PROBLEM-BASED LEARNING IN PHYSICIAN ASSISTANT EDUCATION AT A

UNIVERSITY IN EASTERN SOUTH CAROLINA: IMPROVING AN ACTIVE LEARNING

PEDAGOGY

by

Marvin Scott Wade

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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APPROVED BY:

Bunnie L. Claxton, Ed. D, Committee Chair

Russell L. Claxton, Committee Member

ABSTRACT

The purpose of this applied study was to solve the problem of designing and delivering a problem-based learning (PBL) curriculum which enhances students' critical thinking and prepares physician assistant (PA) students to pass a national certifying examination at a small university in eastern South Carolina. A multi-methods approach utilizing concepts from qualitative and quantitative research was used. The study was guided through a central research question: How can the problems of problem-based learning be improved in PA education at a university in eastern South Carolina? Deeper understanding is discovered through the sub-questions: (a) how would PA education faculty in an interview solve the problems of problem-based learning at a university in eastern South Carolina? (b) how would students in a survey solve the problems of problem-based learning at a university in eastern South Carolina? (c) how would data from student surveys and standardized multiple-choice question instruments provide information related to the problems of problem-based learning at a university in eastern South Carolina? Data collection included personal interviews with five PA faculty, 15 student surveys and documents. Data analysis included bracketing, horizonalization, and coding for themes as well as transformation of data into means and frequencies with triangulation as a parallel analysis of qualitative and quantitative data. The data was analyzed to develop themes which produced three solutions to the problem. The solutions identified were a more thorough alignment of curriculum content across the program, improved faculty facilitation of PBL coursework, and restructuring the peer interactions to include more small group activities, role-playing, and use of patient simulators.

Keywords: problem-based learning, physician assistant education, student learning outcomes, critical thinking

Dedication

This dissertation manuscript is dedicated to my loving family. The love and support poured upon me by my wife, Janiece, has been a true blessing. She has taken the reigns with so much of the family's day-to-day life, provided words of encouragement, and fervent prayer for me and our entire family that this season may be fruitful in glorifying God's kingdom. She is truly the rock that holds this family together, and through her, God has provided me assurance of love, faith, and grace in my life. My children, Jasmine, Samuel, Danika, and Damon, have been gracious and supportive through my long nights and never-ending weekends away from the family. It is my prayer that God allow me to be a witness to them on the importance of education, perseverance, integrity, and work ethic. I have been truly blessed to have their love and support and dedicate this work to them.

Acknowledgements

I would like to start with the most important acknowledgement that only through the love, grace, righteousness, and perfection of Jesus Christ is any of this possible or necessary. This research effort is first and foremost a measure to glorify Him and His kingdom through the service that health care providers are allowed to provide through His wisdom and knowledge. It is by His will that we may all "serve wholeheartedly, as if you were serving the Lord, not people, because you know that the Lord will reward each one for whatever good they do…" (Ephesians 6:7, New International Version).

I would also like to acknowledge my eternal gratitude to my parents, Eddie and Sandra Huddleston, who have guided me through life instilling love, ethics, morality, and dedication to be goal driven and succeed wherever God has planted me. God has worked through them to guide me into His service where once again He may be glorified exponentially in the lives that I have influenced because of them. This academic effort is as much, if not more, their success as mine.

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Finally, I would like to acknowledge the faculty, staff, and students who provide a daily dose of encouragement and support within the physician assistant program. It is truly a blessing to serve in a program with such devoted Christ followers.

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List of Abbreviations

Accreditation Review Commission on Education for the Physician Assistant (ARC-PA)

American Academy of Physician Assistants (AAPA)

American Psychological Association (APA)

End-of-Rotation (EOR)

Institutional Review Board (IRB)

Lecture-based learning (LBL)

Multiple-choice question (MCQ)

National Board of Medical Examiners (NBME)

National Commission for the Certification of Physician Assistants (NCCPA)

Physician assistant (PA)

Physician Assistant Clinical Knowledge Rating and Assessment Tool (PACKRAT)

Physician Assistant Education Association (PAEA)

Physician Assistant National Certification Examination (PANCE)

Problem-based learning (PBL)

Patient Management Assessment (PMA)

Student learning outcome (SLO)

United States Medical Licensing Examination (USMLE)

CHAPTER ONE: INTRODUCTION

Overview

This applied research study sought to solve problems within the pedagogy of PBL at a physician assistant education program at a university in eastern South Carolina. The research examined facets of PBL through the experiences of faculty and students through interviews and questionnaires against measurements of academic success in physician assistant (PA) education. This initial chapter will provide foundational information on physician assistant education including PBL curriculum. The chapter will also identify the problem statement, purpose statement, and significance of the study to PA education. The research questions which will serve as a guide for the researcher in directing the study will also be revealed along with key definitions.

The ability to change behavior, or creating a potential to change behavior, through experiences over time defines the essence of learning (Schunk, 2016). It is one of the great responsibilities for educators to reveal wisdom and knowledge to students to promote their behavioral growth through learning. These concepts provide students an opportunity to succeed in academic, professional, and spiritual well-being throughout life (Greene, 2003). Training in physician assistant education is no exception. One pedagogical approach to achieving this is through problem-based learning (PBL). Although PBL provides a pedagogical approach to enhance knowledge and skill acquisition, retention, recollection, and application, the measurement of outcomes through this approach may conflict with traditional learning models creating a disconnect between teaching and outcomes measurement. This disconnect prompts the need for discovery within the pedagogical approach to ensure that learning and assessment approaches offer optimal academic efficacy for students and educators.

Background

PBL uses student centered learning as a foundation for the integration of knowledge and skills development into application (Ungaretti et al., 2015). This pedagogical approach incorporates discovery learning where inductive reasoning provides opportunity for cognitive growth (Schunk, 2016). The approach allows students to reflect on the knowledge and skill in practical application which enhances acquisition, retention, recollection, and application of information (Yew & Goh, 2016). Health care education, including medical, PA, nursing, physical therapy, and others, have implemented active learning theories such as PBL to strengthen the development of critical thinking (Lewis & Thompson, 2017). To gain better insight into the nature of the problems addressed in this research, it is important to be aware of the historical and social background of the pedagogy in medical education and the theoretical perspective that supports PBL.

Historical Background

PBL was initially conceptualized for use in medical school education; however, it has become a growing pedagogy in other educational forums. This pedagogical practice has been utilized in medical education since the 1960's (Ungaretti et al., 2015). Sweeny (1999) wrote about the developmental constructs that led to instituting problem-based learning in 1969. He identified three key revolutions in medical education that progressed medical education into the use of problem-based learning beginning with the Flexnor report of 1908, the strategy used at Case Western Reserve University in 1952, and the formal introduction to problem-based learning by McMaster University in 1969 (Sweeny, 1999). Johnson and Finucane (2000) chronicled the conception of problem-based learning identifying pioneers in medical education. They write about the early PBL initiatives that began at the School of Medicine at McMaster University in

Canada in 1969 and then discussed how it was implemented in the Harvard University Medical

School's "New Pathways" curriculum in 1985 (Johnson & Finucane, 2000).

In relation to the practice of medicine by physicians, the PA career field is relatively

young at just over 50-years of existence (Sadler & Davis, 2017). The profession was built on a

model of medical school curriculum, training professionals to be physician extenders bridging

the need for increased health care during the late 1960's (Coombs & Pedersen, 2017). Although

the curriculum design for physician assistant programs was initially based off medical school

directives, advancements in the profession have called for changes in curriculum development

for these programs. Developing physician assistant education programs combines the learning

strategies and theories that support educational outcomes for graduate students in health care

education with the standards presented by the Accreditation Review Commission on Education

for the Physician Assistant (ARC-PA) and the PANCE blueprint provided by the NCCPA

(Coombs & Pedersen, 2017).

Social Background

Problem-based learning has been utilized to enhance medical education for more than 40

years. There has been concern for the effective utilization of PBL in physician assistant (PA)

education regarding outcomes for skills and knowledge in clinical practice. PBL is a pedagogy

designed to implement knowledge and skill into clinical practice (Ungaretti, Thompson, Miller,

& Peterson, 2015). Although PBL has been utilized in medical education since the 1960's, its

use in PA education is a much more recent concept (Wardley, Applegate, & VanRhee, 2013).

PBL incorporates the knowledge obtained in traditional lecture-based learning (LBL), along with

faculty facilitation, to allow students an opportunity to develop the critical clinical thinking

needed to develop a differential diagnosis and then provide a therapeutic plan to optimize patient

outcomes (Ungaretti et al., 2015). PA educators should create an academic environment where medical knowledge and skill are delivered to students for optimal application in future clinical practice. The goal, therefore, in the implementation of PBL as a medical education pedagogy, is to enhance the clinical practice of students in a manner more reflective of real-life situations (Ungaretti et al, 2015).

In medical education, faculty strive to deliver scientific medical knowledge, combined with the understanding of the human condition, to bring students the ability to associate medical knowledge with patient signs and symptoms, thinking of the disease processes and identifying their patients as people with lives, families, and stories of their own (Thomas, Kern, Hughes, & Chen, 2016). Clinical practice entails utilization of medical knowledge incorporated with skills and critical decision making (Reddy & McKenna, 2016). Teaching medical practice goes beyond the basic principles of memorization and recall and requires students to be able to process and critically think through patient complaints which may not present exactly as a textbook would represent. Problem-based learning curricula provides a venue for intertwining didactic education into clinical practice (Ungaretti et al., 2015). By blending lecture and problem-based curriculum, it is theorized that students' critical clinical acumen is improved prior to entering actual clinical practice (Wardley et al., 2013). In PA education, the knowledge and skill that the governing bodies feel are essential to accomplishing this clinical astuteness are found in the National Commission for the Certification of Physician Assistants' (NCCPA) Physician Assistants National Certification Examination (PANCE) Blueprint (NCCPA, 2018). This blueprint provides the educators an understanding of what medical knowledge and skill are required for clinicians to adequately care for the sick and injured.

Although the foundation of medical knowledge and skills required for PA students to become certified is found in the PANCE blueprint, the delivery of this information is left to each PA education program to develop (Snyder & Skala, 2018). The ARC-PA provides broad guidance on the standards for curriculum development; however, these standards are only a skeleton for curriculum designers to follow (Snyder & Skala, 2018). These standards cover "current, nationally accepted guidelines for all aspects of PA program operation…characterized as competency-based, the focus on proficiency and performance, relative to the set of Standards, has worked to ensure ultimate success for the profession" (Coombs & Pedersen, 2017, p. s10). The ARC-PA provides a framework for curriculum development and flexibility for individual schools to align their textbooks, instructional delivery methods, outcomes and measurements with the standards individually to provide a unique learning experience for students (Parkay, Hass, & Anctil, 2014).

Physician assistant curriculum, modeled after medical school curriculum, incorporates scientific and clinical content needed to produce health care clinicians (Coombs & Pederson, 2017). William Osler introduced medical students to hands-on training in 1899 (Ungaretti et al., 2015). In the 1950's PBL was added to the curriculum at Case Western University in the United States (U. S.) and developed further through implementation at McMaster University in Canada in the 1960's (Prihatiningsih & Qomariyah, 2016). PA education's inaugural utilization of PBL was in 1997 at Chatham University, and by 2003, three additional programs, Southern Illinois University, University of New Mexico, and Western Michigan University, had implemented PBL as a predominate method within their curriculum (Hawkins, Laird, & Goreczny, 2018). The use of PBL in PA curriculum has grown over the last 15 years. The Physician Assistant Education Association (PAEA) (2018) surveyed 209 PA education programs in 2016 and

discovered that six programs used PBL as a primary mode of instruction and 94 programs provided a mixed problem- and lecture-based curriculum.

Theoretical Perspective

Schunk (2016) described PBL as a discovery learning process. This discovery learning process is founded on theoretical principles where real-life application of problem-solving skills are coupled with foundational knowledge to enhance clinical decision making (Bethell & Morgan, 2011). Researchers have associated PBL with philosophical theories such as andragogy, or adult learning, and constructivism (Chikotas, 2008). The adult learning theories incorporate the sociological and psychological implications of adult learning which researchers have discovered occurs optimally in environments outside of the traditional lecture-based classroom (Lewis & Thompson, 2017). PA education, as a graduate level in higher education, is comprised of adult students who have achieved academic success in previous endeavors and seek a higher level of critical thinking through medical practice. As both a clinician and an educator, this author has found that medical practice, and training students for medical practice, incorporates continued acquisition and processing of knowledge through practical experience as presented through a constructivism theory. The constructivism theory posits knowledge acquisition is heightened through personal interaction in experiential learning environments (Burgess, Roberts, Ayton, & Mellis, 2018). The use of PBL provides a method for curriculum delivery that supports learning through experiences and personal interactions.

The historical and social backgrounds and theoretical perspectives are foundational for this applied research study of problem-based learning in PA education. This information provides a context for the researcher and reader to establish the social, intellectual, and professional factors involved in medical education, specifically for this research, physician

assistant education (Joyner et al., 2013). This introductory information also allows the reader to better understand the nature of the pedagogy and the context of the problems and potential solutions this researcher seeks to discover within a PBL curriculum in PA education.

Problem Statement

The problem is developing PBL curriculum in PA education that enhances clinical competencies, critical thinking, and application of medical knowledge and skill that can improve students' academic success as measured by standardized exam instruments. As clinicians, PAs are responsible for examining patients, ordering and interpreting diagnostic studies, diagnose patients, provide treatment plans and education, prescribe medication, assess and record patient progress as a member of a collaborative health care team with a physician lead (U.S. Dept of Labor, 2017). PBL in PA education allows students to hone these clinical skills with critical thinking processes to evaluate and treat patients (Ungaretti et al., 2015). The student learning outcomes for these clinical competencies are measured through a multiple-choice question (MCQ) direct assessment through the PANCE (NCCPA, 2018). Researchers have found a disparity in the delivery of curricular content through a PBL pedagogy and student learning outcomes assessed with the PANCE and other standardized testing which calls the efficacy of the pedagogy into question (Wardley et al., 2013).

