPs mitigates these issues. Washburn et al. (2020) studied social work students assessing patients with mental disorders. Washburn et al. highlighted the benefit of minimizing the risk of unseasoned clinicians or inexperienced students collaborating with vulnerable patient populations. The researchers used a convenience sample of 22 masters-level students and randomly assigned students into a VSP practice simulation group, a group with no practice, or a group practicing with a SP. Using a standardized self-efficacy tool, data from pre–post participation showed a statistically significant difference between the three groups. Results showed a statistically significant difference for students who practiced with a VSP and correctly diagnosing the mental disorder over students who did not have practice or students who practiced with a SP. In a similar study, Taglieri et al. (2017) conducted a study on 335 pharmacy students randomly assigned to a control group not working with VSP or a group working with VSP. Students completed pre–post participation surveys and assessed using a scoring rubric for patient assessment skills in the clinic. Students who worked with VSP scored significantly higher than students in the control group.

Interacting with VSPs allows students to diagnose or experience collaborating with actual patients (Taglieri et al., 2017; Washburn et al., 2020). Additionally, VSP allows students to collaborate with other healthcare students for IP coordination of care. Some studies related to this research by investigating IPE using VSP. Caylor et al. (2015)

surveyed 21 nursing, medicine, and pharmacy students with pre–post participation data collected using outcomes to measure IPE learning, such as the Interdisciplinary Education Perception Scale and Team STEPPS Teamwork Attitudes Questionnaire. Students participated in team simulations and second life avatars with a VSP. The researchers assigned students various tasks to students such as administering medication or managing a patient with an allergic reaction. The authors only reported favorability results in their study; however, participants gave high ratings overall for the activity. They suggested that further studies measure the effectiveness of simulations with VSPs on IPE outcomes.

The review of literature provided studies involving nursing and medical students. However, there is a lack of studies with OT and PT students. This study explored gaps in the literature to measure the effectiveness of simulation on IPE outcomes from changes in student self-perceptions using the SPICE-R2. However, this research differed in that the interactions were with a SP instead of a VSP.

Virtual Reality

VR is a broad term encompassing a vast array of technology, applications, and uses. The definition of VR used in healthcare education is where students immerse in a computer-generated 3-D simulated environment, interact to practice skills and teamwork, manipulate medical equipment, or interact with a patient (Billings & Halstead, 2012; Wilson & Wittmann-Price, 2015). Immersion in a VR environment occurs through full-body experiences of created sights and sounds through headsets and sensory gloves. The user then navigates through a computer-generated environment, and they can partially determine what happens next (Huttar & BrintzenhofeSzoc, 2020). Students experience VR immersion when they don head-mounted displays and other devices such as hand-held devices or other objects to manipulate the 3D world they are engaging in (McGrath et al., 2018; Wilson & Wittmann-Price, 2015). Other studies have explored other means for student immersion in VR. Dang et al. (2020) studied students' presence rating by comparing three different learning activities of participation in simulation, VR immersion, and virtual worlds through observation of a television monitor. The researchers randomly assigned eight students to one of the three learning activities. Students then Presence Questionnaire, a standardized 33-item outcome measure, pre–post participation of each learning activity. Instead of students using expensive head-mounted displays, researchers created a VR condition by using various smartphones affixed onto cardboard, then placing them over the student's head for VR immersion. Results showed that presence was highest by participating in simulation, followed next by VR, and lastly through virtual simulation observation using a television monitor. These results suggest that the VR environment was not as effective in creating a sense of presence compared to simulation but was more effective than observation through a television monitor.

In its current form, VR provides opportunities for healthcare students to practice nontechnical skills effectively; however, there are limitations using VR for technical skills. Several studies acknowledge this limitation. For example, Williams et al. (2018) found limitations in VR when teaching neonatal resuscitation to nursing students. Namely, realism or fidelity cannot be recreated in VR for performing the technical or hands-on skills of resuscitation.

Additional studies found VR effective in preparing healthcare students for clinical decision-making or recognizing signs and symptoms (Dang et al., 2020; Taylor et al., 2017b). Students would need to engage in simulation to prolong engagement or take the next step of tactile learning needed for students in this setting (Williams et al., 2018). In another study, Giordano et al. (2020) used a quasi-experimental pretest–posttest design to measure the knowledge and attitudes of 50 bachelor of science nursing students after participating in a hybrid simulation activity or VR. Students completed validated outcome measures used to measure knowledge and attitudes before and after participating in either a hybrid simulation or a virtual reality simulation with a patient involved in an opioid-related overdose. Results indicated no statistically significant difference in the knowledge retention or attitudes toward responding to interventions when treating a patient involved in a drug overdose. Results the current studies are mixed when comparing VR to other learning activities. Further studies are needed to describe VR's effects on student learning outcomes across multiple disciplines. Current literature provides nursing and medicine educational research, but other healthcare disciplines are not represented in studies.

Other studies indicate the potential of VR for improving hands-on technical skills. Hsieh and Lee (2017) described a study where inexperienced surgeons entered a VR surgical simulation suite to mimic actual operating procedures to reduce the incidence of errors. One such application that is being developed is a total knee replacement for teaching the surgical planning process, accuracy, safety, and seeing potential risks and errors (Hsieh & Lee, 2017). Forgione and Guraya (2017) also described how VR is being used to train surgeons during laparoscopic techniques of cutting, grasping, and suturing to develop psychomotor skills. However, in both Hsieh and Lee (2017) and Forgione and Guraya (2017), there were no definitive studies to describe the effectiveness of VR on acquisition of hands-on skills. The current literature review indicated descriptors, application and use, and exploration of VR in healthcare education, however there are gaps in knowledge of how VR affects the acquisition of hands-on technical skills or performance of psychomotor tasks.

When searching for VR in OT and PT education, the literature review yielded limited results on student outcomes. However, there are studies demonstrating VR's effectiveness on patient outcomes in clinical practice. VR is used to detect fall hazards in a patient home (Money et al., 2019); support in the rehabilitation of patients after a stroke (Keskin et al., 2020; Levac et al., 2016; Schmid et al., 2016; Threapleton et al., 2018); improving knowledge translation after a brain injury (Glegg et al., 2017); exercise for cardiac rehabilitation to improve quality of life, depression, and anxiety (Vieira et al., 2018); and to distract from pain and anxiety (Glennon et al., 2018). It is evident that the application of VR in the OT and PT clinical settings is beneficial for patients. However, the lack of current literature of VR effects on OT and PT educational outcomes provides potential avenues for future research.

Summary of Simulation in Healthcare

Simulation learning incorporates a variety of environmental situations and patient interactions for student learning experiences. Studies have shown that interactions with a SP can improve knowledge and perspectives toward patient-centered care among athletic training students (Bush et al., 2019; Kinslow et al., 2019). In nursing, Byrne (2020) found that students were less nervous when collaborating with patients in the real-world clinical practice setting after working with SPs. In OT and PT education, interactions with a SP improved students' clinical reasoning (Macauley, 2018) and confidence in clinical preparation (Phillips et al., 2017). There are few studies investigating OT and PT, and the research findings are limited due to the lack of a control group. Also, the studies include only one discipline. The methodology of my study included both the OT and PT, had a control group not participating in simulation, and a group participating in simulation with a SP. This methodology contributes to the gap in knowledge of simulation with a SP with OT and PT students. Simulation learning with a HFM improves nursing students' knowledge and skills for medication calculations, dilution, administration (Konieczny, 2016), and knowledge and skills for airway management among respiratory therapists (Weiss et al., 2016). In OT and PT education, studies on the effect of HFMs on student outcomes are limited. Ozelie and Both (2016) found no difference in clinical fieldwork performance among OT students after participating in simulation with HFMs. There are gaps in the literature to study the simulation effects of the simulation of a HFM has on OT and PT student outcomes.

The scope of this study does not incorporate HFM use because these types of studies look more at hands-on technical skills. Whereas the scope of this study is focused on the interactive collaboration and communication skills among OT and PT students and does not necessitate the need for a HFM. Simulation learning can also occur in virtual environments where the real world is represented with 3D graphics on a computer screen, projected on real-world objects in AR, or interactions through SG applications. These technology applications fall under the virtual world and include the applications of VR and VSP. Simulation with a VSP improved social work student's ability to diagnose patients with mental disorders over those who did not participate with a VSP (Washburn et al., 2020); improved assessment skills in the clinic among pharmacy students (Taglieri et al., 2017); and was favored among students for IP coordination of care among nursing, medicine, and pharmacy students (Caylor et al., 2015). There are limited studies on how VSP simulation interactions influence student outcomes in OT and PT education. This study fills a gap in knowledge by having a control group and substituting a SP instead of a VSP and used a validated measure for student pre–post self-perceptions.

Simulation Learning for Interprofessional Education

The purpose of IPE is to meet the *triple aim* in health care to (a) improve the experience of patients, (b) improve the health of various patient populations, and (c) to decrease medical costs (Boyers & Gold, 2018; Johnson, 2017; Reeves et al., 2017; Stockert & Ohtake, 2017). One of the leading causes of death in healthcare is attributed to medical error, resulting in more than 250,000 per year (Arth et al., 2018). To meet the challenge and in efforts to improve healthcare for patients, educators can integrate IPE learning experiences through a myriad of learning activities, including case studies (Goreczny et al., 2016); chart review and team care planning; (MacKenzie et al., 2017); classroom lecture (Goreczny et al., 2016; Oxelmark et al., 2017); high-fidelity simulation (Coppola et al., 2019); peer role-playing (Kirwin et al., 2017); and online simulation training (Kim et al., 2017). The current literature reveals the use of simulation to integrate

IPE in the training of students in healthcare curricula (Carson & Harder, 2016; Dennis et al., 2017; Hamson-Utley et al., 2021). Distinctions need to be made regarding IP learning in the academic setting versus real-world clinical practice across the patient care continuum. In both instances, IP learning occurs, but the emphasis is on the training of students to foster requisite skills once they enter the clinical realm or in the training of current healthcare providers in their respective settings to influence patient care and healthcare delivery. When integrating IP learning, the term IPE is used in academia, and IPCP is mainly used to describe interactions of providers in clinical practice (Wilson & Wittmann-Price, 2015). The literature review for this research study focused on the use of simulation solely in healthcare education and its influence on student learning on hands-on technical skills and soft skills or nontechnical skills such as teamwork, communication, and collaboration. Therefore, this literature review was organized into two categories, the IPE studies related to teaching technical skills and another for studies related to nontechnical skills.

Technical Skills

IPE aims to change behaviors to decrease medical error, improve patient outcomes, and increase safety. However, there is concern studies have not measured the change in behaviors, which is the end goal needed to impart the desired change (Riskiyana et al., 2018). According to Coggins et al. (2017), working collaboratively as IP teams primarily involve the clinical decision-making that is needed to manage patients. Studies have categorized these skillsets or behaviors as nontechnical or soft skills of patient management. However, there are instances where IP teams work together to deliver hands-on skills. Most studies fall in the realm of the simulation effects on nontechnical skills such as communication, collaboration, and teamwork. However, this section, will examine studies focused on IP team interactions and the delivery of hands-on technical skills using simulation.

Educators can use simulation to train learners on medical techniques and skills used during critical emergencies like resuscitation, airway management, or during complicated surgical procedures. Instead of practicing on actual patients, simulations can be used with SP, task simulators, or mannequins. In this manner, students can practice technical skills repeatedly with no risk of harming actual patients. Rojas et al. (2016) studied the influence of ventilator lab exercises among fourth -year medical students and senior respiratory students. The study enlisted 14 medical and respiratory students randomly paired together and assessed pre–post simulation on time-to-hand patient technical skills. The authors did not provide statistical analysis of the average time it took to complete required technical skills but concluded that the students had positive experiences from simulation and that students requested more opportunities for simulation. Although students seemed to enjoy learning technical skills using simulation, Rojas et al. did not determine whether simulation improved students' ventilator technical skills. In another study, Coggins et al. (2017) further studied the technical skills of airway management in critically ill patients. Coggins et al. expanded the findings of Rojas et al. (2016) by studying the simulation results over a period of 30 months of 283 junior medical students. Students participated in a three-part series of simulation skills to manage anaphylaxis, respiratory failure, septic shock, and myocardial infarction. The study improved students' clinical performance as measured by outcomes used to assess student performance in the clinic. In addition, there was a significant coinciding reduction in the hospital's reported cardiac arrests. Though the findings of Coggins et al. are not inclusive of another IP discipline, the findings of this study are significant because there was a measurable change not only in the academic training of students but also a direct improvement in the real-world clinical practice as observed in the decrease in in-hospital cardiac arrests. Researchers should conduct future studies and should be modeled after the Coggins et al. study to measure IPE's effectiveness in improving patient outcomes.

Other studies have investigated the effects of simulation outside of critical events and examined non-critical events of patient care. For example, in a qualitative study, Nikendei et al. (2016) studied the outcomes of IP simulation-based hospital ward rounds of 29 medical, nursing, and PT students. All the students participated in two simulations where one patient suffered a myocardial infarction, and another patient was poorly managing their diagnosis of diabetes. Data were collected among the participants post-participation in the simulation through focus groups. Nikendei et al. found that students had an increased understanding of the various team member roles when delivering care, such as exercise prescriptions from PT students in the management of diabetes. Students also reported that coordinating interventions was more efficient. Because the patient was at the center of common interest, a more holistic approach was followed regarding decision-making for the patient. The qualitative findings of Nikendei et al. highlighted the potential of simulation for improving patient care management during hospital rounds among IP colleagues. Further studies could follow-up on these findings by measuring IP interactions based on an outcome tool to measure effects of simulation on team members' skills attainment.

In a quantitative study, Sanko et al. (2020) examined the effectiveness of simulation to train students in holistic thinking. Sanko et al. utilized an outcome tool called the systems thinking scale to measure simulation results among 961 participants from five academic institutions. The simulation was based on a scenario called "Friday Night at the Emergency Room." IP teams consisting of nursing, medicine, PT, public health, psychology, and pharmacy students work together to problem solve issues in patient care. Students looked at system-level delivery of patient care occurring at the emergency department, surgery, step-down, and the patient care at a system's level for critical care, triage, intake, patient flow, coordination of lab tests, and patient interventions. Sanko et al. then took pre–post participation measurements on the systems thinking scale, and the results found a statistically significant increase in pre–post simulation participation. The large sample size of the Sanko et al. study demonstrated the benefits that simulation has on system processes. In the study of Sanko et al., the outcome tool used was a self-rating measure. Researchers should conduct further studies to look at the effect on patient care outcomes, such as the findings of Coggins et al. (2017) and the decrease of in-hospital cardiac arrests, or an outcome measure that is not a self-rating but rather a tool that is scored by a supervisor or preceptor.

The current literature on simulation effects on IPE within the hospital setting. In addition, the disciplines of medicine and nursing are well-represented in IP simulation studies (Coggins et al., 2017: Nikendei et al., 2016; Rojas et al., 2016; Sanko et al., 2020). Few studies focus on IP care outside the hospital setting or solely on rehabilitation clinicians such as OT and PT. However, emerging studies address the gap in the literature in these areas. These studies broaden the representation of disciplines and other settings where IP interactions occur. Pitout et al. (2016) conducted a qualitative study of 82 OT, PT, and medical students in an outpatient clinical setting. Pitout et al. assigned students to IP teams representing their respective disciplines. The study design included three simulations involving a patient with multi-trauma, and the technical skills integrated into the simulation were clinical skills that students had already mastered. Students spent two hours in the activity, with the first hour dedicated to IP collaboration and the second hour providing consultation with the SP. The authors gathered post-simulation data using focus groups. PT students indicated that the simulation revealed that they need to work on their profession-specific skills, such as convincing patients to follow their home exercise program. OT students recognized the importance of understanding the patient's home and work circumstances when prescribing care. Medical students complimented their IP team members recognizing that OT and PT students knew what they were doing to manage the simulated patient's care.

The Pitout et al. (2016) study focused on patient interviewing skills, but the authors did not investigate hands-on components of care. In another study, Coppola et al. (2019) used a mixed-method quasi-experimental pretest and posttest design to investigate the hands-on skills of 21 second-year OT and PT students after participating in IP simulation with a computerized mannequin. Researchers gathered data from a convenience sample of students' pre–post simulation participation with a patient who underwent total hip replacement surgery. During the simulation, students practiced the hands-on technical skills of assessing vital signs, repositioning the patient with an abduction wedge between the patient's legs, and managing lines and tubes. Then, the researchers collected post-participation data during 5-minute debriefing sessions. Students commented on both technical skills and nontechnical skills after the experience. Students found value in working together with IP classmates and found it helpful to cooperatively manage patients with complex medical issues and have the support of an IP colleague to manage the patient safely. The qualitative findings of this study regarding technical skills revealed a potential for improving safety for patients during therapy treatment. The current literature revealed qualitative studies that highlighted the benefits of simulation among OT and PT students in the hospital and outpatient settings (Coppola et al., 2019; Pitout et al., 2016). Follow-up studies may focus on using similar simulation interactions and skills and measure student technical skills attainment with a quantitative outcome measure. This study investigated simulation effects OT and PT students' IP attitudes. Though this study primarily looked at the nontechnical skills or soft skills such as communication and collaboration, researchers can direct future studies that measure the effect of simulation on improving hands-on technical skills and the potential opportunities for improving patient outcomes.

Nontechnical Skills

Collaboration in IP teams primarily involves the clinical decision-making needed to manage patients (Coggins et al., 2017). Knowledge, teamwork, cooperation, and efficiency of care are examples of skillsets categorized as nontechnical or soft skills in patient management. The current literature reveals most IPE studies focus on the realm of the effect simulation has on nontechnical skills. This section examines studies focused on IP learning of team interactions and the delivery of nontechnical skills such as communication, collaboration, and teamwork using simulation.