Korpi, Peltokallio, and Piirainen (2019) identified problem-based learning as a pedagogy that enhances long-term knowledge retention and skill development while having the greatest influence on student and teacher satisfaction. The ability to solve complex, real-life problems using critical thinking is essential to clinical practice, and PBL offers a methodology that enhances these skills (Korpi, Peltokallio, & Piirainen, 2019). However, students learning outcomes in medical education fields are most often measured through MCQs. The controversy

then lies in the ability to translate clinical knowledge acquired in PBL through reliable and valid MCQs while maintaining the integrity of the active learning pedagogy (Zahid, Varghese, Mohammed, & Ayed, 2016). Therefore, this research will examine the use of PBL in PA education at an eastern South Carolina university to identify opportunities to improve on the approach where students and educators may find a bridge between knowledge and skill acquisition, recollection, and practical application using non-traditional methods that ensures success on traditional standardized MCQ examinations.

Purpose Statement

The purpose of this applied study is to solve the problem of designing and delivering a PBL curriculum which enhances students' critical thinking and prepares PA students to pass a national certifying examination at a small university in eastern South Carolina and formulate a solution to address the problem. A multimethod design was used utilizing approaches from both qualitative and quantitative methods. The first approach incorporated structured interviews with five PA education program faculty members who are intimately involved in PBL at a small university in eastern South Carolina. The second approach utilized data obtained through 15 student surveys on PBL experiences. The third approach included archival data collected regarding standardized test scores.

Delivering medical knowledge and skill through PBL offers a student-centered alternative to traditional lecture-based learning (LBL) where students are presented with challenging problems relevant to actual clinical practice (Haber-Curran & Tillapaugh, 2015). Research on the efficacy of PBL in medical school education has shown a significant improvement in student motivation, engagement, and achievement measured in standardized testing (Yue et al., 2018; Zahid et al., 2016). Limited research in PA education has not revealed

the same results. In PA education, researchers have only noted significant improvement in PANCE related MCQ standardized test scores in the area of psychiatry (Wardley et al., 2013). This disparity between medical school education and PA education reveals the need for further investigation into PBL in PA education.

Significance of the Study

This research may contribute to the existing research related to PBL in multiple fields, including PA education. The research is targeted towards PBL in PA education where PA educators may gain a deeper understanding of the pedagogy and the methods for enhancing students' critical clinical thinking preparing students for the national certification exam. The research may benefit PA educators and students, as well as faculty in other health care related fields and educators who utilize PBL as a pedagogical practice. The most important stakeholders, though, may be the patients who will be receiving care from PAs who have honed critical clinical thinking skills with a foundation of evidence-based medical science. Research has been accomplished previously in medical school education where PBL promoted clinical competency and improved cognitive knowledge without significantly impacting theoretical knowledge (Zahid et al., 2016). Wardley, Applegate, and Van Rhee (2013) provide the most recent study on cognitive measurement in PA education using a mixed problem- and lecture-based curriculum. In this research, the authors found that PBL did not significantly improve PANCE scores with the exception of one organ-system subtest, psychiatry. This research seeks to bridge the research between medical school and PA education where medical schools have seen the improvements that PA education did not.

The research may contribute to medical education literature to advance learning based on a constructivism theory in adult learning pedagogy where students are actively involved in

experiential learning outside the traditional lecture-based paradigm. Medina (2008; as cited in

Smith, 2014) discovered that a lecture-based didactic presentation, with minimal or no active

student participation, held students' attention approximately 10 minutes until the students

became disinterested. Educators must then find new and innovative ways of capturing students'

motivation and attention in curriculum development in all levels of education, including medical

education. Active learning curriculum in physician assistant education in a flipped classroom

incorporates problem-based learning, use of high- and low-fidelity simulators, and role playing

to enhance student performance (Smith, 2014). This approach, utilizing descriptive research

design, identified active learning as essential elements for PA students' ability to evaluate and

utilize medical knowledge and skill focused on direct patient care "increasing student

engagement, motivation, and higher-order thinking skills" (Smith, 2014, p. 47). Therefore, this

applied research will seek to advance education and add to the literature through discovery of

problems and solutions for PBL in PA education melding clinical reasoning with problem

solving experiences (Burgess et al., 2018).

Research Questions

Research has indicated successful application of PBL in medical education that has not

been seen in PA education (Zahid et al., 2016; Wardley et al., 2013). Doctors and PAs are both

educated with a foundation of basic medical science which is expanded through application of

medical decision-making using critical thinking (Parkhurst, 2015). In analyzing PBL in PA

education for improvements, the researcher has considered the purpose and problem statement to

develop a conceptual framework to formulate questions that will guide the research towards

solutions (Bickman & Rog, 2009). The research will therefore examine PBL in PA education

utilizing applied research methods to answer the central question and sub-questions:

Central Question: How can the problems of problem-based learning be improved in PA education at a university in eastern South Carolina?

Sub-question 1: How would PA education faculty in an interview solve the problems of problem-based learning at a university in eastern South Carolina?

Sub-question 2: How would students in a survey solve the problems of problem-based learning at a university in eastern South Carolina?

Sub-question 3: How would data from student surveys and standardized multiple-choice question instruments provide information related to the problems of problem-based learning at a university in eastern South Carolina?

Definitions

To digest and comprehend the relevance of information, it is important to fully understand the concepts and terminology of a research study (Joyner, Rouse, & Glatthorn, 2013). By defining terminology and explaining key concepts, the author intends to add clarity and consistency for the reader in interpreting the value of previous research and implications of this research.

1. *Curriculum* – Curriculum is the course of study, content knowledge and skills, and learning experiences within educational programs which lead to accomplishing specific outcomes (Parkay et al., 2014).

2. *Problem-based learning (PBL)* – PBL is a student-centered, case-based educational experience where faculty facilitate group interactions guiding students beyond traditional lecture-based instruction (Zahid et al., 2016).

3. *Lecture-based learning (LBL)* – LBL is considered a classical mode of delivering knowledge where a number of students are taught by one teacher as the source of knowledge

providing an economy resources through passive, teacher-centered learning (Tahira, Lodhi, & Abaidullah, 2018).

4. *Accreditation Review Commission on Education for the Physician Assistant* (ARC-PA) – The ARC-PA is a peer-reviewed accreditation organization providing standards and guidance for the education of physician assistants in the United States (U. S.) (Snyder & Skala, 2018).

5. *National Commission on Certification of Physician Assistants (NCCPA)* – The NCCPA is the organization responsible for national certification of physician assistants which is a requirement for clinical practice licensure of PAs in the U. S. (Coombs & Pedersen, 2017).

6. *Physician Assistant National Certifying Examination (PANCE)* – The PANCE is a high-stakes MCQ assessment instrument PA program graduates must pass to obtain certification for initial licensure as PA clinicians (Mirly, Rodriguez, & Coombs, 2017).

7. *Student learning outcomes (SLOs)* – Student learning outcomes represent the knowledge, skills, and competencies that students are to assimilate through an educational process (Schans, 2019).

8. *Critical thinking* – Critical thinking is a cognitive process where analysis and evaluation of data is coalesced with opinions, observations, and prior experiences as a higher-order-thinking is put into practical application (Saputra, Joyoatmojo, Wardani, & Sangka, 2019).

Summary

This chapter revealed the overview and background information related to PA education and the incorporation of PBL as a pedagogy to enhance knowledge acquisition, recollection, and application. The problem lies in the development of an approach to education utilizing a PBL pedagogy to improve clinical competencies, critical thinking, and application of medical

knowledge and skill that would also prepare students to successfully pass the PANCE. The purpose of this applied research study was identified to solve this problem at a small university in eastern South Carolina and to discover solutions which will best address the problem. The author provided a central question and three sub-questions which will guide the study through the research plan.

"You, however, must teach what is appropriate to sound doctrine" (Titus 2:1, New International Version). In these words, the Apostle Paul reveals to Titus principles that educators should realize for all students, that they be taught sound principles. Schunk (2016) wrote about learning and education as the delivery of knowledge to students that would change their behaviors that would be continually developed and endure. PA education, modeled from medical school curricular designs, imparts the knowledge and skill of organ systems and clinical acumen needed for students to become competent heath care providers (ARC-PA, 2018). One pedagogical practice that medical schools and PA education programs utilize to improve the acquisition, retention, and application of these principals is through PBL.

Medical and PA education models have grown from the 1800s when hands-on training was first introduced, to the early 1900s when Flexner posed his model for medical education, into the 1950s when PBL was first introduced (Ungaretti et al., 2015). PBL serves as a method of instruction that is student-focused, where students participate in active group learning activities to discover a deeper understanding of medical science (Korin et al., 2014). Researchers have revealed many positive influences in PBL delivery such as increase student participation, motivation, and enthusiasm with a deeper commitment to learning (Bunting, 2016). This research focuses on continuing these positive influences by seeking a deeper understanding of sound methods to improve PBL in PA education.

CHAPTER TWO: LITERATURE REVIEW

Overview

Educators are charged with delivering knowledge and skills to students to inspire and encourage behavioral change leading to student academic success in future educational experiences, careers, and in personal lives (Van Brummelen, 2002). Early education systems developed by Confucius, Plato, Aristotle, Aquinas, Erasmus, and many others were purposed to draw students to a deeper understanding of philosophy and biblical worldviews while including basic skills such as reading, writing, and mathematical reasoning (Gutek, 2011). Over time, educational philosophers advanced the practice of education by providing numerous theories on human development and learning to reach more students with improved pedagogies focused on retention, recollection, and application of knowledge and skills (Schunk, 2016).

The nature of this review is to provide the background for researching the implications of PBL curriculum on students' clinical knowledge and skills to better understand the problems and potential solutions within the pedagogy. In medical education, including physician assistant (PA) schools, learning theories and pedagogy have driven the trends towards active and applied learning of medical science requiring the development of critical thinking (Lewis & Thompson, 2017). Many medical education programs have incorporated problem-based learning (PBL) into their curriculum as a student-centered experience that allows for newly acquired knowledge to be reflected on, interpreted, critically explored, and applied towards an abstruse and complex problem (Ungaretti, et al., 2015). Although advocates for PBL curricula believe this inquiry learning of self- and peer-reflection serves to enhance student learning, there are researchers who still seek better understanding of the actual impact PBL has on student outcomes (Wardley et al., 2013). This chapter provides the reader with the theoretical framework, related literature, and

summarization to how the literature and framework support continued research on PBL in PA education.

Theoretical Framework

Research and theory are uniquely joined providing a vision of subject matter which guide researchers towards the method and questions which lead to further discovery (Hendricks, Applebaum, & Kunkel, 2010). This research study includes a theoretical framework from a social constructivism theory (Schunk, 2016), adult learning theory (Sanchez & Cooknell, 2017), and model theory (Seel, 2017). These theories guide the researcher's interpretive assumptions within the study to frame relationships, constructs of ideas, and formulate conclusions (Creswell & Poth, 2018). The study also includes conceptual framework, including the learning theories, curriculum development, guidance and standards, and outcomes related to PBL in PA education.

Social Constructivism

Applied research serves to inform readers to enhance decision-making on practical issues, understand behaviors and systems, and generate solutions to problems based on study outcomes (Tolley, Ulin, Mack, Robinson, & Succop, 2016). Social cognitive theory reveals how student and faculty perceptions relate to factors which affect behavior and learning outcomes (Gall, Gall, & Borg, 2007). In short, social cognitive theory examines a social perception of reality as related to variables affecting behavior opposed to several individual perceptions of these variables. The theory developed from scholarly work from philosophers, sociologists, and anthropologist such as Emile Durkheim, Max Weber, and George Herbert Mead, were instrumental in formulating this theory based on initial works on the sociology of knowledge (Hruby, 2001). The framework for this study will utilize this social cognitive theory to examine variables related to curriculum preparation, faculty training and facilitation, student preparation,

assessment methods, and overall learning process through a logical model analyzing goals, resources, activities and outcomes (Bickman & Rog, 2009; Al Buali & Khan, 2018).

Harnessing the nature of social cognitive theory, this applied research is guided by social constructivism where a richer understanding of real-world application of medicine can be modeled in a PBL curriculum (Creswell & Poth, 2018). The research will collect a foundation of experiential knowledge from faculty, student outcome instruments, and student surveys to enrich social dynamics and cognitive learning through implementation of processes supported by these findings. Much like the nature of PBL, this research will institute a community of participants to explore a process, provide feedback, and identify a plan of action for an optimal outcome.

PBL utilizes a constructivism theory of learning that Schunk (2016) described as discovery learning. He wrote that discovery learning provides minimal faculty guidance giving direction and support; however, allows students to "search, manipulate, explore, and investigate" to gain deeper levels of understanding for future application (Schunk, 2016, p. 333). Ongoing exposure to real-life scenarios and complex problems engages students' cognitive and creative processes preparing them for critical clinical thinking in their chosen profession (Prihatiningsih & Qomariyah, 2016). PA education espouses the recollection, analysis, retention, and application of information by a clinician to appropriately care for patients. The effectiveness of PBL in acquiring knowledge and skills for this purpose has been supported by neuroscience as it utilizes multiple aspects of cognition through a variety of processes that facilitate deeper learning (Schunk, 2016).

Adult Learning Theory

As this research study will examine a pedagogical approach in a graduate medical education program the researcher will consider the principles of adult learning theory. Adult

learning theory combines andragogy and self-directed learning ideologies to focus on

philosophies and motivations in adult learning (Sanchez & Cooknell, 2017). In terms of

historical context, adult learning theory is relatively a new concept. The initial work in adult

learning theory began in the field of organizational development and through the work of

educator and researcher Malcolm Knowles (1974, 1984; as cited in Kenner & Wienerman,

2011). Knowles' work prompted educators to examine the differences in characteristics between

traditional and non-traditional adult learners providing a deeper look at the theory behind how

the two groups of students learn. Throughout the decades of research after Knowles',

researchers have discovered methods to optimize learning based on student experiences,

motivations, and maturity (Kenner & Wienerman, 2011).