Qualitative studies can be used early to identify general trends or observations when delving into the research process. Through student interviews, focus groups, or other methods, data can provide insights into students' lived experiences further point to future research with refined qualitative studies, quantitative studies, or mixed methods (Burkholder et al., 2016). Nikendei et al. (2016) conducted a qualitative study with 29 nursing and PT students. Researchers collected data from focus groups after participating in IP simulation with one patient who had a myocardial infarction and the other who had uncontrolled diabetes. The qualitative data results revealed positive themes in nontechnical skills, including improved communication, supporting work of IP tasks, providing care with a sense of a more relaxed environment for learning, and more efficient care coordination due to clear task distribution. A similar study conducted by Gordon et al. (2017) reinforced the findings of Nikendei et al., where themes emerged from 12 participants from medicine, nursing, pharmacy, and OT in communication, teamwork, analytical skills, and personal behaviors. Gordon et al. had a slightly different shift towards contact anxiety within the group playing a role in teamwork and communication. Pitout et al. (2016) was a more extensive qualitative study expanding the findings of Nikendei et al. and Gordon et al. Pitout et al. researched 66 medical students, nine OT, and seven PT students within an outpatient clinic setting and randomly assigned participants in IP teams to perform care on a patient involved in multiple traumas from a stab wound to the right arm. Several themes emerged in the data analysis of post-simulation interviews from the participants, such as gaining an increased sense of their role and others' roles as part of the collaborative team, improved social skills, increased sense of empathy, and greater confidence in caring for patients.

Collectively, qualitative studies have laid down a groundwork of findings where simulation fosters improved communication, delineation of roles, teamwork, increased confidence and decreased anxiety, and collaborative social skills (Gordon et al., 2017; Nikendei et al., 2016; Pitout et al., 2016). Considering the findings of these quantitative furthers understanding of the qualitative data of the lived student experience by objectively quantifying students' simulation experiences. Smith et al. (2018) conducted a quantitative study to measure nontechnical skills of team collaboration among 57 PT, 36 nursing, 2 doctor of nursing practice, and 37 social work students. A quantitative tool called the Interprofessional Practice Collaborative Competency Attainment Survey measured students' pre–post simulation IP attitudes. Students self-reported that they either strongly or somewhat agreed the simulation experience improved critical and thinking skills, ability to prioritize impairments, and confidence in discharge planning. However, there was no statistical significance in student scores when comparing pre–post simulation results. Smith et al. noted limitations in this study as the survey tool showed high pre-participation simulation scores. Since students were in their third or fourth year of academic training, previous simulation or IP experiences in prior coursework may have increased students' pre-simulation scores in pre-participation in this study. This study investigated the simulation effects on OT and PT students' IPE attitudes.

Conversely, in a study by Cunningham et al. (2018), statistically significant findings were found in IP preparedness of 20 PT students and 63 nursing students in a mixed-methods study. The authors used pre–post simulation data to collect after students participated in a 3-hour simulation experience using the Readiness for IP Learning Scale. Nursing and PT students performed respective skills in regarding their disciplines while working in IP teams. Cunningham et al. concluded statistically significant improvements in all four nontechnical skill areas of shared learning, teamwork and collaboration, professional identity, and roles and responsibility. Results from Cunningham et al. provide quantitative evidence that supports the results of qualitative studies regarding the effects of simulation on IPE.

Additional studies provide further evidence of simulation's positive effects on IPE. Karnish et al. (2019) conducted a mixed-methods study with 41 nursing, 46 PT, and 22 medical imaging students. The authors used the IP Socialization and Valuing Scale to collect pre–post participation data after students participated in one of the five 45-minute simulations in an acute care setting. The validated outcome measure utilized in the study assessed students' self-rating of nontechnical skills. Karnish et al. found a statistically significant improvement ($p < 0.001$) in the overall total score in post-simulation scores using a 2-tailed, paired sample t test. Also, qualitative findings through phenomenological inquiry exploring students' lived experiences revealed themes of creating a culture of communication and teamwork and professional role discernment.

The study was limited in its findings as a single simulation lasting only 45 minutes may not solely account for measured changes. A large sample size shows the strength of this study. However, a control group would help strengthen the study findings and further clarify if simulation alone, and no other time-related factors, previous experience, or other course content, factored into the overall improvement in student self-perceptions.

Outcome measures measuring IPE attainment rely on student self-ratings and self-perception. There is value in student awareness and the ability to self-reflect on the changes in self-perceived behaviors. The limitations of seeing outcomes from supervisors or preceptors could provide additional insights and further validation of the influence of simulation on changing student behaviors. Reime et al. (2016) conducted a mixed-methods study involving 123 medical students and 61 nursing students. Students were assigned to two IP groups and participated in two different 15-minute simulation scenarios. Reime et al. collected data using an observation tool that measured six IP areas. Overall, both IP groups showed statistically significant improvements when comparing results from the second simulation performance to the first simulation in closed-loop communication, team cooperation, diagnosing the patient, and prioritizing treatment. Reime et al. also collected qualitative data from post-simulation interviews. They found that strong emotions stemming from making errors in the simulation had long-lasting impressions on students even months after participating in the event. The large sample size strengthened the study findings and further supported the positive effect that simulation has on student development of IP nontechnical skills. In addition, this study adds a dimension that is lacking in most IPE studies. Instead of using student self-perception or self-rating tools, the study is unique. It relies on a preceptor assessment by having faculty ratings and scoring of what they observe in student behavior. Reime et al. acknowledged their study limitations. Their outcome measure was a self-developed tool that was not thoroughly validated, potentially limiting the study findings.

Another limitation of the current studies of the effect simulation has on IPE is the lack of a control group isolating the simulation variable as a DV. Swift et al. (2020) conducted a quantitative study with 119 nursing, and PT students intended to measure if students achieved outcomes in IP communication and collaboration in delivering patient care. The first cohort consisted of nursing and PT students working together as an IP team. The second cohort consisted of only nursing students. When comparing the first and second cohorts, there was a statistically significant difference in completion of required competencies, with completion rates of 76% and 44%, respectively, for students effectively communicating to facilitate teamwork and collaboration in delivering patient-centered care. Swift et al. also concluded that nursing students could practice delegation of tasks when working with PT. More than one profession prompted improved care due to the input of multiple healthcare provider perspectives. The study indicated the benefit of IP colleagues working together to improve communication and delegation. However, there were limitations in the study design, potentially giving bias to the conclusions. Compared to the other cohort who did not have PT present, measuring the ability to collaborate and communicate with team members automatically disadvantages the second cohort because it was challenging to achieve IP outcomes when another discipline was not present. Using a control group of simulation versus no simulation and having both nursing and PT present could improve the study findings. My study included OT and PT students and compared a simulation group with a control group not participating in simulation.

As discussed in this literature review, there are studies similar to this study in scope, measures, and variables investigating the effect of simulation learning on student IPE attitudes. Aligning this study with previous studies that utilized the same outcome measure could fill the gap knowledge on simulation's effect on IPE outcomes. Previous studies used the SPICE-R2 to measure changes in students' attitudes before and after simulation. Nichols et al. (2019) studied the influence of simulation on 130 students from athletic training, nursing, OT, PT, social work, and psychology. They found a statistically significant increase from the pretest to posttest SPICE-R2 subscores in roles and responsibilities from collaborative practice and patient outcomes from collaborative practice. Nichols et al. was not able to compare against a control group. Therefore, the study of Brennan et al. (2021) furthered knowledge of whether simulation influenced student attitudes in the SPICE-R2 with the addition of a control group. Brennan et al. studied 88 medical and pharmacy students and found, between students in simulation and compared against a control group, a statistically significant difference in the overall SPICE-R2 score of IP teamwork and team-based practice and patient outcomes from collaborative practice. There was no statistically significant difference in the overall SPICE-R2 score for IP teams and the team approach to care and the subscore of roles and responsibilities of collaborative practice. Overall, Nichols et al. and Brennan et al. found mixed results on the simulation's effect on student IPE attitudes as measured by the

SPICE-R2. This study continues to add to the findings of Nichols and Brennan by advancing what is not known about simulation learning among OT and PT students with the use of a control group.

Other studies have also used the SPICE-R2 for changes in IPE attitudes but investigated other learning activities not linked to simulation learning (Matulewicz et al., 2020; Nwaesei et al., 2019). Though these studies are not directly linked to the effects of simulation learning on IPE, inclusion in this literature review offers additional insights into the SPICE-R2 for measuring other forms of IPE learning that could occur among students and clinicians. Matulewicz et al. studied 343 students from dental hygiene, dentistry, health administration, nursing, OT, PT, and pharmacy. The SPICE-R2 was different by using a retrospective pretest–posttest assessment. Also, instead of one IPE event such as simulation, students were enrolled in an IPE course featuring lectures, labs, interactive assignments, case studies, and group work. The study did not include the use of a control group. Overall, there was a statistically significant increase in the overall total SPICE-R2 and the subscores. The only exception was among health administration students, where the increase in scores was not statistically significant.

The study of Nwaesei et al. (2019) was also included in this literature review because of the use of the SPICE-R2. Though the study was not in the academic setting, the inclusion of the findings demonstrates the bridge between academia and clinical practice. Bridging academic and non-academic settings could show the efficacy of academic learning in improving healthcare delivery. IPE was created to improve the overall healthcare delivery model and decrease medical errors. Nwaesei et al. studied 39 pharmacy and medical students who engaged in daily rounds, teaching rounds, and weekly lunch and learn sessions in an eight-month-long study. Pretest–posttest SPICE-R2 measures were taken at the beginning and end of the study. Statistically significant increases were noted in all the categories of the SPICE-R2. However, the method of calculating results was different than other studies. Whereas other studies used a cumulative total and subscores (Brennan et al., 2021; Matulewicz et al., 2020; Nichols et al., 2019), Nwaesei et al. collapsed Likert scales of four and five into one category and then reported the percentage of students who chose the agree or strongly agree rating. Additionally, improvements were only noted in individual questions of the 10-item measure, with statistical increases in questions one, four, and six. Nwaesei et al. did not use the SPICE-R2 pre-assigned categories described in the outcome measure instructions. My study furthers what is not known in academia among OT and PT students with a one-time IPE event of simulation with a SP. Studies such as Matulewicz et al. and Nwaesei et al. provide additional context of other IPE learning activities over time and the potential to affect clinicians in clinical practice. These provide further discussion and consideration of IPE in academia and the potential to influence patient outcomes, improve healthcare delivery, and decrease medical error.

IPE learning is used in many healthcare education settings and research has confirmed improvements in both technical and nontechnical skills. Improvements have been found in student IP collaboration skills, communication skills, and team dynamics (Oxelmark et al., 2017; Paige et al., 2017; Wellmon et al., 2017). In addition, IPE has shown to improve behavior among team players to coordinate patient care and improve healthcare outcomes (IPEC, 2011; IPEC, 2016). The current literature revealed limited research on the effects of IPE on OT students (Johnson, 2017) and PT students (Stockert & Ohtake, 2017). The literature reveals gaps in controlling for simulation as a variable in studies. Also, validated and standardized outcome measures are needed to build a body of evidence that measures changes in outcomes from simulation with various healthcare disciplines. At the introductory level, student self-perceptions and ratings provides quantitative insights in the student experience that may lead to further qualitative studies, or studies using tools that are rated by preceptors. This study was designed to contribute to the gap in knowledge on the effect simulation has on first-term OT and PT students' attitudes on the Total SPICE-R2, Teamwork, Roles, and Outcomes.

Summary and Conclusions

Through the literature review, an overview was presented on why the WHO recommended IPE to improve the healthcare delivery. The overall goals of IPE are to achieve the "triple aim" to improve the patient's experience of care, improve the health of patient populations, and reduce medical costs (Brandt et al., 2014; IPEC, 2011, 2016). The quadruple aim added enhanced goals to include the clinician experience to expand upon the triple in healthcare delivery (Bodenheimer & Sinsky, 2014; Hamson-Utley et al., 2021). As a result of the WHO 2010 report, a representative body of IP healthcare disciplines, collectively named and recognized as IPEC, convened and established a working framework for IP collaborative practice competency domains to include IP teamwork and team-based practice, IP communication practices, values/ethics for IP practice, and roles and responsibilities for collaborative practice (IPEC, 2011; IPEC

2016). The establishment of the IPEC core competency domains has become widely accepted in the literature as standards for developing IPE in academia and IP collaborative practice in clinical settings.

One of the major themes that emerged during the comprehensive review of the literature was the integration of simulation as part of IPE learning experiences. One of the essential factors of simulation is considering the type of patient used in the planned simulation activity. The literature described how the use of low-fidelity mannequins and high-fidelity mannequins improved student performance in delivering care and team dynamics (Konieczny, 2016; Kunst et al., 2017; Ozelie & Both, 2016; Roberts & Cooper, 2019; Sherwood & Francis, 2018; Weiss et al., 2016). Virtual reality is another emerging innovation in delivering simulation. The patient can be in a virtual world (Dang et al., 2020; Englund, 2017; Hack, 2016; Taylor et al., 2017a; Winkler et al., 2017), augmented reality (Ball & Hussey, 2020; Carlson & Gagnon, 2016; McCarthy & Uppot, 2019). Researchers explored other innovative applications regarding simulation in healthcare, including serious games and VSP. The use of a SP aligned with the purpose and intent of this study. Various disciplines have explored how interactions with SPs improved student performance in athletic training (Bush et al., 2019; Kinslow et al., 2019) and nursing (Byrne, 2020). Studies have shown that interactions with a SP can improve knowledge and perspectives toward patient-centered care among athletic training students (Bush et al., 2019; Kinslow et al., 2019), nursing students (Byrne, 2020), and OT and PT students (Macauley, 2018; Phillips et al., 2017). However, few studies explored the effect simulation with a SP had OT and PT students. It is also unknown if simulation influences learning because most studies did not use a control group (Brennan et al., 2021) as a variable on student learning. The methodology of my study included both the OT and PT, a control group, and a simulation group with a SP, which has not been previously done among OT and PT students.

Another emerging theme from the literature review was simulation to foster IPE learning experiences. Many healthcare education settings use IPE learning, and research has found improvements in IP collaboration, communication, and team dynamics (Oxelmark et al., 2017; Paige et al., 2017; Wellmon et al., 2017). The current literature could be further categorized by the influence on technical and nontechnical skills when working in IP teams. Studies have shown improved performance in technical skills such as team delivery of resuscitation and critical airway management (Rojas et al., 2016), cardiac arrest (Coggins et al., 2017), and post-operative orthopedic care (Coppola et al., 2019). Nontechnical skills such as communication and teamwork are more aligned with the purpose of this study. Studies have shown that simulation can improve the delivery of team care plans for complex patients (Gordon et al., 2017; Nikendei et al., 2016; Sanko et al., 2020), multi-trauma care (Pitout et al., 2016), discharge planning (Smith et al., 2018), and socialization and values (Karnish et al., 2019). Authors from the current literature review on simulation in IPE acknowledge several limitations and what is unknown in the literature. For example, there may be other factors over time influencing student performance (Karnish et al., 2019), utilization of a validated outcome tool to measure student change in performance or attitudes (Reime et al., 2016), and lack of control for simulation as a variable (Swift et al., 2020). Also, most simulation and IPE studies represent nursing and medicine professions, not OT and PT, as part of the IP team. However, few studies are dedicated to the interactions only between OT and PT, which is a typical clinical partnership experienced in rehabilitation settings.

The current literature reveals limited research on the effects of IPE on OT students (Johnson, 2017) and PT students (Stockert & Ohtake, 2017). The current literature reveals gaps in controlling simulation as a variable in studies. Also, validated and standardized outcome measures are needed to build a body of evidence that measures changes from simulation with various healthcare disciplines (Brennan et al., 2021; Nichols et al., 2019). At the introductory level, student self-perceptions and ratings provide quantitative insights into the student experience, that may lead to further qualitative studies or studies using tools that are rated by preceptors. This study contributes to the gap in knowledge on the effect simulation has on first-term OT and PT students' attitudes on the Total SPICE-R2, Teamwork, Roles, and Outcomes.

Chapter 3: Research Method

Introduction

The purpose of this causal-comparative study using a pretest–posttest nonequivalent control group design was to investigate the difference in first-term graduate OT and PT students' IPE attitudes posttest scores on the Total SPICE-R2, Teamwork, Roles, and Outcomes between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate. To accomplish this purpose, I used archival data from OT and PT students in a course in the first term of their respective programs at HU. The data points were derived from students who completed simulation with a SP and other students who did not, thus creating the opportunity for new comparison research. Outcome measures for my study were part of HU's assessment of educational and programmatic assessment aligned with institutional, programmatic, and course outcomes to evaluate accreditation standards for IPE. The study addressed gaps in the literature noted in Chapter 2 by controlling for simulation as a design element in healthcare simulation studies.

In Chapter 3, I outline the research methodology used for my study. I start by describing the research design and the rationale for implementing this research design for my study. In the next section, the methodology used is described in detail, including the study population, data collection, instrumentation and outcome measures utilized, interventions, and data analysis plan. The chapter concludes with threats to validity and the ethical procedures followed for this study.

Research Design and Rationale

The purpose of this causal-comparative study using a pretest–posttest nonequivalent control group design was to investigate the difference in first-term graduate OT and PT students' IPE attitudes posttest scores on the Total SPICE-R2, Teamwork, Roles, and Outcomes between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate. In this quantitative quasi-experimental causal-comparative design study, I examined how the IVs of simulation learning with a SP, or no simulation, affected the DVs of posttest student attitudes using the SPICE-R2 while controlling for potential variance in IPE attitudes by using pretest SPICE-R2 scores. The SPICE-R2 measured IP teams and team approach to care, teamwork and team-based practice, roles and responsibilities for collaborative practice, and outcomes from collaborative practice. The covariate was student pretest scores on the SPICE-R2 assessment instrument. This study had four RQs and related hypotheses, as summarized in Table 1.

Table 1

Variables and Statistical Treatment by Hypothesis

H	IV	DV	Covariate	Statistical treatment
1	Students participating in simulation versus students not participating in simulation	Total SPICE-R2 posttest scores for IP teams and the team approach to care	Total SPICE-R2 total pretest scores for IP teams and the team approach to care	One-way analysis of covariance
2	Students participating in simulation versus students not participating in simulation	Teamwork SPICE-R2 posttest subscores for IP teamwork and team-based practice	Teamwork SPICE-R2 pretest subscores for IP teamwork and team-based practice	One-way analysis of covariance
3	Students participating in simulation versus students not participating in simulation	Roles SPICE-R2 posttest subscores for roles and responsibilities for collaborative practice	Roles SPICE-R2 pretest subscores for roles and responsibilities for collaborative practice	One-way analysis of covariance
4	Students participating in simulation versus students not participating in simulation	Outcomes SPICE-R2 posttest subscores for patient outcomes from collaborative practice	Outcomes SPICE-R2 pretest subscores for patient outcomes from collaborative practice	One-way analysis of covariance

Note. *H* = hypothesis, IV = independent variable, and DV = dependent variable.

The variables and parameters of this study made it appropriate to implement a quasi-experimental causal-comparative study with a nonequivalent control design. This design was based on the RQs because students were enrolled into previous existing groups comprised of two versions of the same course offered in a different course delivery format. Quasi-experimental research often uses nonequivalent control group designs (Campbell & Stanley, 2015; Warner, 2013). Warner (2013) further stated that quasi-experimental design resembles experimental design up to a point, that differs where quasi-experimental designs compare groups receiving different treatments.

Researchers have less control in a quasi-experimental design over some aspects of the study when compared to a true experimental design (Warner, 2013). For this study, depending on the version of the course, students' archival data sets were assigned to the control group or the simulation group. Furthermore, the design of this study used a pretest–posttest nonequivalent control design (Reichardt, 2019). OT and PT students may have entered the course with varying levels of prior experience in IPE (see Laureate Education, 2017c, 2017h; see Warner, 2013). Therefore, to control for students' prior academic IPE experiences, this research study used a covariate of pretest SPICE-R2 scores and calculated for changes using a one-way ANCOVA.

The pretest SPICE-R2 scores would control for any potential differences among OT and PT students in the control group or the simulation group. The pretest SPICE-R2 provided data to account for potential differences that might exist in students' IPE attitudes. By controlling for prior potential academic variances in students' IPE attitudes through the pretest SPICE-R2, I attempted to highlight the influence that simulation learning with a SP had or did not have on students' attitudes toward IP teams and the team approach to care while minimizing confounding factors from differing IPE attitudes before starting the course. My study consisted of an IV with two categories: (a) simulation with a SP and (b) no simulation. There were four DVs from the SPICE-R2 total posttest scores and three subscore posttest scores. Each DV was provided an appropriate RQ and related hypotheses to be tested. Finally, this study controlled for differences in students' prior levels using SPICE-R2 measures as a covariate.

Variables in the Study

The study used four outcome variables, one IV with two categories, and a covariate. Zorek et al. (2016), provided the SPICE-R2 outcome measure categories. The outcome or DVs were the total posttest SPICE-R2 scores and three subscores, each focusing on different IPEC core competency domains (IPEC, 2011, 2016). For the SPICE-R2, the IPEC domains were (a) Total SPICE-R2, (b) Teamwork, (c) Roles, and

(d) Outcomes. The Total SPICE-R2 and the subscores on the SPICE-R2 were measured using an interval/ratio 1-5 Likert scale.

The IVs consisted of two categorical groups with OT and PT students who participated in simulation with a SP and those who did not. Students enrolled into predesignated course program offerings depending on the program in which they were enrolled. OT and PT students who enrolled in the full-time residential program offering the introductory course participated in a standardized simulation with a SP as part of the course learning activities from integrating simulation and IPE to meet course, programmatic, and institutional learning objectives. OT and PT students who enrolled in the part-time flexible program did not participate in simulation as this course, offered in the Spring 2020 trimester, was part of a newly developed program for OT students. Faculty had not received the formal prerequisite training required on standardized simulation as part of the university training before the start of the course. Pretest–posttest SPICE-R2 scores captured students' attainment of IPE knowledge at the start and end of the course for both the control group and simulation group. These outcomes were collected as part of HU's course, programmatic, institutional, and accreditation outcomes for IPE.

The Research Design and Justification

The quasi-experimental causal-comparative research using a nonequivalent pretest–posttest control group design is one of the most used designs in education, field research, healthcare, and social sciences (Campbell & Stanley, 2015; Reichardt, 2019). Inherent divisions but unequal representation may exist in naturally occurring delineations such as classrooms or healthcare groups of persons (Reichardt, 2019). For example, in healthcare groups and health research, those receiving treatment due to a diagnosis of a particular pathology and those who do not have a particular pathology may have unequal representation (Campbell & Stanley, 2015). My study compared the DVs of two population groups on posttest results after simulation (intervention group) or no simulation (control group). A pretest was administered at the start of the course for the control group and just prior to the simulation experience for the intervention group during the 9th week of instruction. The posttest was administered toward the end of the course after 14 weeks of instruction for the control group or after simulation that occurred during the 9th week of instruction for the intervention group.

In my study, the IV of participation in simulation with a SP or no participation in simulation with a SP provided participant group membership that was mutually exclusive for my research design (see Frankfort-Nachmias & Leon-Guerrero, 2018). The administration of simulation or no simulation was present and met the requirements of the study design choice due to the timing of implementing simulation in different versions of the course in two different programs at HU. The use of existing groups is common in a quasi-experimental design. Still, it lends to a lack of randomization and an inability to control for the influence of other factors in a study. Pretest and posttest in both the simulation group and no simulation group met the research design criteria. Nonequivalence was anticipated due to the use of pre-existing groups and the archival nature of the study and met the nonequivalent design choice. Consideration of external and internal validity issues was identified, evaluated, and assessed in the study to explain other potential factors that might have contributed to observed differences in the study outcomes (Warner, 2013). Considerations for validity are discussed further in the external and internal validity sections of Chapter 3.

The use of a control group in my study differed from other studies examining the effects of simulation on IPE where control was not used (Kirwin et al., 2017; MacKenzie et al., 2017; Nichols et al., 2019). A nonequivalent control group design was appropriate to my RQs because students were enrolled into previous existing groups comprised of two versions of the same course offered in a different delivery format. Additionally, students may have nonequivalent attitudes at the start of the course due to differing life or work experiences. Thus, using the pretest covariate was appropriate for the research design choice. Depending on the version of the course, students' archival data were assigned a code for either the treatment or the control group. Archival data consisted of programmatic evaluation measures integrating simulation and IPE throughout the university curricula. The data included pretest–posttest SPICE-R2 scores from the control group and those participating in simulation with a SP. By using archival data, both time and resource constraints were mitigated because the student data were already completed, and data were already collected.

Research Question and Hypotheses

According to Creswell and Creswell (2018), the purpose of RQs and hypotheses is to narrow the focus and purpose and identify potential relationships between variables within a study. Quantitative hypotheses then state predictions about the research study results and the expected outcomes among the variables in the study (Creswell, 2018). To address the problem and purpose of this study, RQs were developed for each of the scores on the SPICE-R2 and were used to guide the study.

RQ1: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Total SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0$1: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Total SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$1: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Total SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

RQ2: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Teamwork SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0$2: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Teamwork SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$2: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Teamwork SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

RQ3: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Roles SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0$3: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Roles SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$3: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Roles SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

RQ4: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Outcomes SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0$4: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Outcomes SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$4: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Outcomes SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

The design choice of this study was consistent with research designs of previous studies needed to advance knowledge for IPE among OT and PT students. Similar studies used pre–post intervention scores using various outcome measures. In a quantitative study, Kirwin et al. (2017) used pre–post intervention scores from a validated outcome measure called the TeamSTEPPS Teamwork Attitudes questionnaire on 130 pharmacy students after participation in IPE-based activities. In a similar quantitative study, MacKenzie et al. (2017) investigated the influence of IPE-based activities on 248 students' attitudes toward collaborative skills among medicine, pharmacy, OT, PT, and undeclared programs after participating in a 90-minute review of a patient medical record and case conferencing for developing patient goals and a collaborative care plan. The IP Collaborative Competency Assessment Scale collected the pre–post intervention data measuring changes in attitudes toward collaborative skills. The quasi-experimental mixed-methods design of Nichols et al. (2019) was similar in design to my study. Pretest–posttest measures were taken to see the influence of IP simulation-based learning on pre- and posttest scores on the SPICE-R2 from students in psychology, social work, athletic training, OT, and PT. However, Nichols did not include the use of a control group. Experimental quantitative methods with pre–post participation in an intervention are used as a research design choice of IPE studies (Kirwin et al., 2017; MacKenzie et al., 2017; Nichols et al., 2019). My research may advance knowledge in IPE by including data from a control group of students who did not participate in simulation with a SP to confirm the influence of simulation and to serve as a comparison for data of those who participated in simulation with a SP. According to Campbell and Stanley (2015), the control group in my study was aligned with a nonequivalent control group design and was appropriate because of use of pretest–posttest with a control group and participation in simulation with a SP group. I used the same outcome measure with the SPICE-R2 used by Nichols et al. (2019) in their pre–post participation research with OT and PT students. Results may contribute to new knowledge about how simulation with a SP influences student IPE attitudes on the Total SPICE-R2 and subscores of Teamwork, Roles, and Outcomes among those who participated in simulation and controlling for those who did not. using a simulation group and controlling with students who did not participate in simulation.

Methodology

The methodology section of Chapter 3 will include information regarding the study population. I will share procedures for how archived data were gathered within a course and how data included a control group and a group participating in simulation with a SP. Next, I will provide an overview of the instrument used as well as how variables in the study were operationalized and analyzed. My role as a researcher did not conflict with my present position as an employee and core faculty serving as assistant professor at HU. The course used in this study had teaching activities and an outcome measure used as part of the educational assessment of the university's institutional, programmatic, and course learning outcomes. Students were enrolled in the course as part of their curricular progression in their selected course of study. Archival data were used in this study with students enrolled in an introductory patient care management course. Control for personal belief and bias (see Creswell & Creswell, 2018; see Warner, 2013) as a faculty member was achieved through the quantitative design selected for the study.

Population

The target population for my study was OT and PT students who completed a graduate first-term introductory patient care management course while enrolled at HU. HU is a private institution in the western US focusing on health sciences and rehabilitation sciences. Graduate students attend HU to complete first-professional or post-professional studies in healthcare disciplines, including nursing, OT, PT, speech language pathology, and health sciences. The patient care management course had OT and PT students enrolled and took place over a 15-week trimester. The course covered fundamentals of patient care such as informed consent, assessment of vital signs, and managing patient through bed mobility, transfers, wheelchair management, and walking with assistance or with assistive devices. The target population size was 248 students over a 1-year period from January 2020 through December 2020.

Sampling and Sampling Procedures

The sampling methodology used in this study was purposive sampling from the archival data set. According to Daniel (2012), purposive sampling is a nonprobability sampling procedure where elements are selected from the target population, based on fit with the purposes of the study. For my study, students in the control group were from the part-time flexible program or participated in the simulation and were from the full-time residential program. Due to the nature of the part-time flexible program starting as part of a new developing OT curriculum, students did not participate in simulation with a SP. Conversely, students in the full-time residential program did participate in simulation with a SP. These parameters based on course enrollment provided the inclusion criteria to meet the variables within my research. Purposive samples are another nonprobability sampling strategy category commonly used in education, medicine, psychology, and other disciplines (Babbie, 2015; Dinarvand & Golzari, 2019; Molitor & Naber, 2020). Strengths of purposive sampling include more control over who is selected over an availability sampling. Also, because purposive sampling targets specific elements of the target population, the researcher can make more valid generalizations beyond the elements included in the sample (Daniel, 2012). Purposive sampling has weaknesses requiring more resources such as time, money, and personnel. Also, according to Daniel (2012), purposive sampling takes much more effort and requires more up-to-date information than availability sampling. For example, if expert or informant sampling is used, bias from errant information may be provided by experts or informant.

Archival data were used from OT and PT students who completed the pretest–posttest outcome measures from January 2020 to December 2020 at HU. Because of the nature of using archival data, sampling strategies were not applicable. However, in similar studies in healthcare education, the sampling strategy used is that of census sampling to obtain the broadest possible representation from all data consisting of completed pretest–posttest outcome measures (Buyuk, 2020; Irajpour et al., 2019; Mohamadi-Bolbanabad et al., 2019). My research aligned with census sampling, where I utilized all data from the purposive sample that met pre-determined criteria. Incomplete data or outlier data from the census sampling served as the applicable exclusion criteria of my research. Students were selected from the timeframe for completion of the course and according to pre-existing groups based on students enrolled full-time and participating in the simulation and the part-time students not having that option. According to Curran et al. (2015), causal-comparative design studies utilize pre-existing groups where participants are self-selected into comparison groups unrelated to the research goals. In my study, students enrolled into pre-existing groups without influence of the research parameters into a control group without simulation or a group participating in simulation with a SP.

For OT and PT students in the residential offering of the course, faculty received formal simulation training to deliver a standardized simulation integrated into the course. HU incorporated IPE outcomes at the institutional and programmatic levels in the OT and PT curricula by developing standardized simulations to meet IPE accreditation standards. The simulation used the SPICE-R2 to measure students' attitudes towards IP teams and the team approach to care, comprised of the Total SPICE-R2 and subscores of Teamwork, Roles, and Outcomes. OT and PT students enrolled in the flexible program were part of the control group. January 2020 was the first-time offering the patient care management course with OT and PT being enrolled together in the flexible program at HU in January 2020. Because the patient care management course was part of a newly developed OT flexible program, the course faculty had not yet been formally trained on simulation. Hence, the standardized simulation was not offered at the time. However, the course still used the SPICE-R2 as an outcome measure to assess changes in students' IPE attitudes at the start and end of the course.

Power Analysis for Sample Size

Power analysis for sample size in an archival data set is calculated differently because the sample size is pre-determined. Therefore, in studies with archival data with a known sample size, a priori power analysis is not about determining the needed sample size for given values of alpha and power and the estimate of effect size because the sample size cannot be changed. Instead, the power analysis and calculation were determined based on the minimal effect size that would be statistically significant at a given alpha and sample size (Appendix E). For my study, the existing archival data consisted of the control group (n = 28), the simulation group (n = 220), and a total group (N = 248) cases. Minimally detectable effect size in a two-group (did simulation, did not do simulation) ANCOVA depended on the size of the correlation between the DV (post-SPICE-R2) and covariate (pre-SPICE-R2). Due to the nature of using an archival data set, an estimate of cases from the archival data set was n = 200 for completed data available from the designated timeframe and based on typical enrollment numbers in the residential and flexible programs. The power analysis and calculation are summarized in Table 2.

Table 2

Minimally Detectable Between-Group Effect Size for Pre–Post Correlation of 0.40 and 0.70

	Minimally detectable effect size: α = .05, N = 200	
Pre–post correlation	η^2	Cohen's *d*
.40	.0161	.2558
.70	.0097	.1979

In terms of eta-squared (η^2), the smallest statistically significant percentage of variance in post scores explained by the grouping variable is 1.61% and 0.97% for pre- and post-correlation of 0.40 and 0.70, respectively. Small, medium, and large η^2 are .010, .059, and .138, respectively.

Small, medium, and large Cohen's *d* are 0.20, 0.50, and 0.80, respectively. As noted in Table 2, if the pre–post correlation is 0.40 the minimally statistically significantly detectable effect size is 0.26, and 0.20 for pre- and post-correlation of 0.70, indicating medium to large effects in the power analysis.

Procedures for Using Archival Data

Due to the nature of using archival data, specific procedures for drawing the sample, recruitment, and participation were not directly applicable to this research. However, because all completed measures gathered was used, a census sample was applied for all available participant data to achieve the most accurate representation of the data set. In this study, students enrolled into pre-determined groups based on the program of choice for enrollment as part of the part-time flexible course or the full-time residential course. The type of variables related to this study and the RQs included information drawn from the archival data, including pretest scores, posttest scores, participation in simulation with a SP, and no participation in simulation with a SP. Implementation of the SPICE-R2 in the patient care management courses was part of the programmatic evaluation process to assess the effects of simulation and IPE. HU implemented new learning opportunities to meet new institutional and accreditation outcomes to foster more IP collaboration across healthcare disciplines, invested in faculty training, and opened new simulation centers throughout the university network.

Data Collection

The nature of my study drew upon archival data. Therefore, the data collection process did not follow the customary definitions of data collection because there were no applicable procedures for informed consent, recruitment, and study participation. Before I proceeded with data collection, I sought permission from Walden University IRB by completing the application process. After receiving Walden University IRB approval, I then sought approval from the HU IRB by obtaining an IRB Authorization Agreement

(IAA). Once I received approvals from WU and HU, the archival data were retrieved and provided to the researcher. At the start of the patient care management course, students were asked to complete the pretest measure as part of the course, program, and institutional learning outcomes. Students then were asked to complete the posttest measure at the end of the course for the control group or after participating in the simulation with a SP. The outcome measures were archived either through the BlackBoard Learning Management system and SurveyMonkey (SurveyMonkey, n.d.) to record students' pretest and posttest measures. Student's private information such as names, e-mail, or personal identifiable information was not recorded. The archival data set only consisted of the outcome measure responses along with date and timestamp for when responses were recorded. Once HU provided the archival data set approved for the study, the data were analyzed if the outcome measures were complete or partially completed. The pretest–posttest measures contained students' scoring on the SPICE-R2 that assessed students' attitudes on IPE through a total score and subscores using a 10-question tool (Appendix F). The SPICE-R2 used a Likert scale of 1-5 for level of agreement. Permission was granted to use the SPICE-R2 from the author of the measure (See Appendix G). The number of students completing the course in the timeline of January 2020 to December 2020 was 248 students.

All data were exported from BlackBoard and SurveyMonkey to an Excel file for data analysis. The downloaded data and Excel files were stored on a password-protected computer and password-enabled backup cloud drive. The average of the Total SPICE-R2 as well as the average for subscores for Teamwork, Roles, and Outcomes were calculated using a one-way ANCOVA test analysis for correlations between variables and for each of the outcomes. SPSS 28.0 was used for statistical analysis and results and SPSS output are also stored on secured and password-protected hard drives and back-up cloud storage. Data analysis proceeded once all archival data were gathered and screened.

Instrumentation, Validity, and Reliability

The published outcome measure used in this study was the SPICE-R2 that was developed by Zorek, Fike, and Eickhoff (2016). Use of the SPICE-R2 in my study was appropriate because it was a validated outcome measure to assess IPE attitudes. The SPICE-R2 has also been used in other IPE studies (Brennan et al., 2021; Lockeman et al., 2017; Nichols et al., 2019; Gunaldo et al., 2021). The authors of the instrument granted me permission to use the SPICE-R2 in my study (Appendix G).