Andragogy examines the notions of how adults optimally learn (Chikotas, 2008). This

theory posits that adult learning is enhanced in a problem-based, collaborative environment

where the adult students have ownership of aspects within the planning, execution, and

evaluation of the instruction (Halalau, Falatko, & Mi, 2016). This theory is based on the

assumptions of self-concept, the learners' experiences, motivation to learn, and the learning

orientation (Leigh, Whitted, & Hamilton, 2015). In examining a PBL approach in PA education,

each of these assumptions should be weighed in the analysis of variables within the diverse adult

student population.

Because of the diversity of an adult student population within a graduate level medical

program, such as PA education, many of the commonly associated learning theories should all be

taken into account. Adult learners present with varying psychosocial and demographic

backgrounds which should be understood to identify methodology to enrich the learning

experience (Rashid, 2017). These students bring significant life experiences, willingness to

learn, and high expectations met best with experiential, collaborative learning (Sanchez & Cooknell, 2017). Many of adult learning theories principles are supported in social cognitive, reflective practice, transformative learning, experiential learning, and situated learning theories (Rashid, 2017). This applied research study will consider data from both faculty and student sources which will incorporate adult learning theory where offering a mutually respectful climate, collaborative planning and execution, and experiential objectives offer optimal results.

Model Theory

Model theory provides a path to deeper understanding of knowledge as employed in practical application. Through model theory, researchers are able to ascertain the implications and impacts of a phenomenon through a basic representation of observers on a given sample of the phenomenon (Seel, 2017). Model theory, developed for utilization primarily in mathematics through the ongoing development of Lowenheim's theorem (Badesa, 2008) and Schroder's Theory of Relatives (Badesa, 2008), has been adapted for use in other fields to demonstrate contributions of logic and philosophy towards overall outcomes (Arazin, 2016). This theory has also been incorporated into fields of science and art research where finite systems or problems may be analyzed with infinite possibilities for solutions (Gilkey, Karousou, & Ornat, 2016). Simply stated, model theory provides a template of relationships where, "to an observer B, an object A* is a model of an object A to the extent that B can use A* to answer questions that interest him about A" (Minsky, 1965, p. 45, as cited in Seel, 2017). This theory may be applied to dissect the effectiveness of outcomes measurement in PA education by examining the methods of assessments. As an example, in PA education, MCQ assessments are used to model the knowledge and skills required in clinical practice; however, people do not present to clinicians with a list of answers and distractors to select from. Therefore, the concept of presenting a

reflective model which applies in discovering which pedagogical and assessment approaches appropriately introduce clinical knowledge and skill to the intended outcomes related to critical thinking in clinical practice.

Model theory draws relationships between subject matter, where model structures represent the reality of all equivalent subject matter, and the components of that subject matter which draw connections between the model and the potential within the components on the subject (Kment, 2016). It correlates the relationships in PA education pedagogy and assessments by equivocally connecting the practical applications with the academic processes. This theory utilizes object-language representations through mathematical analysis to draw relationships between relevant logical variables within a system of first-order effects (Arazim, 2016; Kment, 2016). An example of this theory in a non-mathematical application:

> This can be illustrated with the example of globes as models of the earth…the globe is not a reduced earth but rather should give answers to particular questions asked for the location of different places or for distances between places on earth. With regard to the chemical composition of the earth, a globe is not significant. (Seel, 2017, p. 933)

In this applied research, the author will examine PBL at a small university in eastern South Carolina. Social cognitive theory will guide the researcher's understanding of the insights provided through the collection of faculty and student experiences in PBL. Recognizing the implications provided through adult learning theory, these experiences may be measured against the andragogy of optimal adult learning in a collaborative environment. Through data collection from relevant, logical sources analyzed against the variables for student learning outcomes, model theory will guide the researcher through potential solutions of real-world application of the phenomenon of PBL in PA education. Each of these theories will serve as a foundation for

building deeper, richer meaning to shared experiences in PBL giving contextual data towards developing potential solutions in improving PBL to enhance student academic performance.

Related Literature

The physician assistant (PA) career field began in 1967 at Duke University when Dr. Eugene Stead trained four prior United States (U. S.) Navy Corpsmen as adjuncts to an overburdened healthcare system (Coombs & Pedersen, 2017). Since that time, PA education programs have grown into the model seen across the U. S. where students traverse two distinct phases of education, a didactic phase where students learn in a formal school structured setting through a multitude of pedagogical practices and a second phase internship style education rotating through multiple medical subspecialists gaining instruction from physicians, PAs, nurse practioners, or other health care specialists (ARC-PA, 2019). Upon completion of the program, graduated students' learning achievement is measured through the PANCE (NCCPA, 2018). Although there are many methods for information delivery in the didactic phase, finding the most efficacious pedagogy continues to be researched.

The related literature in this review provides the reader with a foundation of understanding of PBL and PA education. The available research provides a knowledge base future researcher may be built upon (Joyner et al., 2013). The review will build on the previously mentioned historical and pedagogical context through research on PBL integration in medical school and PA education. The data and conclusions offered by previous researchers provides insight into PA education curriculum design and delivery, learning outcomes, and predictors of PA student success. Understanding these concepts provides the reader with insight into the current issues in PBL and PA education while identifying PBL's role in PA students'

academic success. The following review of related literature also examines previous

researchers' strategies in addressing issues in PBL and identifies potential for further study.

Problem-Based Learning in Medical School Education

Traditional medical school education was first introduced by Abraham Flexner in 1908 as

the result of research posed by The Carnegie Foundation for the Advancement of Teaching

(Parkhurst, 2015). Prior to 1908, medical education consisted of two years of basic medical

science followed by two or three years of preceptorship; however, as the need for physicians

grew and the preceptorships declined, a need for reform was revealed (Slawson, 2012). It was

not until 1899 that Doctor William Osler introduced medical students to hands-on education

allowing students a more active learning experience in medical school (Ungaretti et al., 2015).

Flexner proposed changes in the foundations of medical school education that included two years

of medical science follow by two years within clinical settings that ensured structured education

guided by teaching faculty physicians (Parkhurst, 2015). This century old academic paradigm

has continued throughout the years and is still being utilized in medical education today.

The concept of PBL in U. S. medical school academics was first introduced at Case

Western University in the mid-1950's (Prihatiningsih & Qomariyah, 2016). In 1969, at

McMaster University in Canada, PBL was expanded as a pedagogy within medical education

through newer innovative theories (Ungaretti et al., 2015). After 70 years of education utilizing

traditional lecture in medical education, the bridge between practical application and classroom

instruction was built. This approach brought education theory to medical schools to develop

clinical reasoning skills, improve hypothetico-deductive reasoning, and the application of basic

science and clinical knowledge (Ju & Choi, 2018). These programs included the application of

scientific knowledge into practical settings. PBL was implemented where students would learn

in small groups, studying real patient problems with simulated patients or patient actors to introduce students to a systematic approach to patient management (Ungaretti et al., 2015).

Sweeny (1999) wrote about the developmental constructs that lead to instituting problem-based learning in 1969. He identified three key revolutions in medical education that progressed medical education into the use of problem-based learning. Sweeny (1999) referenced these key revolutions as the Flexnor report of 1908, the occurrence of a case-based strategy used at Case Western Reserve University in 1952, and the formal introduction to problem-based learning by McMaster University in 1969. Each of these developments in medical school education progressed academic delivery of medical science into practical application. Johnson and Finucane (2000) identified pioneers in medical education through initiatives that began at the School of Medicine at McMaster University in Canada in 1969 and the implementation of PBL in the Harvard University Medical School's "New Pathways" curriculum in 1985 (Johnson & Finucane, 2000). These academic innovators at the time forged a path for continued delivery of medical knowledge through problem-based pedagogy.

Theories. Sweeny (1999) also wrote about the utility of problem-based learning, its problems, acquisition concepts of basic science, as well as the development of outcomes and learning objectives. The development and incorporation of problem-based learning in medical education through several iterations over decades was founded on uniting the science of medicine into the practice of medicine (Svinicki, 2007). Each of these concepts, science and practice of medicine, are intertwined and are both critical to sound medical practice. Johnson and Finucane (2000) identified key educational objectives in early problem-based learning curriculum such as the Barrows (1983, as cited by Johnson & Finucane, 2000) objectives that addressed some of the perceived problems with traditional medical education objectives. These

perceived problems included students lacking the ability to apply the didactic knowledge of medical school practically in clinical scenarios (Johnson & Finucane, 2000). Therefore, after almost 100 years of medical education, researchers identified that students lacked clinical acumen despite being taught the science of medicine. Svinicki (2007) also recommended continued research in the development of expanding curriculum options in PBL to determine how and why it has become advantageous in progressing medical education. All of these pioneers in PBL implementation all concluded that there were critical thinking skills that need to be uncovered in medical education that could not be taught in the traditional manners.

Moving forward. The early pioneers in PBL understood that the development of a differential diagnosis, diagnostic strategies, and treatment planning were skills that needed to be honed outside the traditional lecture-based instructional paradigm. Ju and Choi (2018) researched the expanding curriculum theories including the use of hypothesis driven argumentation and deductive reasoning as skills bolstered in PBL. The development of the pedagogy has shown that an essential identification of what reasoning strategies or problem-solving processes are delivered in PBL and to determine where argumentation and deductive reasoning apply in training students for clinical practice (Ju & Choi, 2018). The practice of medicine goes beyond memorization and recollection of data, it should also include how this data is applied towards a patient presentation. The application of PBL has been cited as the "most significant innovation in the past 35 years" (Jindal, Mahajan, Srivastav, & Baro, 2016, p. 77). The use of PBL in medical education has bridged gaps between classroom learning and application of knowledge; however, the same pedagogical practice in PA education has not been proven as effective towards ensuring academic success.

Physician Assistant Education and Problem-Based Learning

Dr. Stead's model for PA education at Duke University was based on the preexisting medical training each of the inaugural students honed through their service as Navy corpsmen (Coombs & Pedersen, 2017). PA education has continued to be modeled after Flexner's medical school structure where initial training in basic medical science is later supported through formal clinical education in the field (Parkhurst, 2015). Although PBL was implemented into medical school academics the mid-1950s, it was not brought into PA education until 1997 at Chatham University and has been a dominant curricular foundation since 2003 at Southern Illinois University, University of New Mexico, and Western Michigan University (Hawkins et al., 2018). Much like medical school, PA education paradigms were focused on a traditional didactic structure for knowledge delivery. The Physician Assistant Education Association (PAEA) (2016) surveyed 209 U. S. PA programs and discovered that six programs utilized PBL as a primary pedagogy and 94 programs utilized a mixed problem- and lecture-based curriculum. Therefore, less than half of the PA programs in the U. S. utilize a pedagogy where science and theory are bridged with practical application.

Most PBL curriculum advocate for learning in a group setting where multiple students collate knowledge, skills, and experience to derive possible solutions to complex problems where there is no one correct answer (Zahid et al., 2016). Group activities provide a forum for students to share cognitive abilities based on their preferential learning styles. Cuevas (2015) wrote about the concept of learning styles and how different people process data based on preferences for visual, verbal, logical, kinesthetic, interpersonal, intrapersonal, musical, and naturalistic intelligences. In PA education, PBL offers students the opportunity to learn through shared discovery and enhance critical thinking across a variety of learning styles. In this environment,

students are able to draw on previous experiences, knowledge, and insights to apply information through self-directed discovery and peer guided discussion improving overall acquisition and application of curricular data for improved recollection in professional application (Prihatiningsih & Qomariyah, 2016; Ungaretti et al., 2015; Hawkins et al., 2018).

Physician Assistant Curriculum Design and Delivery

The curriculum for any educational program, being the total of all learning experiences, should be well planned, lay out specific learning objectives, outcomes, and assessments, identify the purpose and values for the program or coursework, and support the mission and vision of the program and institution (Parkay et. al, 2014). Curriculum may be influenced by multiple stakeholders, including institution administration, governmental oversight, and professional organizations. In physician assistant education, the curriculum content is influenced by professional organizations, the Accreditation Review Commission on Education for the Physician Assistants (ARC-PA), the National Commission for the Certification of Physician Assistants (NCCPA), and the American Academy of Physician Assistants (AAPA) (Coombs & Pederson, 2017). This section will examine the standards and guidance that provide the skeleton for PA curriculum, the traditional approaches to design and delivery, and the integration of PBL into PA curriculum.

Standards and guidance. The ARC-PA (2018) provides standards for curriculum development and delivery which must be met to attain accreditation. For physician assistant education program graduates to become certified, and then to obtain state licensure, students must graduate from an accredited program and pass the Physician Assistant National Certifying Examination (PANCE) (NCCPA, 2018). The AAPA (2012) provides physician assistant educators with the *Competencies for the Physician Assistant Profession* which identifies the

knowledge, skills, and behaviors required for practicing PAs. The NCCPA (2018) offers PA

educators a blueprint of content assessed by the PANCE for implementation into curriculum

design. This blueprint of organ systems and clinical skills provides educators a foundation for

the knowledge and skills that are required within the curriculum to guide students towards

passing their national certification examination. The ARC-PA (2018) standards instruct PA

education programs on the foundations of curriculum including the inclusion of instruction

which promotes problem solving, medical decision making, and collaboration in

interprofessional teams. This guidance sets a tone for the PA education process; however, the

manner for which each PA program employs this guidance within the curriculum structure is

unique to each program. The curriculum standards mandate the use and publication of learning

outcomes, objectives, assessments, and they instruct that course content and student learning

experiences cover the material provided in the *PANCE Blueprint* and *Competencies for the*

Physician Assistant Profession (ARC-PA, 2018). The strategies and methods for developing and

delivering this content is left to the discretion of each program.

Traditional curriculum design and delivery. In 1967, four prior United States Navy

corpsmen became the first graduates of Doctor Eugene Stead's program creating physician

assistant as a profession (Coombs & Pederson, 2017). The initial curriculum design, modeled

after medical school's two years of classroom instruction and two years of clinical experience

was abbreviated into a two-year program consisting of a year of didactic training and one year of

clinical training (Parkhurst, 2015). The physician assistant profession has been modeled after

medical school curriculum since. The didactic phase of PA education's curriculum has

traditionally been a lecture-based learning (LBL) experience with a faculty centered pedagogy

mixed with scientific laboratory study (Loftin & West, 2017; Parkhurst, 2015). This initial year

of PA education it structured to deliver the scientific medical information students will need to apply in the clinical year of training as they enter a supervised practical experience. Often in PA education, the first actual encounter with application of principles takes place during clinical rotations, leaving the first phase of training to classroom learning through an LBL pedagogy.

LBL focuses on the delivery of information by a teacher exhorting information to a class of students. This is the traditional educational approach where the lecturer provides information to a passive learner. In PA education, students are expected to develop understanding of concepts, facts, and theories delivered by the teacher and can retain and recall that information utilizing critical thinking skills through a series of anecdotes, readings and discussion (Smith, 2014). LBL utilizes traditional learning theories such as information processing theory. One of the keys in information processing theory is the concept of attention. Attention is the "concentrated mental activity that focuses on a limited amount of information in sensory memory and working memory" (Schunk, 2016, p. 173). Midlay and Coryell (2010) document research that shows with LBL attention becomes lost after the first 10 to 20 minutes of lectures. Smith (2014) confirms that attention span typically lasts 10 minutes in LBL. This has led some to describe LBL as "death by PowerPoint" or "chalk and talk" (Midlay & Coryell, 2010, p. 39). LBL has been a main staple in education pedagogy since the earliest record of teaching. It is a valuable approach to teaching especially theory and fundamental knowledge and skill; however, it often lacks the dynamics of application of data.

The traditional PA curriculum design has been comprised of the standardized knowledge and skills mandated by professional organizations such as the NCCPA, ARC-PA, and AAPA. The lecture-based pedagogy used to deliver information centered around a cognitive learning theory where students were asked to learn principles, generalizations, and categories of medical

information needed in clinical practice (Parkay et al., 2014). Unfortunately, appropriate

employment of this knowledge may require students to have obtained the information in a

manner suited for application in daily clinical settings (Parkhurst, 2015). As an example, people

may read about inflection, tone, rhythm, and volume when studying music; yet to appreciate

these qualities to the fullest extent, a person must hear the music for themselves. This revelation

brought researchers towards discovery of new and innovative pedagogies and curriculum design

where knowledge and skill were presented in a more meaningful way supporting improved

cognition and application in real-world practice (Blundell & Berardi, 2016). PBL provides one

such example.

     Problem-based learning curriculum. PBL is a pedagogical practice where students

identify a problem, explore that problem in student groups facilitated by experienced faculty, and

utilize critical reasoning skills to derive a desired outcome (Midla & Coryell, 2010). The

concept of PBL is not new to education, although it has only recently gained traction in medical

education. PBL is thought of as student-centered education utilizing a case-study approach to

learning to develop scientific theory into clinical practice. Further, PBL "adopts a problem-

solving approach and goes beyond rote memorization and simple acquisition of knowledge

attributed to the traditional didactic lecture-based teaching" (Zahid et al., 2016, p. 181). In most

PA education programs, PBL utilizes a team-based approach where students work through

clinical vignettes. Students use prior knowledge and expand on that knowledge utilizing group

and individual research to develop differential diagnosis, diagnostic testing plans, treatment

plans, and preventative measures in an active-learner setting (Zahid et al., 2016).

     PBL is formulated on social constructivist ideology where individual learning takes place

through cooperative activities providing cognitive, social, and emotional learning which deepens

retention, recollection, and real-life application (Hang et al., 2015). Student-centered learning, through faculty facilitation of complex issues, allows students to collate data and construct knowledge in an environment that models real-world application (Schunk, 2016). Students may be presented a patient vignette, or have an actor play the role of a patient, then using the fundamental knowledge of medical science, apply critical reasoning to develop a diagnostic plan, assessment, and treatment plan based on the "real-life" scenario.

Research on this framework examined variables in differing curriculum designs and pedagogical practices to understand student perceptions of learning and discovered that students approached learning from a more positivistic mindset with student-centered learning (Haber-Curan & Tillapaugh, 2015). In a PBL enriched curriculum, students, through faculty facilitated groups, may explore the collaboration of theory and science with life application and interpersonal relationships. Students who performed group activities that were problem-based and student-centered built a stronger cognitive rapport, were better able to apply information, and were more adaptive to changing dynamics in application of knowledge and skills (Haber-Curan & Tillapaugh, 2015).

Although the theories and framework support improved application of cognitive and social knowledge through PBL, measuring student outcomes was revealed as a concern discovered through the review of research on problem-based learning. Research in PA education supported the theoretical implications of application in PBL; however, evaluation of student performance on standardized multiple-choice question (MCQ) examinations in PA education did not support the concept that cognitive knowledge base was improved (Wardley et al., 2013). Examinations modeled from the PANCE, based on content from the *PANCE Blueprint*, and found that knowledge acquisition through PBL design was significantly improved in only one

organ-system subset (Wardley et al., 2013). This was contradictory to information in literature related to medical school programs. Literature on medical school outcomes indicated findings that students trained in a PBL-based curriculum "performed significantly better than the didactic lecture-based curriculum students" (Zahid et al., p. 184). Zahid et al. (2016) wrote that a PBL curriculum improved clinical competencies without negatively impacting theoretical knowledge learning. As PA education is modeled after medical school academics, the discrepancy between objectives and assessment through the use of PBL prompts questions about how PA application of PBL may be improved to meet the same assessment results as found in medical school education.

Student Learning Outcomes

Student learning outcomes (SLOs) drive the curriculum design by providing the content, expectations, values, and purpose of discovery and application of knowledge (Schunk, 2016). PA education programs determine unique SLOs by applying the previously mentioned ARC-PA, AAPA, and NCCPA guidance (ARC-PA, 2018). PA programs may also structure curriculum content and delivery on Bloom's Taxonomy based on the higher-level cognitive learning required to acquire and apply information (Nilson, 2016). As clinical practitioners, development of outcomes based on higher-level cognition may give future PAs a greater advantage in practice through heightened critical thinking. PA education outcomes, structured around these principles and guidelines, consist of two subsets, knowledge and skills acquisition (Wardley et al., 2013). Therefore, SLOs may be best achieved through multiple educative theories including behavioral, cognitive, and constructivism in the context of a LBL and PBL pedagogical approach. Employing PBL as a method of design enforces these theories by encouraging learners to

research, integrate theory and application, and develop situational understanding of concepts that lecture-based methods do not espouse (Sroufe & Ramos, 2015).

Educators should assess the SLOs that are best influenced by a PBL curriculum and which are best taught through traditional methods. Kassab et al. (2016) researched concept mapping as a tool for discovering content best influenced by PBL. These authors wrote that mapping scores for observed knowledge and skill attributes in subject matter areas revealed variations based on students' knowledge base not specific content (Kassab et al., 2016). Therefore, it may be discovered that the fundamental medical sciences are best taught through traditional methods and then enhanced through PBL, and clinical reasoning, critical thinking, interpersonal relations, and application of the fundamentals are optimized through PBL. Wardley et al. (2013) concluded that there were areas in a PA curriculum where student performed better in only a select subject matter area in PBL but found no significant difference in the majority of areas when assessed using standardized MCQ instruments. These findings lead this author to question the appropriateness of assessment methodology against the expected SLOs. Sroufe and Ramos (2015) researched PBL curriculum in a graduate business program and concluded that there were cross-discipline benefits in knowledge integration and application; however, the knowledge acquisition was not significantly influenced. Therefore, the utilization of PBL, showing promising impact in some areas of academia, may significantly impact all areas of learning, and not all assessment instruments may be appropriate to measure specific SLOs which are related to knowledge integration and application.

The practice of medicine carried out by medical doctors and PAs requires more than rote memorization of concepts and theoretical knowledge but also the application of these principles in real-world patient-care scenarios (Smith, 2014). PA educators train students to use medical

knowledge and evidence-based practices in treating patients. This author has revealed to students that the practice of medicine should center around the treatment of patients and not diseases. The anatomic and physiologic insult of a disease or injury affects the patient; however, the application of knowledge and skill related to the insult treats the patient. Although PBL has not been shown to significantly improve knowledge acquisition, it has not negatively affected acquisition either (Wardley et al., 2013). Therefore, the use of PBL should be matched appropriately to the SLO and assessed accordingly (Blundell & Berardi, 2016).

Direct assessment. Understanding the efficacy and efficiency of an educational system, program, or curriculum requires assessment (Banta & Palomba, 2015). The NCCPA measures PA graduates' acquisition and application of knowledge and skills through the PANCE, an MCQ instrument organized by organ systems knowledge and clinical skills (NCCPA, 2018). This instrument serves as a direct assessment of knowledge and skill where the student must demonstrate competencies laid out in specific SLOs (Banta & Palomba, 2018). PA students must be able to apply knowledge of scientific facts and theories, patient presentations, and diagnostic reasoning within the construct of a question thread given a set of possible answers. Direct methods have been used to measure medical education in many fields such as the National Board of Medical Examiners (NBME) Parts I and II exams, the PANCE, and the U. S. Medical Licensing Examination (USMLE) (Wardley et al., 2013). However, as the methods of instruction and the understanding of learning progress, the measurement instruments have not.

These assessment instruments measure cognitive level of knowledge, or factual information, recall and recognition, and comprehension with minimal effectiveness in measuring depth and degree of application which the information may be used (Zahid et al., 2016). PAs are required to have these cognitive levels of understanding but are also accountable to apply this

information clinically to treat patients. Unfortunately, in medicine, patients do not always

present illnesses and injuries reflective of the manner it is presented in texts requiring the

clinician to apply medical information across a wide spectrum of possible vignettes (Korin et al.,

2014). The need for critical thinking in applying medical knowledge facilitates the need for

direct measure of knowledge; however, the assessment of clinical thinking application may be

better served through the addition of indirect assessments along with the direct assessments

(Burgess, Roberts, Ayton, & Mellis, 2018).

     Physician assistant assessment tools. As previously mentioned, the PANCE is the final

assessment PA education program graduates must successfully complete as a condition of

certification and licensure (Massey, Stallman, Lee, Klingaman, & Holmerud, 2011). The

PANCE is a 300 MCQ assessment instrument which is created or revised every five years

through a peer reviewed process of practicing PAs and physicians who work with PAs (NCCPA,

2019). This instrument assesses knowledge and skill in two categories, medical content and

clinical tasks (NCCPA, 2019). As successful completion of the PANCE is a requirement for

licensure and certification, it is considered a high-stakes exam where PA education programs'

accreditation becomes reliant on pass rates (Butina, Wyant, Remer, & Cardom, 2017). The ARC-

PA requirement for continued accreditation requires that 85-percent of graduates pass the

PANCE as first-time test takers (ARC-PA, 2018).

     A standardized assessment tool often used in PA education to assess student outcomes

and predict PANCE success is the Physician Assistant Clinical Knowledge Rating and

Assessment Tool (PACKRAT). The PACKRAT is a 225-MCQ assessment instrument written

primarily in vignette format based on a two-dimensional blueprint based on tasks and content

areas (PAEA, 2019). This assessment instrument was introduced to PA education over 20 years

ago to aid students in discovering deficiencies in knowledge areas where more focus was needed (Cavanagh, Lessard, & Britt, 2015). This instrument is an optional standardized instrument provided by the PAEA which has flourished in not only meeting the initial intent of guiding student studies but also in aiding educators in predicting PANCE success (Cody, Adamson, Parker, & Brakhage, 2004; Higgins et al., 2010; Shallenberger, Hutchinson, & Hill, 2006). Although it is an optional instrument, many PA programs utilize this assessment opportunity to provide students and program administrators with better understanding of student achievement.

Indirect assessment. Indirect assessments require students to provide reflection and insight into their learning experience by providing educators feedback on what they have learned rather than demonstrating knowledge and skill (Banta & Palomba, 2015). Indirect assessments through focus groups, surveys, personal interviews, and personal reflection reports have been used by researchers to assess clinical knowledge and skills in a PBL curriculum (Haber-Curran & Tillapaugh, 2015; Loftin & West, 2017). PBL curriculum provides students opportunities to develop skills, using theoretical knowledge and evidence-based medical practice, that are enhanced through behavior and attitude as much as cognition (Ungaretti et al., 2015). Because of the inclusion of behavior and attitude, indirect assessment may provide a more thorough examination of student learning, perceptions, and potential. These behaviors and attitudes may be assessed effectively with indirect measures empowering students to identify areas of improvement and validate discovery of clinical acumen (Banta & Palomba, 2015; Ungaretti et al., 2015). PA programs may choose indirect assessments to gain insight into the critical thinking, interpersonal dynamics, and areas for future improvement with each PBL session through reflection and informal focus group discussion within the PBL groups.

Predictors of PA Student Success

The literature provides significant resources for understanding the fundamentals of PBL,

PA education curriculum and instructional design, student learning outcomes, and measurement

of learning outcomes. The research also offers educators insight into variables to consider that

influence student outcomes and assessment results. These variables include grade-point

averages, PACKRAT exam scores, prior medical experience, Graduate Record Examination

(GRE) scores, and end-of-rotation examination results in the clinical phase of training (Butina et

al., 2017; Honda, Patel-Junankar, Baginski, & Scott, 2018; Massey et al., 2015; Massey et al.,

2011).

Grade-point averages. Grades are used to measure student outcomes, then averaged

across coursework to establish a grade-point average to quantify student overall achievement at

an institution as data used in making decisions about academic supports, access to educational

systems, or as a predictor of future academic success (Allensworth & Luppescu, 2018).

Researchers have examined the impact of undergraduate grade-point averages (GPAs) and PA

education GPAs as predictors of success on the PANCE (Butina et al., 2017; Honad et al., 2018).

Much of the research into GPA as a predictor of PA education success has been focused on

admission variables dividing prerequisite coursework and overall undergraduate GPA. There

have been various conclusions reported regarding a correlation between GPA and PA student

success; however, the literature has revealed authors' reporting a significant correlation between

undergraduate, pre-PA education GPA and overall PANCE scores (Higgins et al., 2010; Honda et

al., 2018). Brown et al. (2013) reported contradictory results where these authors found no

correlation between undergraduate GPA and PANCE outcomes. Honda et al. (2018) wrote that

the discrepancy in previous studies may be associated with variations in the quality of undergraduate programs or institutions.