Studies from Dominguez et al. (2015) and Zorek et al. (2016) were conducted to validate the SPICE-R2. Data from overlapping IP health programs across various institutions were pooled, representing early student learners from medicine (MD, n = 383), nursing (BSN, n = 270), and PT (DPT, n = 157). Confirmatory factor analysis (CFA) was used to evaluate construct validity. Goodness of fit was assessed using the standardized root mean squared residual (SRMR, desired value [*dv*] < 0.08), root mean square error of approximation (RMSEA, *dv* < 0.06), and comparative fit index (CFI, dv > 0.95). Cronbach's alpha was used to calculate the overall subscale-specific reliability scores (> 0.8 good, and 0.7 – 0.8 acceptable). Regression weights (dv > 0.7) and Correlation coefficients (dv < 0.85) for items were calculated to assess relationships between variables within the SPICE-R2 outcome measure.

The SPICE-R2 provided good reliability overall for the entire total outcome measure for IP teams and the team approach to care at 0.83. There was acceptable to good reliability across the subscores for teams and teamwork at 0.74, roles and responsibilities at 0.72, and patient outcomes at 0.83. The overall profession-specific reliabilities for the entire outcome measure were good for medicine (0.83), nursing (0.86), and PT (0.86). Subscale reliabilities were acceptable to good for all professions (ranges between 0.72 to 0.86), with exception to roles and responsibilities for PT at 0.61 and patient outcomes for PT at 0.69. The SPICE-R2 had acceptable fit for all subjects (SRMR 0.05, CFI 0.95, and RMSEA 0.09). Inter-factor correlation coefficients were below 0.85 and were positive ranging between 0.3 to 0.6. Based on the findings from Dominguez et al. (2015) and Zorek et al. (2016), the model structure was confirmed in the study involving 810 nursing, medical, and PT students. The authors recommended the continued use of the SPICE-R2 moving forward. They recommended further studies specific to the data for PT for the sub-optimal fit and reliability of subscores of the IPE outcome measures.

To address the data specific to PT, and to include other health care professions, a follow-up study was conducted by Lockeman et al. (2017) to provide further validity and reliability of the SPICE-R2. In this study, 679 participants from dental hygiene, dentistry, medicine, nursing, OT, pharmacy, and PT from one institution participated in four IPE-based sessions. Reliability measures using pre–post self-assessment on the SPICE-R2 were like those found by Zorek et al. (2016). Across the three subscales, reliability was acceptable to good with ranges for teamwork and team-based practice reported at $\boldsymbol{\alpha}$ =

0.85; roles and responsibilities for collaborative practice at $\alpha = 0.76$; and patient outcomes from collaborative practice to be $\alpha = 0.78$ (Lockeman et al., 2017). The total Cronbach's alpha for all scales combined was $\alpha = 0.85$.

Operationalization of Constructs

The IV was students' participation in simulation with a SP. This variable was determined by the course students enrolled in from their acceptance into the residential or flexible program. Students participating in simulation with a SP were from the residential course and served as the treatment or intervention group. Students who were assigned to the flexible program group were the control group as they did not experience simulation with a SP. This categorical IV was coded as zero for the control group and one for the intervention group (see Frankfort-Nachmias & Leon-Guerrero, 2018).

The four DVs included (a) the posttest Total SPICE-R2 , (b) Teamwork, (c) Roles, and (e) Outcomes. All DVs were treated as-interval/ratio measure (see Frankfort-Nachmias & Leon-Guerrero, 2018; Warner, 2013). The Total SPICE-R2 scores and subscores for Teamwork, Roles, and Outcomes were measured using a Likert scale of one to five. A score of 1 indicated "Strongly Disagree", 2 indicated "Disagree", 3 indicated "Neutral", 4 indicated "Agree", and 5 indicated "Strongly Agree." The covariate variables included the same five measures as used in the posttest.

See Table 1 for the IV, DV, and covariate variables, and how the variables related to the RQs and the statistical analysis used in this study.

Data Analysis Plan

A sequence of four one-way ANCOVA tests was conducted using SPSS 28.0. Before data analysis, the data were cleaned and screened by conducting a frequency analysis to look for outliers outside acceptable standardized deviations for potential input error when students used the Likert scale for the outcome measure in this study.

The statistical test used in this study was the one-way ANCOVA, with the IV being participation in simulation with a SP versus no participation in simulation. The DV was posttest scores of the SPICE-R2 of students participating in simulation with a SP and students not participating in simulation with a SP. The covariate was the same variables attained from pretest administration of the SPICE-R2 instrument. For both the pretest–posttest SPICE-R2, the cumulative score for all 10 items on the overall tool was used. For the subscores, a cumulative score of the designated items was calculated. Gunaldo et al. (2021) used total cumulative scores and subscores in a similar study in the data analysis when administering statistical tests for the SPICE-R2.

One-way ANCOVA can evaluate statistical differences for multiple continuous variables is by grouping IVs while controlling for other variables to reduce error terms. According to Warner (2013), ANCOVA controls the potential effect of the covariate on the continuous DVs. For this study's RQs, the first RQ at the difference between the Total SPICE-R2 scores of students participating in simulation and students who did not. Similarly, the SPICE-R2 also had subscores to measure Teamwork, Roles, and Outcomes. Since the Total SPICE-R2, Teamwork, Roles, and Outcomes measured students' attitudes, the one-way ANCOVA tested for group differences.

Similar studies used cumulative scores on the total SPICE-R2 and subscores (Brennan et al., 2021; Gunaldo et al., 2021) which was also done in the data analysis for this study. The data were organized by the total SPICE-R2 scores for the overall measurement of student IPE attitudes and a cumulative total score of 50 based on the 10-item outcome measure. Cumulative scores of the designated items for the three IPE subscores were also totaled. A score total of 20 was designated for four questions for the Teamwork subscore, and a total of 15 was designated for three questions each for the Roles and Outcomes subscore. The cumulative overall tool and each subscore were used for each test hypothesis. According to Reichardt (2019) a change-score analysis, also known as a difference-in-differences, looks at the difference between the pretest and posttest scores, and calculations were made based on the difference and amount of change between groups. To interpret the one-way ANCOVA tests correctly, the data analysis plan included several steps. DVs from the posttest results of both simulation and no simulation groups were measured as a numerical value, the IV was categorical, and eight test assumptions were tested for and followed as part of the data analysis. According Laerd Statistics (2022), ANCOVA statistics can be verified with a data analysis plan that addresses the following assumptions:

1. Independence of observations
2. Test for normality
3. Linear relationship between covariates and DV for each level of IVs
4. Homogeneity of regression slopes
5. Homoscedasticity

6. Homogeneity of variances
7. No significant outliers

The data set of this study included students participating in simulation with a SP versus students not participating in simulation were mutually exclusive groups. The groups were formed due to students enrolling into a version of the course depending on the program where they gained admission. The statistical assumption independence of observations was met for all four DV because the observations were independent, meaning that a student could only be in one of the groups but not both.

The next statistical assumption for the test for normality was assessed by using predicted values and standardized residuals and not actual scores. To produce predicated values and standardized residuals, a one-way ANCOVA was run using SPSS 28.0. The Shapiro-Wilk test for normality was used and if $p > .05$, the metric would fail to reject the null hypothesis. The standardized residuals were evaluated for the total SPICE-R2 and the three subscores of the SPICE-R2.

The next statistical assumption was to test for linearity between the covariates and DV for each level of the IVs. Scatterplots were created for the Total SPICE-R2 and the subscores and lines of best fit for each group were added for clarity. Visual inspection of the scatterplot would test if this assumption were met or not met.

For the next statistical assumption, homogeneity of the regression slope assesses for an overall relationship within the data set and ignores the IV of which group the participants belong (simulation or no simulation). Therefore, statistical significance had a broader target within the study. Interactivity tests were used in SPSS and scatterplot diagrams to visualize and interpret if this assumption was met or not met.

Verification of the presence of homoscedasticity should be present in the data set for the next statistical assumption. According to Warner (2013) homoscedasticity is described as having the same variance that central to the linear regression model. In a scatterplot analysis, the data should have the same scatterplot point or a distinct linear pattern should be observed among the data points. SPSS was used to create a scatterplot diagram for visual inspection to assess for the assumption of homoscedasticity to be met or not.

The next statistical assumption for homogeneity of variances, Levene's tests for homogeneity of variance was used to verify equal variances across groups. According to Laerd Statistics (2022), the null hypothesis fails to be rejected, when Levene's tests indicates results where $p > 0.05$ which is above the conventional threshold.

Once the statistical assumptions were tested for conditions one to seven, a one-way ANCOVA was run to test for the difference-in-differences in the total SPICE-R2 and SPICE-R2 subscores in four independent procedures. Like other studies using the SPICE-R2, the difference-in-differences of the cumulative scores for the total SPICE-R2 and subscores was utilized (Brennan et al., 2021; Gunaldo et al., 2021). The Bonferroni-Holm procedure for correction on alpha levels would be used and was considered a reliable procedure for conducting multiple statistical tests (Laerd Statistics, 2022). If statistical significance were found with $p < 0.05$, a post-hoc power analysis would be run between and within groups to determine where significant differences were found (Laerd

Statistics, 2022). Tests for partial eta square values were conducted to determine the correlation coefficient (*r*) and the amount of variance that can be attributed to the IVs. Results were based on the existence or lack of statistical significance between posttest scores for the overall SPICE-R2 and IPE subscores and the IV of participation in simulation or no participation in simulation with a SP. The covariate of pretest SPICE-R2 scores was used to control students' previous IPE attitudes.

SPSS 28.0 output was used to interpret statistical significance of findings with $p < 0.05$ and establishing power within this data set as described in the power analysis when using archival data. Statistical analysis was conducted for each of the four RQs. Within and between group differences were illustrated with output data in the corrected statistical model comparing group means while controlling for covariates (Laerd Statistics, 2022). Results from the total SPICE-R2 provided perspective on the general student attitudes of IPE for the Total SPICE-R2 to address RQ1 and the testing hypothesis one. Subscores on IPE provided insights on how simulation did or did not influence various aspects of IPE, Teamwork, Roles, and Outcomes, linked to the RQ and hypotheses two through four. A one-way ANCOVA was the appropriate statistical test to address my RQ and four test hypotheses. Results from the one-way ANCOVA for the RQ and test hypotheses are discussed in further detail in Chapter 4.

Threats to Validity

When conducting quantitative research, the ability to make conclusions based on manipulation of variables being assessed and the results on a particular outcome can be questioned by threats to validity. Other factors can contribute to changes in outcomes or can explain why noted changes occur in a study and these need to be accounted for and considered (Creswell & Creswell, 2018). Therefore, threats to internal validity and external validity were considered and described. External validity threats arise when incorrect inferences are made from a given sample and applied to other persons, settings, or past and future situations. While internal validity can threaten the ability to make correct inferences based on the data from a given population in a study (Creswell & Creswell, 2018; Warner, 2013). External and internal validity threats are discussed in the following sections.

Threats to External Validity

Several external validity issues are important to discuss in relation to my study. Burkholder et al. (2016) defined external validity as the ability to apply study results to other populations or generalizability to other groups or populations. Campbell and Stanley (2015) described the external validity issues when conducting quasi-experimental causal-comparative studies using a nonequivalent control design. The interaction of testing and the variable of simulation or no simulation affects external validity. In my study, the interaction of the SPICE-R2 and simulation or no simulation was a potential external validity where changes in outcome measures may not have been attributed to participation or no participation in simulation. To address this issue, the administration of the pretest and posttest SPICE-R2 immediately preceded and followed participation in simulation.

Threats to testing occur when participants become familiar with the outcome measure over time and remember responses in later testing (Creswell & Creswell, 2018;

Warner, 2013). Reichardt (2019) further explains that experiments assess the treatment results on the testing outcome measure. The researcher's interests must align with the outcome measures and the variables of interest. Also, the effect of simulation may have influence on one area but not others. This affects the ability to generalize results from the outcome measure in other domains (Creswell & Creswell, 2018). To mitigate these issues, my study was aligned to the specific domains of IPE for attitudes toward IP teams and the team approach to care and the three IPE subscores as previously described. Additionally, since the testing outcome measure considered several domains of IPE, the interaction of simulation may have influenced results in one domain and not others. This allowed my study to clarify specific aspects of IPE influenced by simulation participation.

In addition, Campbell and Stanley (2015) identified two issues with external validity that may have a more minor yet potential influence on external validity, including the interaction of participant selection and the treatment or intervention (simulation or no simulation) and reactivity arrangements. According to Campbell and Stanley, selecting participants for intervention introduces a potential for bias. This study mitigated this issue as students enrolled into the course based on their admission to their respective programs, that had no connection or influence on the RQs of this study. Because the control group was part of a newly developing program, simulation was not yet part of the course. IPE outcome measures were still being assessed for programmatic evaluation at the start and end of the course as part of IPE integration for the university. On the other hand, students participating in simulation were part of a course where faculty were trained in implementing a standardized simulation to integrate simulation and IPE to meet institute, programmatic, and course learning outcomes. My study mitigated participant selection and treatment due to the inherent disconnect built in naturally in the classroom division of the simulation between the two groups.

Campbell and Stanley (2015) also described reactivity arrangements as having a potential albeit smaller influence on external validity. Reactivity occurs when participants are aware of the experimental design and will have a perspective of feeling like they are the subjects of research or guinea pigs, therefore, influencing potential responses in the study. To address this potential scenario, like the previous description for interactivity of selection and treatment, the circumstances of student assignment in differing courses were naturally inherent in the courses and were not related to the RQs. Therefore, students were unaware that simulation or no simulation was part of the testing variables. Testing of IPE outcomes were part of the course learning objectives and program evaluation to meet institutional, programmatic, and accreditation outcomes by integrating simulation and IPE throughout the university curricula.

Threats to Internal Validity

There are also potential issues regarding internal validity. One potential threat to internal validity is regression. According to Campbell and Stanley (2015), regression occurs when differences between the control and treatment groups occurs. For example, in studies involving medical or psychological intervention, the control group may consist of participants who do not have psychological or medical pathology such as depression. While the intervention group consists of participants who have depression. If the study were to measure changes in depression because of treatment or lack of treatment, there might be an inherent difference in testing scores among these groups. Creswell and Creswell (2018) further explained that those with extreme scores might have more significant changes in results when compared to those in the control group and potentiates a regression to the mean. To mitigate regression, the design of my study controlled for this by looking for outlier data as described in the data analysis plan for assumption three. Also, OT and PT students may have had similar backgrounds when they gained admittance into the program, if differences were present, using the covariate identified between group variance in the data analysis.

One other potential threat to internal validity identified by Campbell and Stanley (2015) is the interaction of selection and maturation. Campbell and Stanley described maturation as a reason for changes in scores over time. Maturation occurs when scores change due natural causes or gaining in the tested variables over time due to other uncontrolled variables (Creswell & Creswell, 2018; Warner, 2013). For my study, an example may be that students gained increased knowledge in the course by going through learning content that changed their attitudes of IPE. Another possibility is that students may have engaged in IP interactions outside of class in part-time work or in other courses that may also contribute to changes in IPE external to participation in simulation in my study. The research design mitigated these factors and addressed the interaction of selection and maturation. The pretest and posttest were administered directly before and after the simulation activity in the participation group. Therefore, measuring the effect of changes from the simulation could be linked immediately following their experience. In the control group, students did not participate in the simulation. My study was interested in seeing if factors other than simulation changed students' IPE attitudes. Lastly, the covariate of pretest scores helped to mitigate any prior experiences of all students to establish a baseline of IPE attitudes.

Threats to Construct Validity

Dominguez et al. (2015) published evidence of validity and reliability in their study of 221 first-year health administration, nursing, optometry, and PT students. They compared the SPICE-R2 to another outcome measure called the Attitudes Toward Health Care Teams revised (ATHCT-R) in one institution. Evaluation of validity and reliability included confirmatory factor analysis (CFA). The goodness of fit was assessed using a chi-square test, comparative fit index (CFI), and root mean square error approximation (RMSEA). Acceptable values were established as CFI > 0.90 considered acceptable, CFI > 0.95 was considered good, RMSEA < 0.05 was considered good, and RMSEA < 0.08 was considered acceptable (Dominguez et al., 2015). Standardized regression weights (SRW) were used to define the amount of variance, and larger weights were desired. The authors estimated that SRW exceeding 0.6 would indicate good psychometric properties, and SRW of 0.7 were desired because they could explain 50% of item variance. Ideally, average variance should exceed 0.5. These were the guidelines used for this study. The findings supported the likelihood of accurate estimations through the CFA. The Chi-square test was statistically significant for the SPICE-R2, and NC (2.321) was < 3, suggesting that the model demonstrated an acceptable fit. SRW for SPICE-R2 had notably higher percentages of larger regression weights, with 80% exceeding 0.6 and 50% exceeding 0.7.

The SPICE-R2 had higher standardized regression weights than the ATHCT-R. The ATHCT-R had less than 25% of the regression weights exceeding 0.6 and less than 10% of the weights exceeding 0.7. The SPICE-R2 also demonstrated strong convergent validity than the ATHCT-R, which was 0.79, and the SPICE-R2 was 0.86, with stronger reliability indicated for the SPICE-R2. Discriminant validity factors should not overlap excessively with recommended correlations not exceeding 0.85 (Dominguez et al., 2015). Factor correlation coefficients did not exceed the 0.85 threshold for the ATHCT-R and SPICE-R2. Dominguez et al. (2015) concluded that the SPICE-R2 demonstrated better goodness of fit and construct validity than the ATHCT-R. The SPICE-R2 further demonstrated promise as a valid and reliable tool for measuring students' perceptions of IPE. The SPICE-R2 has also been established as a reliable tool with an overall Cronbach alpha of 0.79 (Zorek et al., 2016) and 0.85 (Lockeman et al., 2017).

Ethical Procedures

For this study, I received consultation through the open online Office of Research and Doctoral Services during scheduled open consultative sessions. In addition, I consulted with the head of the IRB for HU to confirm the approval processes required. The Walden University IRB served as the reviewing IRB, and I then sought the IRB approval process with HU. The Walden IRB granted conditional approval (01-11-22-0741932), pending submission and approval from HU IRB and signage of the IAA. I submitted the Walden University IRB approval letter, my study documents, and IAA to the HU IRB to seek approval to meet the conditional approval criteria. HU IRB granted approval, and I submitted all completed documents back to Walden IRB for final review. Walden IRB confirmed completion of the conditional criteria. All IRB's granted full approval was granted, and I was permitted to proceed with my study using the IRB number already provided. I then proceeded with gathering the archival data for analysis.