Although predictors of success are important for program admission, there should also be an understanding for program administrators and faculty on what may predict success once students have matriculated into the PA education program. Researchers have included PA program GPA as variables within the predictive scope for PANCE success (Buntina et al., 2017; Honda et al., 2018). Within this literature, no concrete conclusions regarding PA program GPA and PANCE success was revealed. Assumptions for the lack of correlation between PA education GPA and PANCE scores include a cohort factor, as students are matriculated through the program in cohorts, as well as previous student core science or medical experiences being varied (Honda et al., 2018). The undergraduate, or pre-PA program, GPA may have been obtained through students selecting optimal course loads, class schedules, and professors as well as examining the variations in institutional grading practices. The PA program GPA does not allow for these variables as students matriculate and progress through the program courses in cohorts without the individualization allowed in undergraduate education. With these considerations, future studies may be warranted on the use of program GPA as a predictor of PANCE success.

Prior medical experience. Admission to PA education is a competitive process where prerequisite requirements often include prior medical experience (Brown et al., 2013). A review of literature into PA education predictors of success did not reveal large amounts of data related to studies on students' medical experiences prior to matriculation into PA education. The literature available does not support this facet of admission criterion as significant in predicting PA student or PANCE success (Honda et al., 2018). There are opinions regarding prior medical

experience as a prerequisite for admission with one thought that students may have had varied experiences with improper examples or learned inappropriate information or skills which creates a challenge in change, and another thought that students will build on their prior experiences with faculty facilitation. Unfortunately, more research may be required to gain a deeper understanding of how prior medical experience affects outcomes.

PACKRAT exam scores. As previously mentioned, PACKRAT scores have been included as a statistically significant indicators of success on the PANCE (Gietzen et al., 2018; Massey et al., 2015; Massey et al., 2011; Rizzolo et al., 2018). One author identified a measured correlation coefficient between PACKRAT and PANCE performance at 0.602 and 0.744 (Muma & Wilson, 2006, as cited in Massey et al., 2011). In a study of predictors for PA student success, including GPA, Graduate Record Exam (GRE) scores, PACKRAT scores, and non-cognitive factors, "scores on the PACKRAT were consistently the best predictors of performance on the PANCE" (Higgins et al., 2010). This research strongly supports the use of PACKRAT exam scores as predictors of PANCE success. These exams offer students and faculty the ability to gauge current student achievement and predict future outcomes success. These exams are optional, may not be used for academic grading purposes, and provide a statistically significant relationship to PANCE outcomes. The limiting factor for these exams may be seen fiscally, as there is a charge for each exam, and the time required to administer the assessment.

End-of-rotation exam scores. The ARC-PA accreditation standards for PA education programs require formative evaluations for students in the clinical year of training (ARC-PA, 2018). At the end of each clinical rotation, students are given an assessment instrument which represents the student learning outcomes for that rotation (Massey et al., 2011). Many PA education programs have chosen to utilize the PAEA end-of-rotation exams as their formative

clinical rotation examinations for the seven core rotations (Massey et al., 2015). As educators must assess student outcomes at the end of each clinical rotation, the burden of creating an assessment for each rotation is deferred to the PAEA by utilizing their exams. The PAEA's end-of-rotation exams are standardized MCQ instruments which created by a development board of subject matter experts and psychometricians who review each assessment item for reliability and validity (Rizzolo et al., 2018). Although not initially designed as a predictor for PANCE success, the PAEA's end-of-rotation examinations have been shown to significantly correlate with PANCE scores (Gietzen, Roman, & Hegmann, 2018; Massey et al., 2015; Massey et al., 2011). Authors of a study on the reliability and validity of these exams wrote, "The good reliability of the 7 End of Rotation examination scores and the significant and generally strong correlations of the examinations with and outside 'gold standard' (PANCE) (Gietzen et al., 2018). The only potential limiting factor for program utilization of these exams is the expense, as the PAEA charges for each students' exam with each rotation.

Although GPA, prior medical experience, PACKRAT and end-of-rotation exam scores have all been implicated as indicators of PANCE success, the underlying premise of knowledge and skill acquisition in PA education should be optimally established to build upon student experiences leading to academic success. This applied research study examines the implementation of PBL as a strategy for this knowledge and skill acquisition measured through GPA, end-of-rotation exams, the PACKRAT, and finally the PANCE.

Current Issues in Problem-based Learning

PBL provides a pedagogical approach to education outside of the traditional lecture- and lab-based curriculum delivery. Smith (2014) wrote about the benefits of adult learning theory implementing active learning strategies such as PBL that heighten student engagement, increase

learning motivation, and develop stronger critical thinking skills. Although these positive

attributes have been revealed by many researchers, PBL strategy weaknesses have also been

revealed. PBL weaknesses include resource consumption, organization of material and student

groups, and difficulty with assessing student outcomes.

Resources. Educator resources related to time, faculty availability and training, and

technology are often a source of concern within a PBL curriculum. The challenges in the time

requirement for creating PBL cases, faculty participation, and effectively using technology for

effective PBL implementation can create barriers for educators who aspire to integrate this

student-centered pedagogy (Al Buali & Khan, 2018).

Time. The increased time requirement for educators to generate PBL content and

facilitate group discussions can be a burden on an academic program (Gillette, 2017). Additional

time is required to create unique case vignettes, prepare student actors if used, and prepare

faculty for potential questions or concerns that may be presented with each case. Unlike

traditional lecture settings, where one lecture is presented to each student, PBL often uses a

variety of cases across multiple student groups. This requires faculty facilitators to prepare

several real-life scenarios, including diagnostic study results, for each student group.

Faculty are not the only people who face challenges with PBL. Students in a qualitative

research study on PBL in nursing education reported it was "only moderately effective, time

consuming, and stressful" (Yuan et al., 2011; as cited in L'Ecuyer, Pole, & Leander, 2015).

Developing and facilitating PBL coursework, student synthesis and application of knowledge,

and the discovery process in PBL inherently takes more time than traditional LBL where

students and facilitators have noted a difficulty finding the balance between sufficiently covering

the course content with the time allotted to properly execute a PBL dynamic (Dunsmuir,

Frederickson, & Lang, 2017). Time is only one resource concern in PBL, along with the students, teaching faculty are leading resources in any academic institution.

   Faculty. Effective implementation of PBL requires sufficient faculty to facilitate group discussion activities. The facilitator role is to ensure that learning outcomes are identified while stimulating and guiding discussions without serving as a source of information (Prihatiningsih, & Qomariyah, 2016). Faculty should be prepared to entertain a wide range of questions and expect students to be more inquisitive than in traditional lectures. Burgess et al. (2018) wrote that one facilitator may be responsible for several groups of up to 100 students which does not reflect an effective ratio for facilitated guidance. Ideally, student groups should have ten students or fewer to facilitate small group dynamics and improve learning. AlBuali and Khan (2018) recommended that for a class of 200 students, 20 faculty facilitators would be required. Many PA programs are not staffed with the number of trained facilitators to meet this burden.

   AlBuali and Khan (2018) also wrote that along with the proper student-faculty ratio, facilitators in PBL education must be properly trained in case- and team-based activities where the student-faculty ratios may be increased slightly. Facilitators in PBL group activities must be subject matter experts appropriate for content congruency with the PBL learners; therefore, the facilitators should not be from varying fields of study being experts not only in PBL facilitation but also in medical practice (Prihatiningsih, & Qomariyah, 2016). It would not provide optimal facilitation to utilize faculty from the English or Math departments in PA PBL courses even if they were expertly trained in PBL facilitation within their field of study. Facilitators should be experts in their medical practice and PBL facilitation. In a retrospective research study, experience level of facilitators on student outcomes in PBL for PA education obtained data from 47 PA students and evaluated all of the MCQ and patient management problem (PMP) scores for

the cohort for the year. Six facilitators were involved in the education program, three faculty were classified as experienced and three facilitators were novice in PBL. These authors resulted that there were significant differences in student outcomes based on experience level of the PBL facilitators (Hawkins, Hertweck, Laird, Seckhon, & Kortyna, 2007).

The conclusions Hawkins et al. (2007) reported were supported by Midla and Coryell (2010) who also studied facilitator influences in PBL through a qualitative study with inquiry as to the types of preparation needed for facilitators of PBL pedagogy in PA education. Their research evaluated preparation of PBL facilitators in order to improve student outcomes. They identified the participants by demographics and experience level, and they interviewed them using a semi-structured, open-ended verbal interview. Although the study was focused on preparation for facilitators, only one theme identified a variable that may be considered preparatory. The major themes included factors and prior experience that supported PBL, professional PBL training for new facilitators, and ensuring students are well versed in the PBL process. Further study was indicated to explore other methods of preparing PBL facilitators to improve student outcomes. Therefore, these researchers have all revealed that faculty facilitation, and the training for this facilitation, are vital in providing a quality PBL experience to students.

Technology. Technological advances have permeated all aspects of life including academia; however, research reveals the professional development and proper utilization of technology in pedagogical practice is lacking (Dysart & Weckerle, 2015). In medical education, particularly PBL, the use of technological adjuncts is often either under represented or not effectively utilized (AlBuali & Khan, 2018). The use of high-fidelity patient simulators, computer-generated patient scenarios, simulated electronic medical records, audiovisual

recording adjuncts, and telemedicine technologies are some examples of the resources available to educators. Although there is a plethora of technological resources available to educators and students today, many PBL programs have not implemented or not fully realized the potential for improving curricular design and delivery through technology (Miles, Lee, Foggett, & Nair, 2017). The lack of implementation of technology may be due to the time burden previously mentioned, is intertwined in the faculty training deficiencies, or is not a fiscally prudent investment which institutions are willing to invest.

        Organization. Designing and implementing a PBL curriculum can be a difficult process including specifying roles, designing activities or vignettes, and executing an active dynamic process allowing for student discovery learning (Wang et al., 2016). PBL breaks the traditional mold of education which is largely influenced through lecture and individual study (Smith, 2014). As mentioned, creating the activities, or clinical vignettes, may be time consuming and require significant thought and planning to execute effectively. The facilitation of group activities may also require creative processes to ensure open dialogue among students that is inquisitive and informative while maintaining the focus on professional clinical thought. Although PBL is growing into a premier pedagogy for medical education internationally, design and execution are still often seen as newly innovative and difficult to structure (Shavlakadze et al., 2017). Medical educators often utilize a blended PBL and LBL structure to enhance delivery and delineate burden of organization which often reduce the amount of curriculum introduced in PBL allowing for the PBL coursework to support the LBL content (Miles et al., 2017). As previously stated, the adult learning and model theories where some topics may be better presented through specific approaches. For example, presenting the pathophysiology of a disease state with the anatomical manifestations may be better taught through LBL, the approach

to the clinical aspects of the disease through patient history taking, diagnostics, assessment, and treatment may be best discovered through PBL. Blending the two pedagogies creates better content support yet adds a level of organization where the LBL and PBL material should be mapped appropriately to ensure consistency in content (Prihatiningsih & Qomariyah, 2016).

Assessing outcomes. Student learning outcomes (SLOs) provide the skeleton for content, value, purpose, and methodology for delivery of curricular information (Schunk, 2016). In PA education, these outcomes are largely influenced by the ARC-PA, NCCPA, and American Academy of Physician Assistants (AAPA) (ARC-PA, 2018). Educators are guided to implement the principles of Bloom's Taxonomy to generate higher-level cognitive learning bringing students a deeper foundation of knowledge and skill acquisition and application (ARC-PA, 2018; Nilson, 2016). Higher-level critical thinking, incorporating all aspects of medical knowledge and skill should be presented and assessed with a primary focus of ensuring students are able to take on the role of providing the highest quality health care to their future patients. PBL in medical education provides students an opportunity to explore knowledge and skill content through an active method of acquisition and application, yet students often struggle with defining expected outcomes through this pedagogy (Bunting, 2016).

Unfortunately, there is often a disparity between measuring student outcomes in professional medical education, such as medical school or PA education, when curriculum content is delivered through PBL and then measured with traditional instruments (Burgess et al., 2018). In PA education, student learning is measured with a summative examination provided by the NCCPA where organ system knowledge and clinical skill are represented though an in-depth multiple-choice question examination (MCQE), the PANCE. MCQEs measure cognitive knowledge, factual information, and students' ability to recall or recognize concepts with a

challenge reflecting the depth or degree of knowledge application required in clinical practice (Zahid et al., 2016). Contrary to the standardized outcomes assessment, patients in clinical practice do not present complaints in the form of a MCQ exam. In clinical practice, patient presentations and the critical thinking required to synthesize subjective and objective data into conclusions and plans may be better measured through more indirect assessment in addition to direct MCQE measurements (Korin et al., 2014; Burgess et al., 2018).

An alternative measurement tool which may open further research is the patient management assessment (PMA), a modified-essay question examination consisting of clinical vignettes, which are open ended, requiring students to employ clinical reasoning and critical thinking of patient care scenarios (Hawkins, Goreczny, & Brown, 2018). This assessment instrument employs short-answer questions where students solve medical problems and assess patient problems including summation of clinical reasoning, diagnostic studies interpretation, assessing and diagnosing disease or pathology, and formulating a patient care plan (Chakravarty et al., 2005; Hawkins et al., 2018). A PMA may present students with segments of information regarding a patient care scenario mimicking real-life situations and ask the student to respond clinically to each segment of the scenario providing the students understanding of details related to patient history, appropriate physical exam techniques, diagnostic study requirements, differential diagnosis, treatment modalities, and patient education. The PMA presents a more realistic representation of assessing the clinical practice processes which may not be practical through a MCQ instrument (Hawkins et al., 2018). Although standardized MCQEs have been the mainstay of assessing students in medical and PA education, potential exists for the study of moving towards PMAs as tools to replace the MCQEs.

Problem-based Learning and Academic Success

Jindal et al. (2016) have included PBL as an important addition to the incorporation of medical knowledge and clinical practice. As previously mentioned, there have been arguments on the implications of PBL on academic success in different educational programs.

Medical school academic success. Students who have participated in PBL during medical school are better problem solvers, retain information better, and are able to integrate scientific principles and clinical problems (Dolman & Schmidt, 1996, as cited by Bate, Hommes, Duvivier, & Taylor, 2014). Several sources of literature report that students who participated in PBL during medical school were more apt to be lifelong learners. These students were better equipped to identify gaps in their own knowledge, stay current in reviewing the most up-to-date evidence-based practices, and challenge the conceptual frameworks to further edify their desire to understand (Bate et al., 2014). Although the Bate et al. (2014) discuss the improved self-regulated learning, academic success is typically something that is quantified through standardized testing or evaluations.

Vuma and Sa (2015) studied academic achievement by using multiple choice questions (MCQs) and progressive disclosure questions (PDQs) to examine the effectiveness of PBL on academic outcomes. The overall conclusion that Vuma and Sa (2014) came to was that PBL did significantly influence academic success. Jiménez-Mejías et al. (2015) also researched the academic outcomes of students who participated in PBL compared to those who were solely taught using traditional educational methods. A 50-question cumulative MCQ examination was given to students of both a PBL and a traditional LBL course, and the PBL students scored significantly higher (Jiménez-Mejías et al., 2015). The research shows that medical school students' academic performance is improved through PBL, so the concern still arises whether

this success is universal and applies to PA education. Some answers to this disparity in

assessment outcomes based on PBL approaches in PA education may be revealed through this

and future research.

      Physician assistant education. PBL in medical education research has been found to

provide significant improvement in student achievement. This principle has not been seen in PA

education. Wardley et al. (2013) studied the academic success in PA education. These authors

used MCQs and standardized testing, along with skill acquisition evaluations to measure the

academic influences that PBL has on PA education. Utilizing students from multiple cohorts, in

differing stages of their educational journey, these authors concluded that there were only two

subject areas, psychology and reproductive medicine, where students' scores were significantly

improved through PBL over traditional LBL (Wardley et al., 2013). In a separate study,

Wardley, Applegate, Almaleki, and VanRhee (2016) studied the stress levels of PA students

correlated with PBL. In this study, they concluded that an increase in stress levels among the

PBL participants may have negatively affected their academic performance. In both of these

studies, the authors studies did not show a significant difference between the PBL and the LBL

participants regarding academic success, stating that both groups scored similarly in all areas

except those mentioned (Wardley et al., 2013; Wardley et al., 2016). These studies did not

specifically reveal details of PBL approaches which leads this researcher to examine the PBL

pedagogy in more detailed discovery. Regarding increases in stress, the researchers could not

conclude that PBL was the sole source of increased stress, attributing possibilities of heavy

academic burden, finances, and other common student stressors as being influential (Wardley et

al., 2016). The limited research in PBL on academic performance provides significant historical

background and lays a foundation for continued exploration.

Other health care professions' education. PA education research is not the only source of conflicting data with the medical school successes. Gould, Sadera, and McNary (2015) researched academic performance for undergraduate nutrition students at a Mid-Atlantic university. These authors studied the differences in academic outcomes between students being taught using PBL and traditional online education strategies measured using standardized MCQ tools. They concluded that both the traditional pedagogy and PBL resulted in statistically equal academic outcomes (Gould, Sadera, & McNary, 2015). So, although the PBL pedagogy did not significantly impact positive outcomes, the approach did meet with statistically similar outcomes as the traditional approaches related to MCQ performance. Of note, there were measured non-academic achievements that were significantly improved through the use of PBL. These included intrinsic and extrinsic motivations and self-directed learning strategies (Gould et al., 2015). So, although the academic acquisition of knowledge was not significantly improved as measured through MCQEs, PBL did have benefits that traditional learning did not have.

Strategies in Research to Address Issues in PBL

Curriculum design and delivery should be centered on personal and social competencies which influence the behavior and application of knowledge and skills for effective practice (Van Brummelen, 2002). Educators are therefore challenged with creating an environment that overcomes barriers to curriculum delivery where students can effectively meet the learning objectives. Parkhurst (2015) wrote about critical aspects in PA education where students perform better in an active, experiential environment where scientific medical facts are integrated with patient care application. Having examined obstacles in PBL pedagogical PA practices, researchers have worked to find methods to overcome and improve active learning while delivering the content needed for sound clinical practice.

Improved PBL design strategies. Lewis and Thompson (2017) wrote that PA education must go beyond transmitting medical content but to "stimulate the higher levels of learning that will allow students to become skilled clinicians and competent professionals" (p. 196). Academic theorists and researchers have examined multiple philosophies that engage students and cultivate education. Burgess et al. (2018) conducted a qualitative research study on PBL in a medical curriculum where four themes were represented: guided learning, problem solving, collaborative learning, and critical reflection. These themes generated a construct in curriculum design and development where the previously mentioned challenges of time, organization, and assessments were improved through student-centered learning processes resulting in "better preparation, immediate feedback on progress, and smaller group sizes" (Burgess et al., 2018, p. 6).

Korin et al. (2014) revamped the PBL return sessions to improve the curriculum design and delivery based on a multiple session dynamic where students were able to use role-playing and group activities to strengthen cognitive critical thinking. These authors concluded that the change in curriculum design led to improved student and faculty engagement, better organization, and deeper content discovery through multiple case presentations where students participated in authentic case vignettes (Korin et al., 2014). These studies support the positive influences of PBL's active learning theory while relieving previously noted burdens that detract from student learning.

Faculty training and institutional supports. Often faculty enter higher education institutions as subject matter experts within their fields of study without formal experience with pedagogy or academic theories and rely on academic professional development to gain these experiences (Dysart & Weckerle, 2015). There are many ways of providing faculty training

where the institution recognizes a need for improvement and growth among the faculty. Parkhurst (2015) chronicled results from a 2014 PA educator retreat where themes were established in faculty development needs in modern PA training. In examining PA education at five unique programs, these educators identified improvement needs in facilitating teamwork, dynamic small group learning, PBL and problem-solving, and patient-centered experiences (Parkhurst, 2015). Although it is important to recognize faculty limitations regarding PBL, educators should also implement plans to improve on these limitations.

AlBuali and Khan (2018) researched solutions to these challenges in medical education, which apply to PA education. These authors included efficacious use of technology, faculty as leaders in change, institution recruitment of additional faculty, and modification of assessment practices as solutions to PBL challenges (AlBuali & Khan, 2018). Faculty and students have all identified improved learning efficacy through heightened faculty experience and training in developing and facilitating PBL courses (Bunting, 2016). Faculty should be effectively trained in facilitating group activity where unstructured problems test student critical thinking, guiding students through the discovery process, and encouraging multi-disciplinary approaches with collaborative, constructive deliberation (Sroufe & Ramos, 2015).

Faculty training and institutional supports are also manifested in improved assessment of PBL outcomes. Korin et al. (2014) discovered that blending direct and indirect assessment through professional roundtable focus group type discussion, session blogging, and presenting a milestone case improved authentic assessment of critical clinical thinking. This study aids in solidifying the concept of assessment to measure clinical knowledge and skills through non-traditional tools. Loftin and West (2014) used self-efficacy measures prior to and after a problem-based activity to examine differences in individual learning. Although these authors did

not find significant differences in self-efficacy between the team-based or non-team-based groups, they did identify a method of measurement in PBL coursework (Loftin & West, 2014). The literature therefore supports that new and innovative assessment tools, outside the realm of traditional direct assessments, are potentially successful in measuring student coursework and outcomes.

Student engagement. Educators must find innovative and motivating methods of content delivery to encourage students' active participation in education (Schunk, 2016). PBL offers students a means to reach outside standard classroom dynamics and become more active participants in their learning. Bunting (2016) researched student perceptions of PBL in medical school where student participants offered opinions which denoted the main benefits in PBL being more opportunity for student engagement, increased student motivation to learn, and development of critical thinking skills. Zahid et al. (2016) researched PBL in medical schools using a quantitative approach analyzing MCQE outcomes, grade-point-averages (GPAs), and objective structured clinical examinations (OSCEs) concluding that PBL students performed better with these variables than non-PBL students partially due to increased participation and motivation within the programs.

Student engagement and motivation is often influenced by factors which include intrinsic and extrinsic motivators (Schunk, 2016). Cuevas (2015) identified student learning styles are also influential in student learning and motivation, noting that not all students learn equally and that curriculum design and delivery are most impactful when learning styles are taken into consideration. PA students in group activities through PBL bring a variety of learning styles and a wide range of experiences which enhance the learning environment. Sroufe and Ramos (2015) wrote that PBL offers students an opportunity to share knowledge and integrate learning across

learning style dynamics. This collaborative learning model; therefore, brings multiple learning styles together to enhance education efficacy by allowing all students to implement learning based on their individual styles while influencing students with dissimilar styles (Cuevas, 2015).

Allowing students to participate collaboratively reduces potential stressors in learning styles-learning (Cuevas, 2015). PA education is often very stress inducing for students. Wardley et al. (2016) researched student perception of stress within a PBL and LBL blended curriculum. These authors concluded that there was actually no significant difference in stress levels between the students in blended PBL and LBL curricula versus those in only an LBL curricula; however, they note that the inductive stressors were significantly different between the groups (Wardley et al., 2016). Stress is a natural component of academics, as well as in much of life; yet, there was no additional stress in the PBL group therefore not detracting from the benefits previously mentioned by its use. Reddy and McKenna (2016) researched student perceptions of an innovative PBL curriculum. These authors' research was based on reflections students revealed about their feelings towards being referenced as "guinea pigs" in an experimental PBL program. The overall discovery was that students realized the inaugural nature of the PBL curriculum and felt marginalized by the language used, feeling that the pedagogy was not fully supported by the faculty or administration, the efficacy of the education was not substantiated, and that the students' education was not the priority over the analysis of the curriculum (Reddy & McKenna, 2016). This author finds that the study revealed that student motivation and engagement is influenced by faculty support, enthusiasm, and focus on student-centered learning.

Summary

The literature review in this chapter provides readers with the theoretical framework of this applied research and the conceptual framework of PA education curriculum development including traditional and PBL pedagogies, standards and guidance, student learning outcomes, and outcomes measurement. Research related to the intricacies of a PBL curriculum were revealed to provide readers a deeper understanding of the historical concepts bridging PBL implementation in medical schools and PA education. The literature exposes current problems researchers have uncovered within PBL including resource utilization and consumption, organization, and outcomes measurement disparities. In examining the outcomes measurements, it was important to also examine previous research related to the impact of PBL on academic success in both medical school and PA school. Researchers in medical school PBL application have found significant impact to cognitive measures through MCQs, improved social dynamics, and bolstered student motivation (Bate et al., 2014, Vuma & Su, 2014). PA education research related to PBL and academic success were not as optimistic where authors wrote about similar improvements in clinical acumen and student motivation; however, they could not conclude that PBL improved outcome measurement through MCQ's related to PANCE scores or similar standardized testing (Wardley et al., 2013, 2016). The chapter concluded with strategies identified in previous research to overcome and improve the student-centered active learning pedagogy through better design strategies, enhanced faculty development and institutional support, and new approaches in student motivation. The literature review provides a solid background of research that this applied research study can build upon to add to the literature concerning developing a pedagogically driven curriculum that enhances clinical competencies,

critical thinking, and application of medical knowledge and skill in a manner that can adequately

prepare students to pass the PANCE.

CHAPTER THREE: METHODS

Overview

The purpose of this chapter is to describe the methods of the study to include the research perspective, the type of research conducted and specific context of the research. This applied research study analyzes methods to improve problem-based learning (PBL) in physician assistant (PA) education at a university in eastern South Carolina. This chapter will define the research questions, detail the research design including the setting, participants, role of the researcher, and specific procedures conducted to perform the research. The chapter will also describe the researcher's role in the study, including relationships and associations, the methodology for data analysis and a summary of the research methods.

Design

This applied research study was conducted using a multimethod approach and employed techniques from qualitative and quantitative research examining relationships between subjective and objective data to triangulate the data (Bickman& Rog, 2009). Applied research serves to inform readers to enhance decision-making on practical issues providing a richer understanding of behaviors and systems based on outcomes (Tolley, Ulin, Mack, Robinson, & Succop, 2016). Applying principles from qualitative and quantitative research to explore the depth of data through a multi-methods approach provides readers a more complete understanding of the problems and potential solutions than either approach individually (Haddadi, Hosseini, Johansen, & Olsson, 2017).

Applied research focuses on subject matter issues and potential practical application of the results by examining how things work while seeking discovery of options for improvement (Guthrie, 2010). The researcher analyzed faculty responses to personal interviews in relationship

with student survey responses and archival data of standardized test scores to determine a solution where PBL may be improved to enhance student academic success as measured through standardized examinations. The study includes assurances for reliability and validity of data to ensure the interpretations and correlations between qualitative and quantitative data meet with the highest standards of quality. As the literature reveals mixed viewpoints on the quality of findings in some applied research, special considerations were given to ensure the data and conclusions reflect the experiences and correlations between participants (Haddadi et al., 2017; Ivankova, 2014). Reduction of perceived disadvantages in applied research were mitigated by this researcher by using triangulation within the data analysis to provide a rigorous and methodical examination of participants experiential data (Haddadi et al., 2017). Through this applied study, the author intended to complete the research model outlined by Guthrie (2010) where a problem is identified, data is collected and analyzed to reach conclusions that lead to action to improve or solve the target problem. The design of this study began with research questions focused on the problems in PBL which set the agenda for discovery of practical solutions (Bickman & Rog, 2009).

Research Questions

This research sought to discover a deeper understanding of the implications of PBL on student outcomes and examine solutions to problems within the pedagogy. The study focus was to answer the following research questions:

Central Question: How can the problems of problem-based learning be improved in PA education at a university in eastern South Carolina?

Sub-question 1: How would PA education faculty in an interview solve the problems of problem-based learning at a university in eastern South Carolina?