Other ethical procedures that I had in place were related to the data treatment. There was potential for a conflict of interest because I was employed at HU as a faculty team member for the course examined in the study. The potential for any conflict was minimized because standardized simulations and the SPICE-R2 were integrated with the course for programmatic evaluation to meet institutional and programmatic outcomes and accreditation standards. Quantitative data and results from student outcome measures were anonymous as the aggregated data of Survey Monkey and BlackBoard did not have identifiable student information. Upon request, I provided deidentified data to my committee members through a password-protected cloud account. My research procedures ensured privacy, and the archival data will be stored for at least 5 years as per HU and Walden University research policy on a password-protected work computer. Any hard-copy data generated will be kept in a locked file cabinet at my office, which also has a lock to the door at HU for at least 5 years. Following the expiration of minimum time for retention, primary and residual data will be destroyed following HU's policies and procedures for computer-based and hard-copy data. The nature of my study was such that positional power differentials between researcher and participants were not applicable because the study's scope was delimited to student participation in simulation with and without a SP.

Summary

In Chapter 3, I explained my research design and the rationale used for my chosen design for my study. This chapter also provided an overview of the methodology, research population, sampling and sampling procedures, and procedures for using archival data. Further details were provided for instrumentation and operationalization of constructs as related to my study and operationalization of the variables with supportive studies that provided validation and reliability studies related to the outcome measure used in my study. Next, details regarding my data analysis plan were discussed and considerations were made for threats to external and internal validity and how these were addressed in my study. The chapter concluded with the procedures that I followed to address ethical considerations for my study.

In Chapter 4, I will discuss my data collection procedures in more depth. I will provide inferential statistics for the data set and descriptive statistics of the participants in my study. My overall statistical analysis will be presented along with appropriate statistical data, charts, and graphs illustrating the variables of my study. Chapter 4 will conclude by providing an overall summary of the results from the data collected and how the findings answer the research RQs related to this study.

Chapter 4: Results

Introduction

The purpose of this causal-comparative study using a pretest–posttest nonequivalent control group design was to investigate the difference in first-term graduate OT and PT students' IPE attitudes posttest scores on the Total SPICE-R2, Teamwork, Roles, and Outcomes between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate. For the purposes of organization, and to present the results in the following sections of Chapter 4, the Total SPICE-R2 score is presented as Panel A, while Teamwork, Roles, and Outcomes will be presented as Panel B, Panel C, and Panel D, respectively. This study explored the effect of simulation learning with a SP on students' IPE attitudes using SPICE-R2 pretest–posttest measures. To address the problem and purpose of this study, four RQs were developed for each of the scores on the SPICE-R2 and were used to guide the study.

RQ1: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Total SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

H_01: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Total SPICE-R2 between those who participated in simulation with a SP and those

who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$1: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Total SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

RQ2: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Teamwork SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0$2: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Teamwork SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$2: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Teamwork SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

RQ3: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Roles SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0$3: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Roles SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$3: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Roles SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

RQ4: What is the difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Outcomes SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate?

$H_0$4: There is no significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Outcomes SPICE-R2 between those who participated in simulation with a SP and those

who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

$H_1$4: There is a significant difference in first-term graduate OT and PT students' IPE attitude posttest scores on the Outcomes SPICE-R2 between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate.

Chapter 4 includes the results of this quantitative and causal-comparative study using a pretest–posttest nonequivalent control group design study. I begin with a description of my data collection process, including information of the student demographics from which archival data were retrieved and the demographics of the student sample. I then continue by outlining the results of my data collection with descriptive statistics, addressing assumptions and data for each of the four research hypotheses. I end the chapter with a summary of my findings.

Data Collection

The nature of this study included the use of archival data, and therefore participants were not recruited. Rather, archival data were retrieved from pretest and posttest data from January 2020 to December 2020. Pretest and posttest outcome measures were gathered from a control group (n = 28), a simulation group (n = 220), and the total group (N = 248) of students. Due to the archival data nature of this study, there were no noted discrepancies in the data collection process.

Archival data pertained to students in a control group (n = 28) and students in a simulation group (n = 220), for a total (N = 248) student archival records of pretest–posttest measures. There were three incomplete records with no posttest measures in the control group and three incomplete records with no posttest measures in the simulation group. These entries were removed from the data set with a filtered control group (n = 25), a simulation group (n = 217), and a total (N = 242) included in the data analysis. Item responses were left blank in the data set if no response was given in either the pretest or posttest measures.

When conducting the initial data analysis on the entire data set (N = 242), when testing for the assumption test for normality, the simulation group (n = 217) was not normally distributed (Shapiro-Wilk test $p < 0.001$). According to Laerd Statistics (2022), the one-way ANCOVA test is more robust when evaluating the assumption of normality when the sample size for the groups is equal or nearly equal. The SPSS 28.0 select-cases function was used as a result of the simulation group failing to meet the assumption of normality. Because there were only 25 cases in the control group, the select-cases function was used to randomly select 25 cases from the 242 simulation cases to equalize the number of control and simulation data sets (N = 50). The one-way ANCOVA was rerun with the sample (N = 50) for the data analysis. This resulted in a random sample being used to run the second data analysis with a select-cases sample from students participating in simulation. According to Creswell and Creswell (2018), using a randomized sample is ideal where an individual has an equal probability of being selected. The sample of students from the simulation group (n = 25) in the second run of the data analysis was considered representative of the larger initial simulation group (*n* = 217) because the probability of choosing individuals was equal and randomized.

The baseline descriptive characteristics of the sample, shown in Table 4, illustrate the variables in this study, including the mean and standard deviations from the IVs (control and simulation) and the DVs of the posttest Total SPICE-R2 scores and the posttest SPICE-R2 subscores of Teamwork, Roles, and Outcomes. The archival data did not include other demographics except for the reporting of OT and PT students in the simulation group. The differentiation of the OT and PT students was not included in the control group data set. Because there was no differentiation of OT and PT in the control group, and because the differentiation of the disciplines was not part of this data analysis, the variable of OT and PT student discipline was not further investigated in this study or data analysis. OT and PT students were looked at together as one group with graduate OT and PT students.

Descriptive statistics that characterized the sample of this study, as shown in Table 3, included the pretest and posttest for all the SPICE-R2 scores (Total, Teamwork, Roles, and Outcomes). Data consisted of OT and PT students in the control group (*n* =25), simulation group (*n* =25), and total group (*N* = 50). The Total SPICE-R2 score had a maximum of 50, and the Teamwork SPICE-R2 subscores had a maximum of 20 and the SPICE-R2 subscores for Roles and Outcomes each had a maximum of 15.

Table 3

Descriptive Statistics Posttests (n = 25 for Control and Simulation, N = 50 Total)

SPICE-R2 variable	Group	Pretest mean	Pretest standard deviation	Posttest mean	Posttest standard deviation
Total SPICE-R2	Control	38.4	6.84	41.28	5.534
	Simulation	40.36	3.29	44.28	4.108
	Total	39.38	5.40	42.78	5.056
Teamwork	Control	15.96	3.34	15.92	3.290
	Simulation	17.64	2.18	18.32	2.340
	Total	16.8	2.91	17.12	3.075
Roles	Control	11.16	2.23	12.56	1.917
	Simulation	10.32	1.86	12.92	1.498
	Total	10.74	2.08	12.74	1.712
Outcomes	Control	11.28	2.28	12.80	1.803
	Simulation	12.4	1.26	13.04	1.513
	Total	11.84	1.91	12.92	1.652

Overall, when comparing the groups, the simulation group had higher pretest and posttest mean scores across all SPICE-R2 measures than the control group. The only exception was the Teamwork pretest subscore, where the control group had a higher mean than the simulation group. As an example of higher scores among the simulation group, when looking at the Total SPICE-R2 measures, the simulation group had the highest pretest mean ($\bar{x}$ = 39.38, *SD* = 5.40) and posttest mean ($\bar{x}$ = 44.28, *SD* = 4.108). The control group had a lower pretest mean ($\bar{x}$ = 38.40, *SD* = 6.84) and posttest mean ($\bar{x}$ = 41.28, *SD* = 5.534). Additionally, both the control and simulation groups increased across SPICE-R2 scores when comparing the pretest to the posttest measures, except for the Teamwork subscore for the control group, where there was a slight decrease from pretest to posttest scores.

The inclusion of a covariate was justified and included in this model to answer the four RQs. For this study's data analysis and statistical test, the one-way ANCOVA calculated and compared two groups of control and simulation as the IVs and posttest SPICE-R2 total and subscore as the DV. The pretest SPICE-R2 total and subscores were used as the covariate. Because OT and PT students may enter the program with differing IPE attitudes, the one-way ANCOVA and the study variables allowed for control of students' potential differences before starting the course. Therefore, using the covariate of pretest scores for all SPICE-R2 measures was justified. The covariate removed the mean effect where differences may have existed between students before starting their coursework or participating in simulation with a SP. Similar studies (Brennan et al., 2021; Nichols et al., 2019) used a one-way ANOVA and paired *t* tests for data analysis when investigating the effect of simulation on SPICE-R2 measures. This study differed from studies in the current literature by using a one-way ANCOVA for the data analysis.

Results

Several statistical assumptions appropriate for this study were essential for quantitative data analysis. As per Laerd Statistics (2022), there are six assumptions for one-way ANCOVA. In the following sections, each assumption is discussed, along with procedures and tests for each assumption, and whether the assumption was met or violated based on the data and variables of my study.

Assumption Test for Normality

To test the assumption for normality, a one-way ANCOVA was run in SPSS 28.0. Results from this procedure allowed for calculations to assess the homogeneity of variance and produce residuals of the ANCOVA model. Residuals were then used to assess for the assumptions of normality and homoscedasticity, as well as to check for outliers (Laerd Statistics, 2022). According to Laerd Statistics (2022), assumptions of normality are not evaluated against actual scores collected but are assessed using predicted values and standardized residuals. According to Laerd Statistics, the one-way ANCOVA is considered robust to violations of normality, requiring near-normal data to produce valid results.

The Shapiro-Wilk test for normality is used when testing for normality, with sample sizes of $n \leq 50$ (Laerd Statistics, 2022), and was used to assess for the normality within-group residuals. Therefore, the Shapiro-Wilk test was run for each IV category, that included the Total SPICE-R2 scores and SPICE-R2 scores for Teamwork, Roles, and Outcomes. For *p*-values where $p > .05$, the metric failed to reject the null hypothesis. Therefore, as presented in Table 4, standardized residuals were evaluated for the Total SPICE-R2 score and the SPICE-R2 subscores for Teamwork, Roles, and Outcomes.

Table 4

Tests for Normality

Shapiro-Wilk test *p*-value	Control group	Simulation group
Total SPICE-R2	.625	.035
Teamwork	.245	.135
Roles	.248	.047
Outcomes	.113	.340

As shown in Table 4, standardized residuals were normally distributed among the testing variables. The standardized residuals were not normally distributed for the Total SPICE-R2 simulation group (Shapiro-Wilk test $p = .035$) and for the Roles SPICE-R2 subscores simulation group (Shapiro-Wilk test $p = 0.047$). Because an equal or near-equal number was used in the second run of the data analysis, tests for normality resulted in slight deviations. Therefore, the assumption for normality in my data analysis was met (Laerd Statistics, 2022), and the assumption for linearity of the covariate and dependent variables was assessed next.

Assumption for Linearity of the Covariate and Dependent Variables

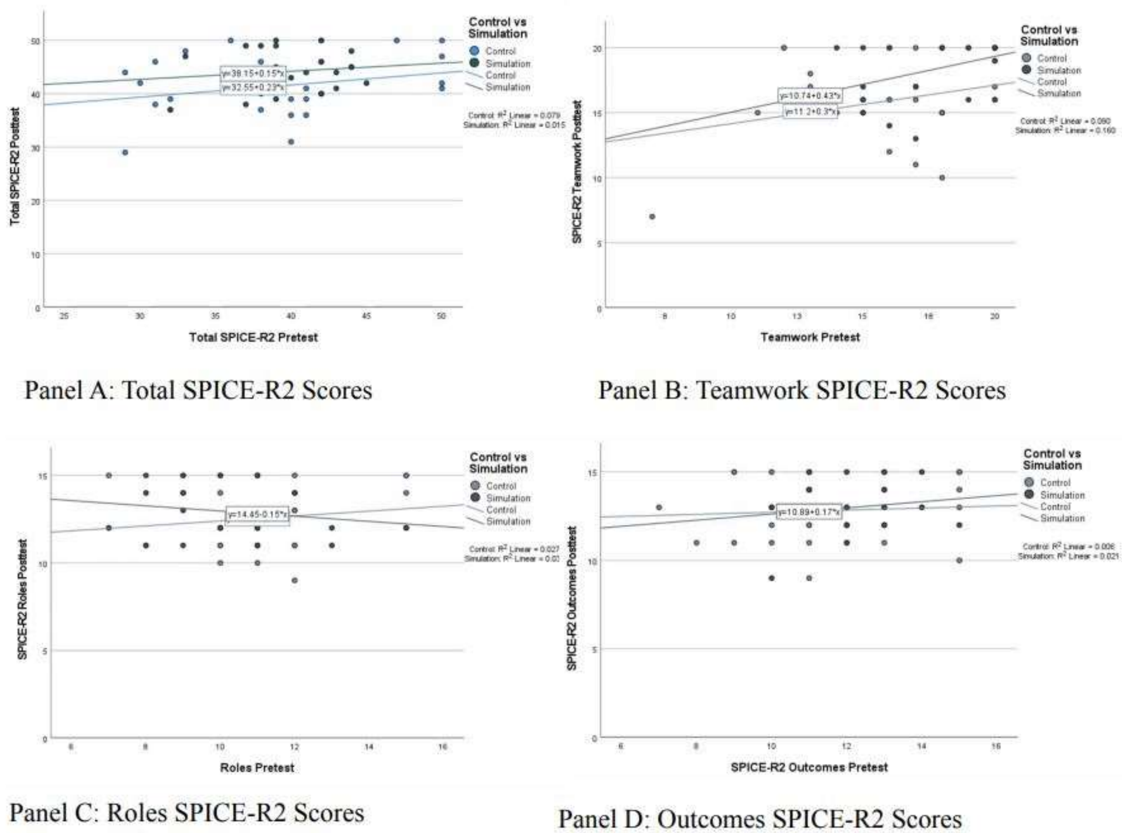
According to Laerd Statistics (2022), the assumption for linearity assumes that the covariate of pretest scores was linearly related to the DV of posttest scores for all the IV groups (control and simulation). Data for this assumption were evaluated by using SPSS 28.0 and creating scatterplots of posttests for the Total SPICE-R2, and subscores for Teamwork, Roles, and Outcomes versus the pretest for each level of the groups.

Scatterplots were created for the Total SPICE-R2, and subscores and lines of best fit for each group were added for additional clarity.

As shown in Figure 5, there was a linear relationship between the pretest and posttest Total SPICE-R2 scores (Panel A), as well as SPICE-R2 subscores for Teamwork (Panel B), Roles (Panel C), and Outcomes (Panel D) as observed by visual inspection of the scatterplot. The assumption for linearity was met, and the assumption for homogeneity of regression slopes was assessed next.

Figure 5

Pre- and Posttest Scatterplots for the SPICE-R2 Scores



Assumption for Homogeneity of Regression Slopes

The assumption for homogeneity of regression slopes was assessed to check that there was no interaction between the covariate of pretest scores and the IVs of the control and simulation groups. Interactions between the covariate and the IVs were evaluated for statistical significance. The General Linear Model Univariate procedure for SPSS 28.0 was used to generate a model of the interactions between the covariate and IVs of this study for each level of the SPICE-R2 scores. According to Laerd Statistics (2022), to determine the statistical significance level, the Tests of Between-Subjects Effects and the interaction of the control and simulation groups with pretest scores were examined. If the interaction was not statistically significant ($p > .05$), the assumption for homogeneity of regression slopes was met, and the assumption was not violated.

As shown in Table 5, there was homogeneity of regression slopes for the Total SPICE-R2 score as the interaction term was not statistically significant, $F(1, 46) = .051$, $p = .822$.

Table 5

Tests of Between-Subjects Effects, Total SPICE-R2 Posttest

Dependent variable: Total SPICE-R2 posttest

Source	Type III sum of squares	*df*	Mean square	F	Sig.
Control/Simulation and Total SPICE-R2 pretest	1.201	1	1.201	.051	.822
Error	1076.034	46	23.392		

a. *R* squared = .141 (adjusted *R* squared = .085).

As shown in Table 6, there was homogeneity of regression slopes for the Teamwork SPICE-R2 subscore as the interaction term was not statistically significant, $F(1, 46) = .190$, $p = .665$.

Table 6

Tests of Between-Subjects Effects, Teamwork Posttest

Dependent variable: Teamwork posttest

Source	Type III sum of squares	*df*	Mean square	F	Sig.
Control/Simulation and SPICE-R2 Teamwork pretest	1.433	1	1.433	.190	.665
Error	346.947	46	7.542		

a. *R* squared = .251 (adjusted *R* squared = .202).

As shown in Table 7, there was homogeneity of regression slopes for the Roles SPICE-R2 subscore as the interaction term was not statistically significant, $F(1, 46) = 1.365$, $p = .249$.

Table 7

Tests of Between-Subjects Effects, Roles Posttest

Dependent Variable: Roles Posttest

Source	Type III sum of squares	*df*	Mean square	F	Sig.
Control/Simulation and SPICE-R2 Roles pretest	4.089	1	4.089	1.365	.249
Error	137.816	46	2.996		

a. *R* squared = .040 (adjusted *R* squared = -.022).

As shown in Table 8, there was homogeneity of regression slopes for the Outcomes SPICE-R2 subscore as the interaction term was not statistically significant, $F(1, 46) = .134$, $p = .716$.

Table 8

Tests of Between-Subjects Effects, Outcomes Posttest

Dependent variable: Outcomes posttest

Source	Type III sum of squares	*df*	Mean square	F	Sig.
Control/Simulation and SPICE-R2 Outcomes pretest	.382	1	.382	.134	.716
Error	131.376	46	2.856		

a. *R* squared = .017 (adjusted *R* squared = -.047).

Overall, the assumption for homogeneity was met for Total SPICE-R2 and the SPICE-R2 subscores for Teamwork, Roles, and Outcomes. There were no interactions with pretest measures in my study, and the assumption test for homoscedasticity was examined next.

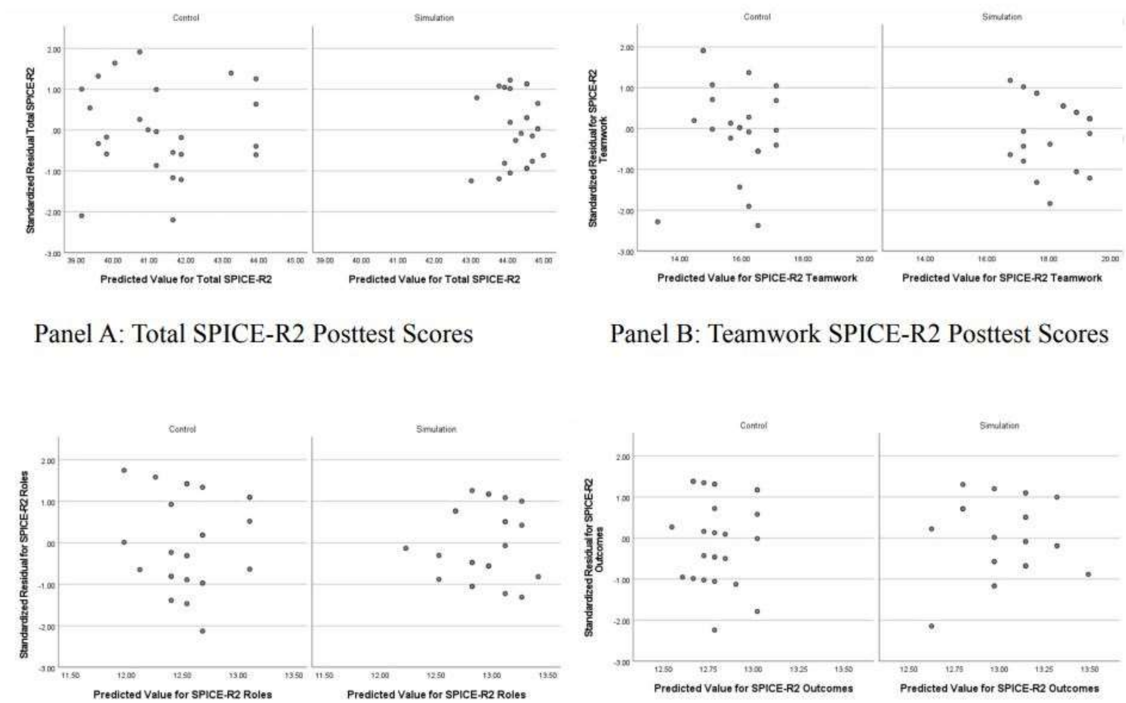
Assumption for Homoscedasticity

The assumption of homoscedasticity is essential in a one-way ANCOVA. To test for this assumption, homoscedasticity of error variances was measured within each group and if the error of variances was equal between groups (Laerd Statistics, 2022). A scatterplot was created using SPSS 28.0 of the standardized residuals against the predicted values and paneled by the IVs of control and simulation. Next, each scatterplot were visually inspected for each variable to examine the spread of points across the predicted values. Either a patterned distribution or an equal and random spread was determined for each variable. If the standardized residuals in the scatterplot appeared randomly scattered and constantly spread, the assumption for homoscedasticity was met.

As shown in Figure 6, there was homoscedasticity, as assessed by visual inspection of the standardized residuals plotted against the predicted values for the Total SPICE-R2 scores (Panel A), SPICE-R2 Teamwork (Panel B), Roles (Panel C), and Outcomes (Panel D) subscores. The assumption for homoscedasticity was met, and the assumption for homogeneity of variances was tested next.

Figure 6

Scatterplots for the Standardized Residuals for Control and Simulation



Panel A: Total SPICE-R2 Posttest Scores

Panel B: Teamwork SPICE-R2 Posttest Scores

Panel C: Roles SPICE-R2 Posttest Scores

Panel D: Outcomes SPICE-R2 Posttest Scores

Assumption for Homogeneity of Variances

The assumption for homogeneity of variances in the one-way ANCOVA assumes that the variance of residuals is equal for all IV groups (Laerd Statistics, 2022). If they are unequal, the Type I error rate can be affected. For this study, the standardized residuals should have been equal for the different categories of IVs (control and simulation).

Levene’s test of equality of variances was used to determine if this assumption was met or violated. If Levene’s test was statistically significant ($p < .05$), there were not equal variances and therefore violated the assumption of homogeneity of variances. Instead, heterogenous variances would be present. If Levene’s test was not statistically significant ($p > .05$), then equal variances were assumed, the data set had homogeneity of variances, and the assumption was met.

For this study, variances were homogenous, as assessed by Levene’s homogeneity of variance test for the Total SPICE-R2 score ($p = .290$). Also, variances were homogenous, as assessed by Levene’s homogeneity of variances test for the SPICE-R2 Teamwork subscore ($p = .249$), the SPICE-R2 Roles subscore ($p = .208$). and the SPICE-R2 Outcomes subscore ($p = .302$). The assumption for homogeneity for variances was met for all the variables, and the assumption for significant outliers was evaluated next.

Assumption for No Significant Outliers

According to Laerd Statistics (2022), there should be no significant outliers in the IV groups in terms of the DV. Unusual scores (outliers) with extremely low or high values could significantly negatively affect results and statistical tests especially with smaller sample sizes. The typical cut-off of ±3 standard deviations to assess outliers (Laerd Statistics, 2022) was used to screen this data. SPSS 28.0 was used to sort the standardized residuals in descending order to screen for outliers. There were no outliers in the Total SPICE-R2 scores or SPICE-R2 subscores for Teamwork, Roles, and Outcomes in my study.

Interprofessional Teams and the Team Approach to Care

A one-way ANCOVA was run to determine the effect simulation with a SP on posttest Total SPICE-R2 scores after controlling for pretest Total SPICE-R2 scores (Table 9). After adjustment for pretest SPICE-R2 Total scores, there was not a statistically significant difference in posttest SPICE-R2 Total scores after simulation with a SP, $F(1, 46) = 1.201$, $p = .822$, partial $\eta^2 = .001$. The results of this study did not reject the null hypothesis. Therefore, there was no significant difference in overall SPICE-R2 scores on attitudes towards IP teams and the team approach to care for first-term graduate OT and PT students who participated in simulation learning using a SP.

Table 9

One-Way Analysis of Covariance, Total SPICE-R2 Posttest

Dependent variable: Total SPICE-R2 posttest

Source	Type III sum of squares	*df*	Mean square	F	Sig.	Partial Eta squared
Control/Simulation & SPICE-R2 Total pretest	1.201	1	1.201	.051	.822	.001
Error	1076.034	46	23.392			

a. *R* squared = .141 (adjusted *R* squared = .085).

Interprofessional Teamwork and Team-Based Practice

A one-way ANCOVA was run to determine the effect simulation with a SP on posttest SPICE-R2 subscores for Teamwork after controlling for pretest SPICE-R2 subscores for Teamwork (Table 10). After adjustment for pretest SPICE-R2 subscores for Teamwork, there was not a statistically significant difference in posttest SPICE-R2 subscores for Teamwork scores after simulation with a SP, F(1, 46) = 1.433, p = .665, partial η^2 = .004. Therefore, there was no significant difference in SPICE-R2 scores on attitudes of IP teamwork and team-based practice for first-term graduate OT and PT students who participated in simulation learning using a SP.

Table 10

One-Way Analysis of Covariance, Teamwork Posttest

Dependent variable: Teamwork posttest

Source	Type III sum of squares	*df*	Mean square	F	Sig.	Partial eta squared
Control/Simulation and SPICE-R2 Teamwork pretest	1.433	1	1.433	.190	.665	.004
Error	346.947	46	7.542			

a. *R* squared = .251 (adjusted *R* squared = .202).

Roles and Responsibilities for Collaborative Practice

A one-way ANCOVA was run to determine the effect simulation with a SP on posttest SPICE-R2 subscores for Roles after controlling for pretest SPICE-R2 subscores for Roles (Table 11). After adjustment for pretest SPICE-R2 subscores for Roles, there was not a statistically significant difference in posttest SPICE-R2 subscores for Roles after simulation with a SP, $F(1, 46)$ = 4.08905.512, p = .249, partial η^2 = .029. The results of this study did not reject the null hypothesis. Therefore, there was no significant difference in SPICE-R2 scores on attitudes of roles and responsibilities for collaborative practice for first-term graduate OT and PT students who participated in simulation learning using a SP.

Table 11

One-Way Analysis of Covariance, Roles Posttest

Dependent variable: Roles posttest

Source	Type III sum of squares	*df*	Mean square	F	Sig.	Partial eta squared
Control/Simulation and SPICE-R2	4.089	1	4.089	1.365	.249	.029
Roles pretest						
Error	137.816	46	2.996			

a. *R* squared = .040 (adjusted *R* squared = -.022).

Patient Outcomes From Collaborative Practice

A one-way ANCOVA was run to determine the effect simulation with a SP on posttest SPICE-R2 subscores for Outcomes after controlling for pretest SPICE-R2 subscores for Outcomes (Table 12). After adjustment for pretest SPICE-R2 subscores for Outcomes, there was not a statistically significant difference in posttest SPICE-R2 subscores for Outcomes after simulation with a SP, $F(1, 46) = .832$, $p = .716$, partial $\eta^2 = .003$. The results of this study did not reject the null hypothesis. Therefore, there was no significant difference in scores on attitudes of patient outcomes from collaborative practice for first-term graduate OT and PT students who participated in simulation learning using a SP.

Table 12

One-Way Analysis of Covariance Outcomes Posttest

Dependent variable: Outcomes posttest

Source	Type III sum of squares	*df*	Mean square	F	Sig.	Partial eta squared
Control/Simulation and SPICE-R2	.382	1	.382	.134	.716	.003
Outcomes pretest						
Error	131.376	46	2.856			

a. *R* squared = .017 (adjusted *R* squared = -.047).

The RQs for my study were to answer if there was a difference in first-term graduate OT and PT students' SPICE-R2 attitude scores based on participation in simulation learning using a SP? For my study's data analysis and statistical test, the one-way ANCOVA calculated and compared two groups of control and simulation as the IVs and posttest SPICE-R2 total and subscores as the DV. The pretest SPICE-R2 total and subscores were used as the covariate. Because OT and PT students may enter the program with differing IPE attitudes, the one-way ANCOVA and the study variables allowed this study to control students' potential differences before starting the course. Based on this study's results, there was no statistical difference in first-term graduate OT and PT students' SPICE-R2 attitude scores after participating in simulation learning using a SP.

Summary

Chapter 4 included the key findings from this study and included the assumptions associated with a one-way ANCOVA. The data from this study showed the assumption for linearity of the covariate and DVs were met. There was a linear relationship between the pretest–posttest Total SPICE-R2 scores, and the subscores for Teamwork, Roles, and Outcomes as observed by visual inspection of the scatterplot. The assumption for homogeneity of regression slopes was met by determining the statistical level of significance with the Tests of Between-Subjects Effects. The overall Total SPICE-R2 score and the subscores of Teamwork, Roles, and Outcomes were not statistically significant ($p > .05$). Thus, the interaction of the control and simulation groups with pretest scores and the assumption for homogeneity of regression slopes were met, and the assumption was not violated. To test for the assumption of normality, the Shapiro-Wilk test was used to determine statistical significance. If *p* - values were not statistically significant ($p > .05$), the metric failed to reject the null hypothesis. The overall Total SPICE-R2 score and subscores for Teamwork, Roles, and Outcomes, were met for some criteria and not met for others. According to Laerd Statistics (2022), the one-way ANCOVA is sufficiently robust when sample sizes are equal or near-equal, and slight deviations of normality do not appreciably contribute to Type I errors. The second run of my data analysis created equal control and simulation data sets. Slight deviations in the statistical analysis were found for the simulation group for the Total SPICE-R2 score ($p = .035$) and the Roles SPICE-R2 subscore ($p = .047$). Therefore, the assumption for normality in this data analysis was addressed. For the assumption of homoscedasticity, scatterplots were created from standardized residuals against the predicted values and paneled by the IVs of control and simulation. Visual inspection of the scatterplots revealed a randomly scattered and constantly spread of plots were determined. Therefore, the Total SPICE-R2 score and subscores for Teamwork, Roles, and Outcomes met the assumption for homoscedasticity. The assumption for homogeneity of variances was assessed using Levene's test of equality of variances. If Levene's test was statistically insignificant ($p > .05$), then equal variances were assumed, the data set had homogeneity of variances, and the assumption was met. The Total SPICE-R2 score and subscores for Teamwork, Roles, and Outcomes all had $p > .05$, demonstrating homogeneity of variances in all criteria, and the assumption was met. The assumption for no significant outliers was evaluated by screening for ±3 standard deviations. There were no outliers in the Total SPICE-R2 scores or SPICE-R2 scores for Teamwork, Roles, and Outcomes. Therefore, the assumption for no significant outliers was met. Overall, this study's key findings and data answered the four RQs and associated hypotheses that there was no statistically significant difference in graduate OT and PT students' SPICE-R2 attitude scores after participating in simulation learning using a SP.

In Chapter 5, I will restate my study's purpose and the nature of my study. I will then describe the methodology I utilized and why I conducted this study. A summary of the Chapter 4 key findings will be summarized and connected to the current finding and themes of the literature and within my discipline. An overview of this study's limitations and recommendations for future studies will be discussed regarding simulation learning in health and rehabilitation sciences. Chapter 5 will conclude with discussions on social change through my research and potential contributions this work will provide in healthcare education and preparing students to be collaborative practice-ready clinicians.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this causal-comparative study using a pretest–posttest nonequivalent control group design was to investigate the difference in first-term graduate OT and PT students' IPE attitudes posttest scores on the Total SPICE-R2, Teamwork, Roles, and Outcomes between those who participated in simulation with a SP and those who did not, while controlling for the pretest SPICE-R2 scores as a covariate. Archival data of these measures consisted of data from students who did not participate in the simulation and students who did participate in the simulation. The IV of my study consisted of two categories with students who participated in simulation and those who did not. The DV was students' posttest data on the SPICE-R2 outcome measure. The covariate was students' pretest data on the SPICE-R2 outcome measure. The nature of this study featured a quasi-experimental causal-comparative research paradigm using a pretest–posttest nonequivalent control design. Archival data were used for pretest–posttest measures from students before and after participation in simulation with SP and pretest–posttest measures for a control group that did not participate in simulation. By using the archival data available for this study, the rationale for exploring the influence of simulation and comparing it to students with no simulation was justified. Additionally, the pretest scores in both groups allowed a covariate to compare for differences among the groups, if they did or did not exist, in prior experiences or attitudes toward IPE.

This study's key findings and data answered the question of whether there was a difference in first-term graduate OT and PT students' SPICE-R2 attitude scores based on participation in simulation learning with a SP. The total SPICE-R2 was used to answer RQ1. The subscores of the SPICE-R2 answered RQs 2 through 4 by measuring Teamwork, Roles, and Outcomes. This study used the one-way ANCOVA to calculate and compare the IVs consisting of the two groups (control and simulation) and the DVs consisting of the posttest SPICE-R2 total and subscores. The pretest SPICE-R2 total and subscores were the covariate. Because OT and PT students may enter the program with differing attitudes towards IP teams and the team approach to care, the one-way ANCOVA and the study variables allowed for control in potential differences that students might have had before starting the course. The results indicated no significant statistical difference in graduate OT and PT students' Total SPICE-R2 scores after participating in simulation with a SP. Additionally, there was no significant statistical difference for the subscores for Teamwork, Roles, and Outcomes after participating in simulation learning using a SP.

Interpretation of the Findings

The pretest–posttest outcome measures of the SPICE-R2 results from graduate OT and PT students who either did not participate or did participate in simulation with a SP were viewed through the lens of Kolb's ELT and Pardue's framework for IPE (Kolb, 1984; Pardue, 2015). Kolb's ELT provided a learning model through stages where students engage in Kolb's concrete experience using simulation with a SP. After participation in simulation with a SP, students progressed through the latter stages of Kolb's ELT during debriefing and after their experience or when they encountered similar situations related to the simulation. Pardue's framework for IPE also provided a model for student learning oriented toward IP goals and competencies. After engagement in simulation with a SP, aligned outcome measures about IP competencies allowed students to self-reflect on their attitudes about IP and the team approach to care. It is important not to generalize Kolb's ELT or Pardue's framework to explain all the learning among students during the simulation event. Other theories or cognitive processes may have also contributed to student learning; however, researchers have found Kolb's ELT as a useful as a starting point for understanding the effect that simulation learning may or may not have on students' attitudes toward IPE (Fewster-Thuente & Batteson, 2017; Pardue, 2015; Poore et al., 2014). Some of the findings confirmed or extended the findings from the literature, whereas other results from my study disconfirmed the current literature. In the following sections, I interpret Kolb's ELT and Pardue's framework for IPE and the control variables, participation in simulation with a SP, the effect on posttest SPICE-R2 scores, and the effect of factoring in pretest SPICE-R2 measures on the study.