Sub-question 2: How would students in a survey solve the problems of problem-based learning at a university in eastern South Carolina?

Sub-question 3: How would data from student surveys and standardized multiple-choice question instruments provide information related to the problems of problem-based learning at a university in eastern South Carolina?

Setting

The setting for this applied research was a PA education program at a university in eastern South Carolina. This site was selected to examine PBL within PA education at a newly established PA program where preconceived ideology or "always done that way" bias may be eliminated as the program has only matriculated two cohorts. The second reason for selecting this site was accessibility to faculty, students, and related data through the researcher's familiarity with the university. As detailed later, the researcher has a relationship with the program which allows for access to data sources without implications for coercion. This relationship affords the researcher open communication with the university administration to negotiate the proper protocols to ensure research within ethical and moral standards which will not impede the validity or reliability of data collection or analysis.

The university selected for this study is a small, private, Christian university in South Carolina. The institution offers courses in undergraduate, graduate and doctoral studies for residential, online, and blended venues. The university's total student population is 3,575 of which 60% are Caucasian and 40% are categorized as "minority" (Anonymous South Carolina University, 2018). The PA program is a 24-month Master of Medical Science degree awarding program. The curriculum consists of a 12-month didactic phase and a 12-month clinical phase. The PA program has two cohorts of 25 and 30 students respectively with a mean age of 25-

years-old and a demographic breakdown where 25.5% are male and 74.5% are female. The two

cohorts are 3.5% African-American, 2% American Indian, 11% Asian, 6% Hispanic, 1.5%

Pacific Islander, and 76% Caucasian (Anonymous South Carolina University, 2019).

Participants

Participants for the study were selected using purposeful sampling of principal faculty in

PA education at the eastern South Carolina University (Bickman & Rog, 2009). The population

of faculty includes six full-time teaching faculty including a Program Director, Director of

Didactic Education, and Director of Clinical Education, two full-time teaching faculty and three

part-time adjunct faculty members (Anonymous South Carolina University, 2019). These

faculty members have a minimum of three years of clinical practice and two years in PA

education with experience in PBL. Five faculty members, one males and four females, were

purposefully selected from the population of participant volunteers to be interviewed for this

study.

Student participants were selected to complete a survey related to experiences in

problem-based learning. To obtain specific data related to the research topic, purposeful

sampling was also used to select participants for the surveys (Creswell & Poth, 2018). This

purposeful sampling of students was selected from second year, or clinical year, physician

assistant students who have completed the didactic year of training including all problem-based

learning curriculum. The students were selected from the target university's physician assistant

program. Fifteen students from a cohort of 25 eligible students were selected to complete the

survey. The sample of participants consisted of three males and 12 female students who have

completed all aspects of PBL curriculum in PA education at the university in eastern South

Carolina.

The Researcher's Role

I am a physician assistant with 16 years of clinical practice employed as the Director of Didactic Education and Assistant Professor of Physician Assistant Studies. I have been employed by the institution and served in this role for two years. As Director of Didactic Education, my role is the oversight of curriculum development and implementation, maintaining accreditation standards, and analyzing student outcomes for continuous process improvements. My knowledge and understanding of the curriculum provide insight into the dynamics of pedagogical practices, technological implementations, and faculty-student interactions. I have intimate knowledge and collaborative influence in curriculum delivery and design. I have no administrative or personnel authority over any of the faculty participants, reducing any implied bias or potential for coercion by his conducting research within the PA program. The student participants were surveyed in their clinical year of training; therefore, any administrative or academic oversight for these students has been transferred to the Director of Clinical Education. As such, any implied bias and coercion concerns has been mitigated sampling students who have already surpassed their didactic year within the program. To further eliminate perception of bias, bracketing were employed to set aside personal experiences in collecting and analyzing data (Creswell & Poth, 2018). As a Christian educator, I have committed myself to faith integration within the entire PA curriculum where biblical worldviews are shared to stress the values revealed in the Gospel of Mark, "love your neighbor as yourself" (Mark 12:31). The data from this research allowed me to analyze and synthesize information to improve curriculum development, design, and delivery enhancing student learning outcomes and boosting student PANCE performance.

Procedures

The research entailed multiple procedures in data collection and analysis ensuring ethical considerations are met and data collected meets the highest standards of reliability and validity. Institutional Review Board (IRB) approval was obtained prior to any data collection to ensure ethical considerations for any human subjects involved in the study (See Appendix A). IRB approval is designed to protect the overall welfare, justice, and respect for the individuals involved in research (Creswell & Poth, 2018). Approval was also obtained from the target institution's administrative leadership, IRB, and PA program director (See Appendix B and C). After IRB and appropriate approvals were secured, data collection began with the solicitation of participants for faculty interviews and student surveys.

Faculty participation were solicited through letters of invitation to PA faculty who met the qualifications to participate in the study. As the participants were selected through purposeful sampling to intentionally involve a faculty group which can best inform the researcher about PBL curriculum, invitation letters were sent to PA faculty at the target university who have direct, first-hand experience with PBL (Creswell & Poth, 2018). The invitation letter was sent from the target university's PA program administrative staff to the faculty by electronic mail to the potential participants' faculty email addresses. The letter included a description of the study and a caveat that participation is optional and that there will be no adverse repercussions for declining participation (See Appendix D).

Student participation through survey questionnaires were solicited purposefully as well. Participation were invited through electronic mail to the students relating the purpose of the survey and assurances for anonymity. A statement related to the optional nature of participation without negative repercussion was also included. The invitation was sent by the target

university's PA program administrative staff to second year PA students who have completed all

aspects of didactic training and who have therefore successfully completed all PBL courses (See

Appendix E).

Informed consent forms were required from both faculty and student participants prior to

beginning the data collection process (see Appendix F and G). Faculty interviews were

scheduled with participants upon receipt of completed informed consent forms. The faculty

interview responses were collected through both written documentation and audio recording of

the session. The participants were asked a series of open-ended questions related to experiences

in PA education and PBL curriculum. These interview questions are detailed later in this chapter

and may be found in Appendix H.

Student participants were provided with a link to the online survey, through electronic

mail communication with the program administrative staff, once informed consent forms were

received by the researcher. The students were able to access the survey for 30 days from the

time of receiving the link. Student participants were able to save the progress within the survey

and complete at their pace; however, the survey was limited to a 30-day window. Only fully

completed surveys were included in the data collection. Student survey questions are detailed

later in this chapter and may be found in Appendix I.

Data collection included information obtained through faculty interviews, student

surveys, and standardized test scores reflective of content measured in the PANCE. The

assessment scores for PACKRAT and PAEA End-of-Rotation examinations were provided to the

researcher with all personally identifying data removed by the PA program administrative staff.

The data was analyzed using both qualitative and quantitative procedures identifying the

patterns, themes, and correlations between experiences of participation groups. Data collection

and analysis incorporated bracketing, horizonalization, coding for themes, memoing, and member checking throughout (Creswell & Poth, 2018; Gall et al., 2007). The researcher used triangulation to analyze the data and interpret experiences across variable effects (Bickman & Rog, 2009). The data collection and analysis methodology are detailed in the following sections.

<center>**Data Collection and Analysis**</center>

The researcher applied multiple data collection techniques to assimilate information encompassing facets of PBL from faculty and student perspectives. Data was collected through faculty interviews, student surveys, and archival data of standardized test scores to gain deeper context to the problems and potential solutions in a PBL pedagogy.

Interviews

The first sub-question for this study sought to discover how PA education faculty, in an interview, would solve the problems of problem-based learning at a university in eastern South Carolina. Data was collected from the five faculty participants through face-to-face personal interviews. The interviews may have been conducted by telephone as an alternative means of data collection if the participant was unable to meet personally or if there was a concern for confidentiality where a personal interview was not possible. The researcher conducted semi-structured interviews with participants using open-ended questions to establish rapport and elicit a free flow of participants' beliefs, assumptions, experiences, and visions (Bickman & Rog, 2009). Each participant was asked the same open-ended questions to obtain a deeper understanding of their experiences (Creswell & Poth, 2018).

Based on prior research of university faculty experience, use of technology in higher education, education theory in PA education, and the impact of student stress on PANCE performance, the researcher asked the following questions (Jaipal-Jumani, Figg, Gallagher,

Scott, & Ciampa, 2015; Dysart & Weckerle, 2015; Smith, 2014; Wardley, Applegate, Almaleki, & VanRhee, 2016):

Interview Questions for Physician Assistant Faculty

1. How would you describe your professional experience as a physician assistant?

2. How would you describe your experience as a teaching faculty in physician assistant education?

3. What formal education or academic experience do you have, including any college degrees in education, formal workshops, faculty development, or on-the-job training?"

4. What pedagogy do you espouse in delivering content to students in your current coursework, such as lecture-based, problem-based, laboratory and active student learning activities, or blended online and in-class teaching?

5. Why do you choose these methods of teaching?

6. What types of resources do you implement in your instructional methodology?

7. How would you describe the nature or formatting of the PBL curriculum in PA education at your institution?

8. What approaches to student learning do you feel are most efficacious?

9. What type of preparatory course or program does your program offer to students to enhance their readiness to take the Physician Assistant National Certifying Examination (PANCE)?

10. What do you believe are the least effective approaches to student learning in PA education?

11. How would you describe the methods employed by yourself or your program to ease student stress?

12. What factors have the most impact on PANCE scores?

13. How would you recommend improving problem-based learning at your institution?

Interviews were audio-recorded for transcription and reflection during the analysis phase of the research. During the interviews, the researcher took detailed notes reflecting verbal and non-verbal responses with annotations on inflection, emphasis, demeanor, and other attributes which may affect the analysis of data (Bickman & Rog, 2009). Each interview was transcribed for analysis once all interviews were completed.

The faculty interview questions were selected to represent details within PBL previously identified in the literature. The first five questions pertain to faculty experiences as practicing clinicians and in academia. A concern addressed through the literature was that often faculty are experts in their respective occupational fields without having formal training in academia or pedagogical practices (Dysart & Weckerle, 2015). These questions also address concerns related to potential needs in faculty training in academic principles and PBL facilitation (Parkhurst, 2015). Interview questions four and five also provide the researcher insight into the concerns about pedagogical influences on student learning and outcomes measurement in PA education (Wardley et. al, 2013; 2016). Faculty responses to questions six and seven provide the researcher data related to effective use of resources. Examination of the literature revealed that resources, including technology, time, and faculty manhours are often ineffectively utilized, particularly related to PBL (Al Buali & Khan, 2018). Student stress influenced by a PBL curriculum are addressed in questions 10 and 11. Previous research in PBL application in PA education concluded that student stress was significantly impacted by PBL curriculum (Wardley et al., 2016). The remaining questions relate to factors that influence PANCE pass rates

including methods of instruction, extra-curricular engagement, and PA program design including PBL (Lewis & Thompson, 2017; Reddy & McKenna, 2016; Zahid et al., 2016).

Data analysis. Analysis of faculty interviews utilized processes including bracketing, horizonalization, and coding for themes. Bracketing allows the researcher to identify and set aside personal experiences and view the data from an unbiased perspective (Creswell & Poth, 2018). The researcher identified key experiences where personal bias may influence response interpretation and bracket according to participant experiences. Horizonalization allows the researcher to utilize key words or phrases, numbered notations, and other reflective notes within the original interview dialogue or transcription to provide insight into deeper meanings (Creswell & Poth, 2018). This technique may include data related to verbal and non-verbal cues that the respondent provides which adds meaning to the language within the interview giving a richer perspective on the context (Creswell & Poth, 2018).

The qualitative data was then be analyzed using open and axial coding to focus on specific contextual patterns and concepts (Richards & Hemphill, 2018). The researcher used coding to identify and develop a menu of themes predominate among all the participants (Raskind et al., 2019). Open coding allows researchers to detect thematic concepts and patterns in data where axial coding provides researchers a method of connecting patterns of themes to collate data into deeper meaning (Richards & Hemphill, 2018). Data condensed into themes, coded for collation and further qualitative data within the research, was composed into a foundation for narrative description from the participants' perspective using imaginative variation (Creswell & Poth, 2018).

Student Surveys

The second sub-question for this study explores how students in a survey would solve the problems of problem-based learning at a university in eastern South Carolina. Student surveys from the 15 survey participants were collected examining student experiences within a PBL curriculum to include questions on how the curriculum may be improved to enhance cognitive learning. The student surveys included questions related to experiences in PBL and the implications on PA competencies outlined in the *PANCE Blueprint* and the accreditation standards for PA education (ARC-PA, 2018; NCCPA, 2018). The survey asked a series of 5 questions where the participants used a Likert-type Scale to reflect experiences "did not meet expectations" to "exceeded expectations" with a "not applicable" option for participants who felt the question did not apply to his or her experiences. Refer to the listed questions and associated numerical scoring for details. These results were analyzed as quantitative data as discussed later. The participants were then asked two open-ended questions, which they responded in narrative format, for qualitative analysis. The section of open-ended questions required an answer by the participant (see Appendix I).

Survey Questions for Physician Assistant Students

Please choose the best answer to describe your expectations.

1. How would you characterize the organization of the problem-based learning curriculum?

   ( ) 1 - Did not meet expectations
   ( ) 2 - Partially met expectations
   ( ) 3 - Met expectations
   ( ) 4 - Partially exceeded expectations
   ( ) 5 - Exceeded expectations
   ( ) 0 - Not applicable

2. How would you characterize the impact of problem-based learning on your

preparation for clinical practice?

( ) 1 - Did not meet expectations
( ) 2 - Partially met expectations
( ) 3 - Met expectations
( ) 4 - Partially exceeded expectations
( ) 5 - Exceeded expectations
( ) 0 - Not applicable

3. How would you characterized the impact of problem-based learning on your preparation for the Physician Assistant National Certifying Examination?