Interprofessional Teams and the Team Approach to Care

The first hypothesis of this study prompted a one-way ANCOVA test for difference in the Total SPICE-R2 scores between first-term graduate OT and PT students who participated in simulation learning using a SP and those who did not while controlling for covariate SPICE-R2 pretest measures. In a review of the literature, there were statistically significant improvements in various outcome measures that did not use the SPICE-R2 (Coppola et al., 2019; Cunningham et al., 2018; Karnish et al., 2019; Macauley, 2018; Paige et al., 2017; Phillips et al., 2017; Reime et al., 2016; Swift et al., 2020; Wellmon et al., 2017). In these studies, various validated outcome tools measured improved attitudes and behaviors after simulation either with a SP, low fidelity, or HFM. IP teams and the team approach to care were improved in areas such as communication, team delegation and efficiency, shared learning, teamwork, collaboration, team cooperation, and patient diagnosing (Coppola et al., 2019; Cunningham et al., 2018; Karnish et al., 2019; Paige et al., 2017; Reime et al., 2016; Swift et al., 2020; Wellmon et al., 2017). Because the test results showed no statistical significance, this study disconfirmed previous studies that showed improved IP teams' attitudes on IP teams and the team approach to care after simulation. One of the possible reasons for a different outcome in this study was the exploration of the effect of students participating in simulation compared to students in a control group. Many authors in the current literature on IP simulation studies noted in their discussions or limitations section that further investigation or comparison against a control group would strengthen their findings. This study added the dimension of a control group for which no statistical significance was found in the Total SPICE-R2.

Though most studies noted statistical significance after simulation, some studies found no statistical significance. This study extended the findings of Brennan et al. (2021), who used a research design similar to the design of this study and used the SPICE-R2 in pretest–posttest measures, a group participating in simulation with a SP, and a control group. Brennan et al. also found no statistical significance in comparing the control group and simulation ($p = .10$) among medical, pharmacy, and nursing students. However, Brennan et al. did find statistical significance in the SPICE-R2 subscores of Teamwork and Outcomes. Further discussion and considerations as to why there was a mixture of significance and no significance that occurred in the study findings are presented in the following section on the SPICE-R2 Outcomes subscore . Together with the work of Brennan et al., this study extends the findings by adding students in OT and PT to the body of knowledge where simulation with a SP did not have a statistically significant change in the Total SPICE-R2 score representing IP teams and the team approach to care.

Interprofessional Teamwork and Team-Based Practice

The next hypothesis involved whether there was a difference in the SPICE-R2 scores on Teamwork between first-term graduate OT and PT students who participated in simulation learning using a SP and those who did not and those who did not while controlling for covariate SPICE-R2 pretest measures. In a review of the literature, there were statistically significant improvements in various outcome measures that did not use the SPICE-R2 (Coppola et al., 2019; Costello et al., 2017; Cunningham et al., 2018; Karnish et al., 2019; Macauley, 2018; Paige et al., 2017; Phillips et al., 2017; Reime et al., 2016; Smith et al., 2018; Swift et al., 2020; Wellmon et al., 2017). In these studies, various validated outcome tools measured improved attitudes and behaviors after simulation either with a SP or with low fidelity, or a HFM. IP teamwork and team-based practice themes were improved in areas such as collaboration, critical thinking, decision making, teamwork, team performance, IP socialization, mutual support, perceived need and perceptions of actual cooperation, and cultural competence (Coppola et al., 2019; Costello et al., 2017; Cunningham et al., 2018; Karnish et al., 2019; Paige et al., 2017; Reime et al., 2016; Smith et al., 2018; Swift et al., 2020; Wellmon et al., 2017). As discussed previously, Brennan et al. (2021) used a similar research design to this study and found a statistically significant difference (p = .02) in the SPICE-R2 Teamwork subscore . Based on the results of this study, that found no statistical significance, this study disconfirms previous studies that found improvement in attitudes in the SPICE-R2 Teamwork subscore. One of the possible considerations for disconfirmation was that this study explored the effect of students participating in simulation compared to students in a control group.

Though most studies noted statistical significance after simulation, some studies found no statistical significance. This study extended the findings of Nichols et al. (2019), who did not indicate a statistically significant change (p = .181) in IP teamwork and team-based practice. Nichols et al. utilized a similar research design as this study, who included using the SPICE-R2 in pretest–posttest measures and students participating in simulation with a SP. The study conclusions in the literature were limited due to having no control group. Another note was that studies found mixed results with significance and no significance with the SPICE-R2 overall and subscores (Brennan et al., 2021; Nichols et al., 2019). Together with Nichols et al., whose study included OT, PT, athletic training, nursing, and psychology, this study extends the findings by adding students in OT and PT to the body of knowledge where simulation with a SP did not have a statistically significant change in the SPICE-R2 Teamwork subscore representing IP teamwork and team-based practice.

Roles and Responsibilities for Collaborative Practice

The next hypothesis addressed whether there was a difference in SPICE-R2 scores on Roles between first-term graduate OT and PT students who participated in simulation learning using a SP and those who did not while controlling for covariate SPICE-R2 pretest measures. In a review of the literature, there were statistically significant improvements in various outcome measures that did not use the SPICE-R2 (see Bethea et al., 2019; Coppola et al., 2019; Costello et al., 2017; Cunningham et al., 2018; Smith et al., 2018; Swift et al., 2020; Wellmon et al., 2017). In these studies, various validated outcome tools measured improved attitudes and behaviors after simulation either with a SP or with low fidelity, or a HFM. Roles and responsibilities for collaborative practice themes were improved in areas such as understanding of roles, IP socialization, critical thinking, collaboration, responsibilities, and professional identity (Bethea et al., 2019; Coppola et al., 2019; Costello et al., 2017; Cunningham et al., 2018; Smith et al., 2018; Swift et al., 2020; Wellmon et al., 2017). Nichols et al. (2019) utilized a research design similar to that of this study and found a statistically significant difference (p = .001) in the SPICE-R2 Roles subscore. Based on the results of this study, that found no statistical significance, previous studies that reported improvement in attitudes on roles and responsibilities for collaborative practice are disconfirmed.

Though most studies noted statistical significance after simulation, some studies found no statistical significance. This study extended the findings of Brennan et al. (2021), who did not indicate a statistically significant change (p = .62). As discussed previously, Brennan et al. utilized a similar research design to this study. Together with

Brennan et al., this study extends the findings by adding students in OT and PT to the body of knowledge where simulation with a SP does not have a statistically significant change in roles and responsibilities for collaborative practice.

Patient Outcomes From Collaborative Practice

The last hypotheses to verify addressed whether there was a difference in the SPICE-R2 on Outcomes between first-term graduate OT and PT students who participated in simulation learning using a SP and those who did not while controlling for covariate SPICE-R2 pretest measures. In a review of the literature, there were statistically significant improvements in various outcome measures that did not use the SPICE-R2 (see Reime et al., 2016; Smith et al., 2018; Swift et al., 2020). In these studies, various validated outcome tools measured improved attitudes and behaviors after simulation either with a SP or with low fidelity or a HFM. Patient outcomes from collaborative practice were improved in areas such as prioritizing patient impairments, discharge planning, effective communication to achieve patient-centered care, and prioritizing treatment (Reime et al., 2016; Smith et al., 2018; Swift et al., 2020).

Other studies with a research design similar to that of this study found a statistically significant difference in the SPICE-R2 Outcomes subscore (Brennan et al., 2021; Nichols et al., 2019). Based on the results of this study, that found no statistical significance, previous studies that found improvement in patient outcomes from collaborative practice are disconfirmed. Brennan et al. (2021) and Nichols et al. (2019) both found mixed significance and no significance with simulation and the overall and subscores of the SPICE-R2 and with control or no control, respectively. In contrast, this study found that there was no statistical significance on all SPICE-R2 measures when combined with simulation. One of the primary distinctions of all the noted studies in the current literature was the use of statistical analysis using procedures such as the one-way ANOVA, paired *t* test, and one- or two-tailed *t* tests. According to Warner (2013), the ANCOVA would be used in nonequivalent comparison groups in which there are differences in groups prior to intervention in areas such as age, motivation, or ability that might affect the outcome variable. In the current literature, studies either did not have a control group, which would disqualify the use of ANCOVA, or when a control group was present, ANCOVA was not used. ANCOVA was not identified in any previously noted studies from the current literature review, so these studies could not speak to the potential of differences between groups prior while considering student pretest scores. Therefore, this study extends the findings that there was no significant difference in the overall total and subscore SPICE-R2 scores with a control group and simulation with a SP group while accounting for the covariate of pretest SPICE-R2 scores.

Study Results in the Context of Kolb and Pardue's Theoretical Frameworks

The results of this study were framed through the lens of Kolb's ELT (1984) and Pardue's framework for IPE (2015). Kolb's ELT has been used as a basis for simulation in many studies (Brown & Bostic, 2016; Johns et al., 2017; Pardue, 2013; Poore et al., 2014). The placement of the pretest SPICE-R2 allowed students to self-assess their own attitudes on IP teams and the team approach to care prior to participating in simulation. Students in the control group completed the pretest SPICE-R2 at the start of the course. In this study, simulation with a SP represented the concrete experience for students to participate or observe in Stage 1 of Kolb's ELT. After the simulation, students engaged in Kolb's second and third stage of reflective observation and abstract conceptualization, respectively, in the simulation debriefing process. During this time, students engaged with a facilitator to reflect, discuss, and share what they observed and thought during the simulation. At the conclusion, the posttest SPICE-R2 was administered to capture any changes in attitudes resulting from the simulation experience. Students would then engage in the fourth stage of Kolb's ELT of active experimentation in the days and months following the simulation, where they could encounter similar situations or apply learning to different experiences throughout their academic and clinical learning. Students in the control group did not experience the simulation; however, changes in their IPE attitudes were still assessed because they went through the patient-care management course without the IV of simulation.

The results of this study indicated that there was not a statistically significant difference after simulation with a SP between the control and simulation groups with a pretest covariate. There are several reasons that there was no significance in the SPICE-R2 across all measures. In the context of Kolb's stages of learning, this could be due to the placement and timing of the posttest SPICE-R2, where students did not truly progress through all four stages of Kolb's ELT. This placement right after the simulation would place student learning after Stage 3 of Kolb's ELT of abstract conceptualization. With limited opportunity for student metacognition on what transpired, and no opportunity to engage in Stage 4 of active experimentation, students might not have been able to develop significant changes in their IPE attitudes. This is also confirmed by Zull (2006), who stated that learning occurs when students develop their own representations instead of having knowledge transferred to them; the personal development also affects attitudinal changes. The author also stated that students should pass through stages of experience (i.e., simulation) and knowledge to discern, compare, and form new wisdom and learning. Statistical significance could result if a follow-up SPICE-R2 were administered at designated time intervals such as 6 or 12 months, as a longitudinal study, after student experiences in coursework or when they are in clinical rotations. A follow-up post-SPICE-R2 as a third timepoint could potentially capture student changes in attitudes after having opportunities to engage in Kolb's fourth stage of active experimentation. Timing the administration of a posttest within Kolb's stages could be one rationale for the results of my study. The next consideration would be pretest measures of the SPICE-R2 prior to simulation.

In experimental studies, results can either be significant or no significant difference, and each contributes to furthering knowledge on the topic of interest. Though the results of this particular study showed no statistical significance across the SPICE-R2 which confirmed, disconfirmed, or extended the current evidence, this could be explained within the lens of Kolb's ELT and variance among students prior to the first stage of Kolb's concrete experience. During the SPICE-R2 pretest measure, students may have already come into the course with higher attitudes about IPE as demonstrated where the results were high in overall in mean score for the pretest SPICE-R2 total and subscores. With little room for improvement with averages near or greater than four on the Likert scale in each category, measuring changes overall could have been improved but not at a sufficient threshold for a statistically significant change in these instances. This phenomenon may also attribute to what was observed for mixed results in the current literature where simulation had statistically significant influence on some areas of IPE and did not in others (Brennan et al., 2021; Lockeman et al., 2017; Nichols et al., 2019; Gunaldo et al., 2021). Because of the use of the one-way ANCOVA, the results in this study may demonstrate effects of pretest measure variability among students prior in pretest scores and is factored out of posttest scores when conducting an ANCOVA. Thus, this study resulted in no significant findings among the testing variables. The one-way ANCOVA for this study was a unique statistical analysis that was not present in current literature studies. This distinguished this study's overall results from other studies, adding more context and extending findings regarding simulation and IPE.

The lens of Kolb's theory provided the framework for student learning during a single simulation event within one course and provided explanation for student learning frames in this research design. Within the current literature, authors discussed a need for curricular development across the span of time to capture student learning across the continuum of learning (Arth et al., 2018; Hean et al., 2018; Lockeman et al., 2017; Paige et al., 2017; Wellmon et al., 2017). Pardue's IPE framework (2015) provided context for IPE learning across the curriculum and across multiple learning activities. Time and varied IPE learning such as simulation and other learning opportunities, may be more effective in scaffolding IPE and across Bloom's taxonomy of hierarchical levels of learning (Arth et al., 2018; Hean et al., 2018; Lockeman et al., 2017; Sabus & Macauley, 2016; Stockert & Ohtake, 2017; Wellmon et al., 2017). Authors have also noted that students' self-assessment or attitudinal scales were mismatched as they tend to score themselves higher than their peer or faculty assessors. Especially when peers or faculty use tools assessing actual observed IPE skills or IPE products from students (Lockeman et al., 2017; Paige et al., 2017). Therefore, Pardue could provide the framework for the strategic placement of multiple learning events or IPE educational models for students to acquire skills over time and across multiple learning modalities. Pardue described a process of pedagogical reflection, wherein relation to this study would coincide with Kolb's fourth stage of active experimentation. During a time of pedagogical reflection, students may have opportunity to apply what they learned from the simulation and carry this with them throughout their academic learning. Having students self-assess their IPE attitudes could help highlight concepts and themes of IPE to help shape student learning in the future. This overlapping point between Kolb and Pardue allows for the threading of a course and learning methods into a well-developed IPE curriculum. As noted by many authors in simulation and IPE, thoughtful planning of outcome measures could potentiate more rigorous results in changing attitudes, behaviors, and skills for improved patient outcomes (Arth et al., 2018; Hamson-Utley et al., 2021; Hean et al., 2018; Lockeman et al., 2017; Stockert & Ohtake, 2017; Wellmon et al., 2017). Though this study focused solely on the innovation of simulation learning, there are promising studies that utilized multiple IPE learning events and measured the effect of student learning across curricula and time (Brennan et al., 2021; Matulewicz et al., 2020), which is discussed in more detail in the recommendations section of this chapter.

Limitations of the Study

This study utilized archival data, so the process of participant recruitment strategies and the inclusionary and exclusionary processes used for participants were not applicable. Therefore, all the archival data were intended to be used, thus creating a census sampling. Inclusionary and exclusionary criteria was applied to the archival data, wherein at the start of data analysis, inclusionary criteria would use all completed pretest–posttest measures, and exclusionary criteria were applied in instances where there was incomplete data or where there was not a matched pretest–posttest measure. One other exclusionary criterion described was for significant outliers as described in the data analysis phase. However, the results yielded no significant outliers, and none of the data were excluded.

Purposive sampling was utilized for creating the IV groups of students who participated in simulation with a SP and a control group of students who did not. Students self-selected into either of these groups due to the nature of the program to which they preferred to enter as previously described for acceptance into the part-time flexible program or the full-time residential program for OT and PT. Students self-selected into predetermined groups that existed prior and were independent of the study parameters, so issues of selection bias and trustworthiness were minimized, addressed, and not applicable. It was necessary to draw a random sample from the purposive sampling of students because of the first data analysis. A second data analysis was run for conformity to the assumptions for using the ANCOVA. In statistical analysis, as per Creswell and Creswell (2018), a random sample was preferred as it is considered representative of the whole sample population because all student data had equal opportunity of being selected.

The limitations of this study regarding participants were that they were limited to OT and PT students. Consideration of geographic generalizability could be extended to outside of the area in which the study was conducted. In that area, students gained acceptance to the program from all over the United States and some students were international students. However, the archival data did not include student location in the demographics and therefore the study findings are limited to the geographical location of this study. Another limitation was based on students in the control group were enrolled in the part-time flexible program and students in the simulation group were in the full-time residential program. This limitation was minimized because the coursework, course objectives, and learning objectives were standardized across both programs in the curriculum.

This study also had limitations related to time factors. Students in the control group completed the pretest at the start of the course and the posttest after 15 weeks of instruction. Students in the simulation group completed the pretest and posttest during the ninth week of instruction. However, this study measured potential changes before and after simulation with the pretest and posttest given during the simulation. This was compared to the control group with OT and students participating in the entirety of the course without simulation. The number of participants was also a limitation with a smaller number of control students (n = 28) and a larger number of students in simulation

($n = 220$). In the data analysis, a random sample using the random select function of SPSS 28.0 was used to have equal number of data sets in the data analysis.

Limitations of generalizability were bound to the parameters of this study, and the study's findings are limited by the participant population of OT and PT students. However, the interaction between OT and PT students adds more disciplines studied within the healthcare team and where other studies in the current literature did not include these disciplines. It also adds geographically to where the study findings have occurred, which may differ from previous studies within the current literature. The timing of learners for this study was linked to first-term early graduate students, whereas other studies have contributed findings among undergraduate students, graduate students, and students in the middle, or toward the end of their academic training. The remaining transferability of the study was also bound by simulation learning with a SP. Simulation learning, as described in the literature, could take different forms such as using a low-fidelity mannequin, HFM, and various methods of VR, VSW, and AR, where these simulation environments could contribute differently to student learning and outcomes.

Recommendations

Recommendations for further research are based on the results and limitations of the study. The first recommendation is related to the finding that the change in student attitudes on the posttest SPICE-R2 was not statistically significant after simulation with a SP. Therefore, more research needs to be done about potential changes in IPE attitudes over time when given more engagement in Stage 4 of Kolb's ELT of active experimentation. Another post-simulation SPICE-R2 could be administered in a longitudinal study for students once they had a chance to engage in their first clinical rotation and work with actual patients in the clinical setting. Active experimentation may be afforded to students when they can apply what they have learned in the academic setting and then see these in a tangible way, compare what they learned in simulation, and apply their knowledge to similar clinical situations or circumstances. Results would then be calculated using a repeated measures ANOVA on the simulation group and compare both groups as was performed in this study. Results from these types of studies may provide further insights on student attitudes towards IPE through another time point using the SPICE-R2, while also adding more insights into similar studies that model the parameters of this study.

The second recommendation is related to the study finding no significance across all SPICE-R2 measures whereas other similar studies found mixed results (see Brennan et al., 2021; Nichols et al., 2019). Therefore, more research needs to be done on similar testing variables of a control group, simulation group, and pre- and posttest measures while administering a one-way ANCOVA in the data analysis. The ANCOVA can factor the potential variance that may exist among students on pretest measures. The results of this research were unique in that the specific variables and parameters utilized the SPICE-R2 and a one-way ANCOVA. Similar studies used other measures such as the one-way ANOVA or paired *t* test in the data analysis (Brennan et al., 2021; Nichols et al., 2019). More robust studies could further confirm, disconfirm, or extend findings on the affect that simulation may have on student IPE attitudes that they may have prior to entering the course, and the influence potential varying levels of disagreement or agreement on the pretest measures would have on posttest measures. Additionally, other studies that use other quantitative measures, other than the SPICE-R2 that similarly measure student self-assessment items on IPE, could utilize a one-way ANCOVA to test for significance that would further expand the boundaries of what is understood in the areas of IPE and simulation.

The last recommendation is related to the limitations of this study. There are several recommendations that could further expand on the limitations and broaden the boundaries of this study. The first was this study was done with a total of $N = 248$ OT and PT students' archival records. Therefore, this study could be replicated in similar HU institutions where OT and PT students have opportunity for IP collaboration and learning to, from, and with one another. Studies in different geographic locations, or other OT and PT curricula could further broaden the generalizability of the study findings. Furthermore, other disciplines that are not well represented in the current literature could also implement similar studies using the research design and parameters to broaden the boundaries of this study. The next limitation to consider is the current literature discussed how student self-assessment and self-perception of IPE attitudes or self-rated competency can mismatch what is observed from faculty or peers who are investigating behaviors or products of IPE directly from students (Lockeman et al., 2017; Paige et al., 2017). To address the disparity of student self-assessment versus preceptor assessment of IPE behaviors, multiple learning modalities and activities spanning across time throughout the curriculum have shown to improve student IPE skills and behaviors (Matulewicz et al., 2020; Nwaesei et al., 2019). Therefore, future studies should examine the link of how student self-assessment on competencies or attitudes on IPE, such as the SPICE-R2, correlate with preceptor-rated student attainment of observed IPE behaviors and skills. It would be of interest to see how this study would relate with student demonstration of IPE skills in simulation as assessed by faculty or peers.

One final consideration to expand upon the limitations of this study is the method of delivery for simulation. This study examined students participating in live simulation with a SP. Given the challenges facing healthcare education in light of the pandemic of COVID-19, many educational settings shifted the delivery of learning and engagement. Some content delivery shifted from face-to-face, to online, telehealth, and virtual settings. Therefore, future studies that compare various ways of delivery simulation through VR, AR, VSP, or through telehealth would differ from face-to-face simulation with a SP. Because many learning institutions had to shift in the delivery of education, alternative options in VR and other online technologies, so future studies would broaden the boundaries of simulation delivery and the effect on student IPE outcomes.

Implications

This study may contribute to positive social change in several ways. First, at the individual level, the results of this study showed the effects of simulation with a SP on OT and PT students. Although, the study showed that there was no statistically significant difference, there was still an overall mean increase in the total and subscores on the SPICE-R2. Students can also learn more on using innovative approaches to learning, such as the integration of simulation in the delivery of healthcare education. By becoming familiar with the potential benefits of simulation, students may advocate or encourage university leaders to seek opportunities for simulation to be part of their academic training.

There is also potential for change at the organizational level. Academic leaders, program directors, IPE directors, or university board members can evaluate current practices of IPE at their institutions and evaluate how to improve or link IPE simulations or activities to better align with desired outcomes. In consideration of programmatic assessment, there are implications for methodology as it pertains to curricular design. For example, the type of statistical analysis, such as the one-way ANCOVA used in this study, may create different perspectives of what the data show. Various data analysis and metrics can paint a different picture of student achievement and outcomes assessment.

Additionally, this study can advance academic practice and policy. Faculty can evaluate IPE simulation with thoughtful planning on alignment of simulation scenarios, desired objectives, and the outcome measures utilized. There are implications for theoretical frameworks such as opportunities for allowing engagement in Kolb's ELT stages. For example, faculty can consider course administration such as the timing assessments to maximize student learning based on ELT and what is best educational practice for engagement within stages of learning within the model. At the curricular level, there are potential implications of using Pardue's framework for mapping IPE and assessing educational effectiveness and best placement for administering assessments to allow for student learning and achievement throughout the curriculum.

This study can also advance positive social change for the learning, instruction, and innovation of simulation. Current literature continues to demonstrate that some studies find that there is statistical significance in improving student IPE outcomes, but there is no statistical significance in other instances. Simulation did not exist in the curriculum prior to this study at HU, thus allowing for the innovation of simulation for this study. Though the results of this study showed no statistical significance, there was still an overall increase in mean scores across the SPICE-R2. The innovation of simulation can still be assessed in learning and instruction to meet student needs and improve learning in the training of future healthcare providers.

Conclusion

The key findings of this quasi-experimental causal-comparative research pretest–posttest with a nonequivalent control group design was to explore the effect of simulation learning on graduate OT and PT students' attitudes towards IP teams and the team approach to care. Among the OT and PT students at HU, there was not a statistical difference for the Total SPICE-R2 . There was also no statistical difference for the SPICE-R2 subscores for Teamwork, Roles, and Outcomes. Though there was no statistical significance found in this study, there is significance in these findings as it shows the data under a different method of analysis using ANCOVA. Using the one-way ANCOVA accounted for the differences students may have had prior to starting the course through pretest measures and factored this effect out of the posttest results. This method allows educators to look more closely at the educational theories that may describe why this may occur, the potential alignment of activities and outcomes, and other factors that may affect student IPE learning with simulation.

In the United States, 250,000 deaths occurred annually due to medical error (WHO, 2010), and even more recently, the overall number remained relatively unchanged with a little more than 250,000 deaths still occurring from medical error (Arth et al., 2018; Siperd, 2018). There is ongoing debate on the accuracy, methodology, and metrics that were used to calculate these statistics; nonetheless, it remains importantly clear that deaths resulting from medical error is something that should be addressed and is noteworthy for our efforts to promote social change. The overall goal of IPE is to meet the quadruple aim of (a) improving patient care, (b) improving the health of populations, (c) lowering healthcare costs, and (d) improving the clinician experience (Hamson-Utley et al., 2021; IPEC, 2016). This study helps in emphasizing IPE early in the educational training of future healthcare providers, and provides students the opportunity to self-assess attitudes towards IPE, which can potentially lay the foundation to be mindful practitioners of principles of collaborative practice. Simulation provides opportunities for students to apply IPE principles while in academic training before entering clinical practice. Therefore, the practice of improving learning and instruction through innovations such as simulation can foster the attainment of IPE ideals to prepare students as collaborative practice-ready clinicians. Students can then progress through their academic training with IPE knowledge and onward to healthcare practice to cultivate the positive social change necessary to improve healthcare delivery, decrease medical error, and improve healthcare for patients and providers.

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Appendix A: Permission for Use of Simulation with a Standardized Patient for Figure 1

Norman Belleza

From: Maureen Johnson
Sent: Tuesday, October 12, 2021 9:33 PM
To: Norman Belleza
Subject: RE: Permissions for use of IPE simulation figure/image

Dear Dr. Norman Belleza,

Your dissertation looks very interesting! I would like to read your completed work.

Yes, you have permission to utilize the IPE/simulation image on pg. 3 of our published work from our [redacted]pository.

Good luck!

Sincerely,

Mo Johnson, [redacted]

From: Norman Belleza [redacted]
Sent: Tuesday, October [redacted]
To: Maureen Johnson [redacted]
Subject: Permissions for [redacted] figure/image

Dear Dr. Maureen Johnson,

I am granting permission for use of an image for my dissertation entitled "Affect of Simulation Learning on Graduate Student A[redacted]ofessional Teams and the Team Approach to Care" as part of my coursework and studies for [redacted]would also like to see your permission to utilize the IPE/simulation image on pg. 3 of our published [redacted]Repository? Please let me know if you are willing to grant permission for me to utilize this image [redacted] in my dissertation and publication work that may come after completion of my dissertation. Thank you so much.

1

Figure 1

Simulation with a Standardized Patient

Appendix B: Permissions for Kolb's Experiential Learning Theory for Figure 2

Norman Belleza

From: Lori Thuente [redacted]
Sent: Wednesday, October 13, 2021 9:52 AM
To: Norman Belleza
Subject: EXTERNAL: Re: Permissions to use figure/image for my dissertation work

[EXTERNAL EMAIL] DO NOT CLICK links or attachments unless you recognize the sender and know the content is safe.

Hello!
Thanks so much for reaching out! Of course you can use this figure and anything else that may be helpful to you!
If you have any additional questions, please don't hesitate to ask!

On Wed, Oct 13, 2021 at 10:51 AM Norman Belleza [redacted]

> Good morning Dr. Fewster-Thuente,
>
> My name is Norman Belleza, and I am working on a dissertation through Walden University that focuses on simulation and interprofessional education. I have referenced and used your study and article entitled "Kolb's Experiential Learning Theory as a Theoretical Underpinning for Interprofessional Education." This was a wonderful work that has been helpful in guiding me through my dissertation journey. I am now entering the proposal and data gathering stage of my dissertation. One of your figures (Figure 1) is a graphical representation of Kolb's ELT. I wanted to respectfully request permissions to re-render this image in my dissertation? Proper acknowledgement will be indicated in dissertation and subsequent print related to my intended study as well. Please let me know if this permission is granted. Thank you so much for your consideration and time.
>
> Sincerely,
>
> **Norman Belleza,** [redacted]
>
> (he/him/his)

Appendix C: Pardue Framework for Interprofessional Education in Figure 3

Norman Belleza

From:	Karen Pardue [redacted]
Sent:	Tuesday, August 3, 2021 9:37 AM
To:	Norman Belleza
Subject:	EXTERNAL: RE: Seeking permissions from theoretical framework for IPE

[EXTERNAL EMAIL] DO NOT CLICK links or attachments unless you recognize the sender and know the content is safe.

Good afternoon Dr. Belleza;
Thank you for reaching out to me. I am pleased to learn that you found my proposed educational framework to be helpful in your conceptualization and implementation of interprofessional education. I am happy to grant you permission to use both the framework and the accompanying figure/visual in your dissertation study.

I am very familiar with the SPICE R-2 and utilized this instrument in a subsequent study involving novice (1st year) health profession learners. This was a multi-site study, involving students from the [redacted] University. The citation for this recent instrumentation study is:

Patel Gunaldo, T., Lockeman, K., **Pardue, K.,** Breitbach, A., Eliot, K., Goumas, A., ... & Mills, B. (2021). An exploratory, cross-sectional and multi-institutional study using three instruments to examine student perceptions of interprofessional education. *Journal of Interprofessional Care*, 1-8.

I know that you, too are committed to the early introduction of IPE in health profession education. I firmly believe we can improve health care teams, and subsequent patient outcomes, if we teach students from the very beginning the contribution of all providers to patient/family/community health.

I hope this information is helpful to you! Please do not hesitate to reach out if you have additional questions. Best wishes with your ongoing doctoral work and dissertation. Warm regards, Karen Pardue

Karen Pardue, [redacted]

Appendix D: Permission for Interprofessional Collaboration Competency Domain in Figure 4

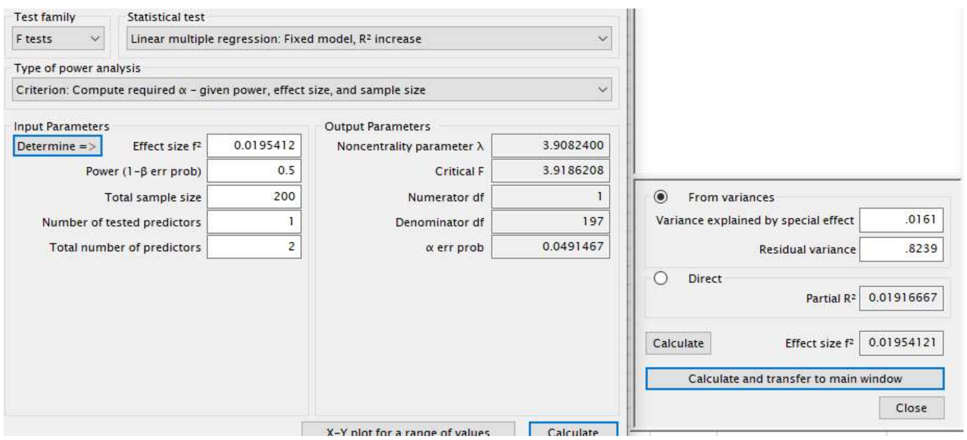
CORE COMPETENCIES FOR INTERPROFESSIONAL COLLABORATIVE PRACTICE: 2016 UPDATE

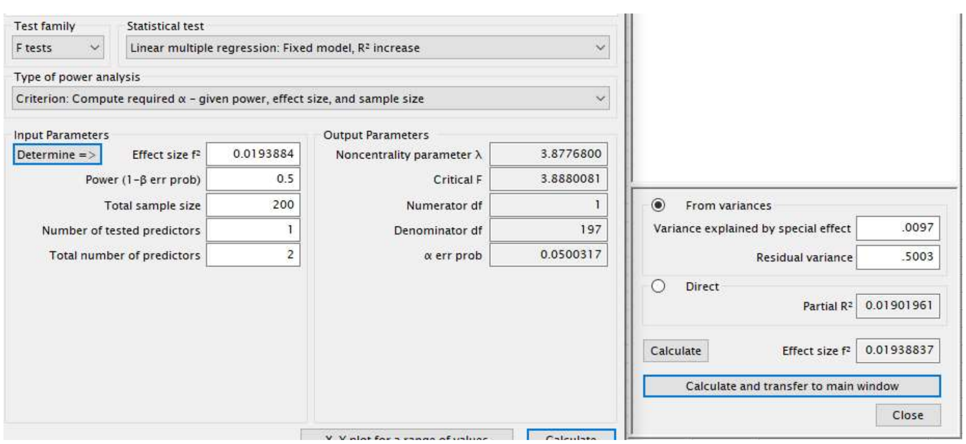
Suggested Citation:
Interprofessional Education Collaborative. (2016).
Core competencies for interprofessional collaborative practice: 2016 update. Washington, DC: Interprofessional Education Collaborative.

Appendix E: Statistical Output Data for G*Power

*ANCOVA Power Graph for Sample Size Estimation (G*Power)*

In G*Power you can solve for the alpha level for various combinations of the correlation between pre–post to determine the smallest detectable group effect size. The first screenshot below is for a .40 correlation between pre–post. The variance explained by special effect is the η^2 for the group effect; the residual is 1 – (square of the correlation + η^2) = 1 – (.16 + .0161) = 1 - .1761 = .8239. Calculations included manipulation of the special effect value and corresponding residual until the α error probability settled at approximately .05. The second screenshot is for pre–post correlation of .70 (r^2 = .49).





Appendix F: Students' Perceptions of Interprofessional Clinical Education—Version 2

SPICE-R2 Instrument

Dear Student:

In this survey you are being asked about your attitudes toward interprofessional teams and the team approach to care. By ***interprofessional team***, we mean two or more health professionals (e.g., nurse, occupational therapist, pharmacist, physical therapist, physician, social worker, veterinarian, etc.) who work together to plan, coordinate, and/or deliver care to patients/clients.

PLEASE NOTE: The following scale progresses from "Strongly Disagree (1)" → "Strongly Agree (5)"

INSTRUCTIONS: **Please be candid as you indicate the extent of your disagreement/agreement with each of the following statements related to interprofessional teams and the team approach to care.**		***Strongly Disagree (1)***	***Disagree (2)***	***Neutral (3)***	***Agree (4)***	***Strongly Agree (5)***
1. [T]	Working with students from different disciplines enhances my education	1	2	3	4	5
2. [R]	My role within an interprofessional team is clearly defined	1	2	3	4	5
3. [O]	Patient/client satisfaction is improved when care is delivered by an interprofessional team	1	2	3	4	5
4. [T]	Participating in educational experiences with students from different disciplines enhances my ability to work on an interprofessional team	1	2	3	4	5
5. [R]	I have an understanding of the courses taken by, and training requirements of, other health professionals	1	2	3	4	5
6. [O]	Healthcare costs are reduced when patients/clients are treated by an interprofessional team	1	2	3	4	5
7. [T]	Health professional students from different disciplines should be educated to establish collaborative relationships with one another	1	2	3	4	5
8. [R]	I understand the roles of other health professionals within an interprofessional team	1	2	3	4	5
9. [O]	Patient/client-centeredness increases when care is delivered by an interprofessional team	1	2	3	4	5
10. [T]	During their education, health professional students should be involved in teamwork with students from different disciplines in order to understand their respective roles	1	2	3	4	5

Factors:
T = Interprofessional Teamwork and Team-based Practice
R = Roles/responsibilities for Collaborative Practice
O = Patient Outcomes from Collaborative Practice

Appendix G: Permission to Use Students' Perceptions of Interprofessional Clinical Education—Version 2

Norman Belleza

From: Zorek, Joseph A [redacted]
Sent: Tuesday, August 3, 2021 8:15 AM
To: Norman Belleza
Subject: EXTERNAL: Re: Permission to utilize SPICE-R2 for students in our program

[EXTERNAL EMAIL] DO NOT CLICK links or attachments unless you recognize the sender and know the content is safe.

Hello Dr. Belleza,

Congratulations on your progress! Yes, please feel free to include SPICE-R2 and any of the other documents I shared with you as an appendix or in the works cited section.

Good luck on your next steps!

Best,
Joe

From: Norman Belleza [redacted]
Sent: Monday, Augu[redacted]
To: Zorek, Joseph A [redacted]
Subject: RE: Permission to utilize SPICE-R2 for students in our program

Good afternoon Dr. Zorek,

I wanted to thank you so much for your permissions and the additional resources which have been very helpful to me as I continue to develop my study and dissertation work. One of the requirements is the inclusion of the SPICE-R2 tool/outcome measure in the appendices of my submitted work. May I request and seek your permission to have the SPICE-R2 included in the appendices? Once again, I am humbly grateful and thankful in your work in IPE and I look forward to your response at your earliest convenience. Many thanks for all that you have already provided to me and I look forward to sharing results from the work I am doing with our students as I move forward in the study and dissertation process.

Very respectfully,

Norman Belleza [redacted]