( ) 1 - Did not meet expectations
( ) 2 - Partially met expectations
( ) 3 - Met expectations
( ) 4 - Partially exceeded expectations
( ) 5 - Exceeded expectations
( ) 0 - Not applicable

4. How would you characterize the use of technology in your problem-based learning courses?

( ) 1 - Did not meet expectations
( ) 2 - Partially met expectations
( ) 3 - Met expectations
( ) 4 - Partially exceeded expectations
( ) 5 - Exceeded expectations
( ) 0 - Not applicable

5. How would you characterize the overall impact of problem-based learning on your physician assistant education?

( ) 1 - Did not meet expectations
( ) 2 - Partially met expectations
( ) 3 - Met expectations
( ) 4 - Partially exceeded expectations
( ) 5 - Exceeded expectations
( ) 0 - Not applicable

Survey Questions for Physician Assistant Students (open-ended questions)

6. How would you describe your experiences in problem-based learning during the didactic year of your physician assistant education?

7. How would you improve the problem-based learning curriculum to enhance your

preparation for the Physician Assistant National Certifying Examination?

The student survey questions are presented to further examine previous research which supports further examination. Question one pertains to students' perceptions of PBL organization where L'Ecuyer et al. (2015) identified students' reflections of PBL as being only moderately effective. Organization within a PBL curriculum was identified as a challenge which needs to be examined; therefore, understanding student perceptions of this challenge is prudent to optimizing solutions (Shavlakadze et al., 2017). Questions two, three and six examine students' experiences with PBL on their preparation for both clinical practice and taking the PANCE. A major purpose of this research is seeking a modality of education for preparing students for clinical practice and for successfully passing a national certifying exam. As mentioned in the literature, a discrepancy exists between educational systems, medical school and PA education, towards the efficacy on academic achievement using PBL. Wardley et al. (2013) noted a lack of significant impact on PANCE scores with PBL, yet medical school research reveals significant improvement in standardized MCQEs (Jindal et al., 2016). Question four examines technology utilization in PBL. AlBuali and Khan (2018) recognized that opportunities for expanding academic use of technology is underutilized. This question provides the researcher data on technology use and impact of the use on PA students at the target institution. Question seven relates to students' overall experiences with PBL within their PA education. Wardley et al. (2016) reported data where student stress levels and academic success were not impacted, or potentially even negatively impacted, through the use of PBL during the didactic phase of training. This is contrary to multiple sources of literature in medical school education. This final question provides data relevant to students' perceptions of their overall PBL experiences.

Data analysis. Analysis of student open-ended questions in the student surveys utilized the same processes as the faculty interview data including bracketing, horizonalization, and coding for themes. The researcher again identified key experiences where personal bias may reveal a potential for bias and bracket accordingly. Horizonalization of student survey data was again used to allow the researcher to utilize key words or phrases, numbered notations, and other reflective notes within the survey responses to provide insight into deeper meanings which was collated with faculty interview data and quantitative response data. Open and axial coding was also be used to focus on specific contextual and conceptual words or phrases with high frequencies of responses (Richards & Hemphill, 2018). This coding identified and developed a menu of themes which was collated with faculty interview themes.

Quantitative data. The Likert-type scoring provided in the quantitative portion of the student survey was analyzed along with collected archival data. The methods for data analysis are detailed with the archival data.

Archival Data

Sub-question three of this applied research uses qualitative survey results and assessment scores to discover how quantitative survey data provide information related to the problems of problem-based learning at a university in eastern South Carolina. Archival Data was collected from students' Physician Assistant Clinical Knowledge Rating and Assessment Tool (PACKRAT) and PAEA End-of-Rotation (EOR) exam scores. These scores were broken down by both organ system knowledge and clinical skills as presented in the *PANCE Blueprint* (NCCPA, 2018; PAEA, 2019). The entirety of the inaugural class of the target university had not taken the PANCE during the timeframe of this research; therefore, as the PACKRAT and PAEA EOR scores have been implicated as valid and reliable sources of predictive success on

the PANCE, these scores were utilized to measure cognitive success (Massey et al., 2015; Massey et al., 2011; Rizzolo et al., 2018). Students have the option of delaying taking the PANCE after graduation; therefore, there was some student PANCE data that is not available during the research of this new PA education program. The researcher utilized PACKRAT and PAEA EOR scores to enhance discovery of student outcomes.

The PACKRAT and PAEA EOR exams are peer-reviewed standardized instrument provided by the PAEA to PA education programs to guide student preparation for taking the PANCE (PAEA, 2019). As previously mentioned, the existing research supports a positive correlation between PACKRAT scores and PANCE scores allowing the researcher limited ability to identify potential PANCE outcomes for students who have not taken the PANCE (Cody et al., 2004; Massey et al., 2015; Massey et al., 2011; Rizzolo et al., 2018; Shallenberger et al., 2006). Data was utilized from the exam scores available for the inaugural cohort of students who have completed all PBL coursework within the program's didactic year of training.

Data points utilized for analysis include a breakdown by content area, including cardiology, dermatology, endocrinology, otorhinolaryngology, ophthalmology, gastroenterology, hematology, infectious disease, neurology, obstetrics and gynecology, orthopedics and rheumatology, psychiatry, pulmonology, and renal with urology. The data points also include task areas of clinical interventions, clinical therapeutics, diagnosis, diagnostic studies, health maintenance, history and physical, and scientific concepts (PAEA, 2019; NCCPA, 2018). The scores utilize comparisons between scores of the sample cohort against a reported national mean score. Scores means were further broken into year groups of first time, first-year students and all second-year test takers from the sample populations compared with the national mean scores.

Data analysis. The quantitative data collected, standardized exam scores and Likert scale responses to student surveys, was transformed for analysis within a qualitative structure through transformation of the data (Bickman & Rog, 2009). Quantitative data was transformed into frequencies and means according to themes previously isolated within the qualitative analysis (Bickman & Rog, 2009; Collingridge, 2013). Exam score data was collated into tables representing knowledge and skill content, as well as overall scoring for the standardized testing, thematically coded with the survey responses utilizing combined participant Likert scoring. The mean data within the quantitative sampling was used to identify central tendencies amidst the measured categories where the influences of a PBL experience may lead to conclusions against student outcomes (Gall et al., 2007). The transformation of data allowed the researcher to collate outcomes results with the coded themes revealed in the analysis of participant interview responses and open-ended student survey responses (Collingridge, 2013).

Quantitative survey scores, standardized exam scores, PACKRAT and PAEA EOR exams were used in conjunction with interview data to perform triangulation of data. Triangulation is a parallel analysis of qualitative and quantitative data sources are examined to determine interpretation and perceptions regarding variable effects (Bickman & Rog, 2009). The triangulation of research data combines methodologies to examine a particular phenomenon through analyzing convergences, inconsistencies, and contradictions in data sets to alleviate single strategy deficiencies in conclusions (Cronin, 2014). Data were examined for inconsistencies across the variables to analyze data that compromises the inferences and correlations between the student experiences and faculty interview data when compared with standardized test scores (Ivankova, 2014).

Reliability and validity. Interview data reliability was addressed through participant feedback in the form of member checking where the respondents reviewed rough drafts of the transcripts, conclusions, and narratives to provide input to the accuracy of the data interpretation (Creswell & Poth, 2018). Member checking, considered a gold standard of quality assurance in qualitative research, enhances the triangulation of data in assessing the convergences and inconsistencies of the researcher's perspective against the participants experiences (Madill & Sullivan, 2018).

Memoing was accomplished where the author will capture thoughts and interpretive meanings as reflection is derived in discovery creating an audit trail of researcher thoughts throughout the research (Creswell & Poth, 2018). The use of memoing aligned with conceptual and theoretical concepts underpinning the participant experiences allows the researcher to "develop a deeper conceptual appreciation of the data" by fluid analysis and re-examination of ideas and insights to gain a more complex understanding of the participants' experiences (Patel et al., 2016).

Ethical Considerations

Ethical considerations in research included ensuring the equity, honesty, and humane conditions of the study are all appropriately addressed (Joyner et al., 2013). These practices are invaluable to the building of trust, honesty, and integrity of the researcher, the research, and stakeholders. These considerations also reduce the possibility of the researcher "going native" (Creswell & Poth, 2018, p. 57). This refers to the researcher developing a bias in support of the research subjects to skew data and analysis towards the benefit of the participants. This researcher addresses these ethical issues with the guidance of the IRB, professional organizations, university administration, and informed consent procedures. Considerations will

also be made to safeguard data throughout the study.

Professional Organization Standards

The National Commission for the Accreditation of Physician Assistants (NCCPA), the American Academy of Physician Assistants (AAPA), and the Physician Assistant Educational Association (PAEA) will be consulted to ensure compliance within the profession. Resources from these institutions was utilized to support the analysis and conclusions within the research. These professional organizations' resources also provide ethical and procedural guidance in the collection, analysis and utilization of data.

Informed Consent

Participants in the study were thoroughly informed and provided an opportunity to acknowledge informed consent prior to the collection of data. Researchers must inform participants of the types of information obtained and disclosed, the use of the data, an explanation of the voluntary nature of the study with options for withdrawing, and any benefit or incentives for participating (Gall et al., 2007). The participants were provided a full description of the nature, purpose, and procedures for the study with strict assurances for confidentiality and anonymity. Informed consent for the research participants included language that reflects the participants' option to withdraw from the study at any time without fear of reprisal or loss of confidentiality or anonymity. All narratives reflecting content revealed in personal interviews, analysis of written or recorded transcripts is told from the perspective of the participant to reduce implied researcher bias.

The researcher contact information was made available throughout the study to allow participants to reveal any questions or concerns as they arise. The researcher has disclosed any affiliations, funding, or involvements to all stakeholders, including the reader of the final

research documentation, to reveal any potential source of bias or potential for deceptive practices. No personally identifying remarks were collected or revealed by the researcher. Archival data collection was limited to institution, cohort, and standardized exam score related statistics.

Other Ethical Considerations

Approval was obtained from each of the participating university to ensure ethical compliance and assure participants are authorized to provide data according to respective university guidance. American Psychological Association (APA) guidelines for publication were strictly adhered to for citations and reference material to ensure identification of authorship in literature review and source reference material. Throughout the research, data was safeguarded through multiple means through digital and physical security (Creswell & Poth, 2018). Backup copies of computer files were secured on password protected systems only accessible to the researcher. High-quality digital recording and transcription technology, password protected, was utilized in all interview sessions. Anonymity and confidentiality was assured through masking of, or removing, personal identifying information (PII) where the only source of this PII will be on a master listing which was stored securely and separately from the rest of the data. Student surveys and archival data were collected anonymously without PII associated with data or responses. The interview participants' identities are kept confidential through pseudonyms and coding in analysis and reporting.

<div align="center">

Summary

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Moore et al. (2018) wrote a literature review on factors associated with PA student learning outcomes and revealed many considerations including student demographics, admissions processes, students' previous academic experience, and emotional intelligence. None

of the literature revealed any faculty or program curriculum design or delivery considerations

(Moore, 2018). Wardley, Applegate, and Van Rhee (2013) researched pedagogy in PA

education against student knowledge acquisition measured through student performance on a

standardized test modeled from the PANCE. These authors focused their study on two

pedagogical approaches, lecture- and problem-based learning (Wardley et al., 2016). Research

in PA education has been conducted on admission criteria and predictors of success, this author's

research will bridge the gap to determine practices that will influence student success, measured

by PANCE results, after matriculation regardless of previous predictor studies (Moore, 2018).

This chapter detailed the methods which was employed to conduct an applied research

study to solve the problem of educating PA students in a PBL environment at a university in

eastern South Carolina and to formulate a solution to address the problem. The author has

detailed the research design as well as the central and sub-questions which will guided the

research. The chapter provided readers a picture of the research setting, identified the

participants who will provide the data, and the researcher's role in the study. Data collection and

analysis utilizing ethical research methodology, as approved by the IRB, and including guidance

from professional organizations to analyze data from faculty interviews, student surveys, and

standardized test instrument results.

CHAPTER FOUR: FINDINGS

Overview

The purpose of this applied study was to solve the problem of designing and delivering a PBL curriculum which enhances students' critical thinking and prepares PA students to pass a national certifying examination at a small university in eastern South Carolina and formulate a solution to address the problem. The researcher identified through the literature that there may be a potential disconnection between application of medical knowledge and skill with student outcomes measurement through standardized MCQ examinations may be bridged utilizing techniques applied in the pedagogy of PBL. Therefore, the central question that guided the research was posed, "how can the problems of problem-based learning be improved in PA education at a university in eastern South Carolina?" This chapter will detail the results of the research including a description of the participants and a presentation of the results of the collected research data. Data results in this chapter will reveal faculty interview participants' experiences detailed in themes correlated with student participants' experiences provided by student surveys. The analysis of this data culminated into three themes. The themes produced from the data included improving the alignment of content across the program courses, while taking learning style and adult learning theory into account, improving faculty facilitation through formal and informal faculty development and improved facilitation strategies, and restructuring the peer interactions to include more small group and role playing activities along with increased use of high-fidelity patient simulators. This data is then supported through archival data of student assessment scores represented by participants PACKRAT and PAEA End-of-Rotation Examinations.

Participants

Bickman and Rog (2009) wrote that researchers cannot study everyone everywhere over all time periods relative to a problem, therefore sampling of a population is needed to obtain information relevant to the problem from a select pool of participants relevant to the problem. This research utilized participants who have intimate involvement with PBL in PA education by either teaching or learning from the pedagogy. These participants included faculty who have experience in PA education delivering PBL curriculum and students who have completed coursework utilizing a PBL approach.

Faculty Participants

Five PA education faculty members were purposefully selected to be interviewed in semi-structured interviews regarding experiences in PBL. The faculty participants included five primary faculty members with an average age of 39-years-old. There were four female and one male participants. The faculty participants were ethnically divided into one Dominican-American and four Caucasians. Two of the faculty members have doctorate level educations and three of the faculty members have Master's degrees with two enrolled in doctoral level education programs. The faculty members have an average of 7.2 years of clinical experience prior to teaching. The faculty participants have an average of 4.6 years in higher education and two years' experience with PBL. Throughout this research, each of the faculty members will be referred to by pseudonyms, Faculty One, Faculty Two, Faculty Three, Faculty Four, and Faculty Five.

Student Participants

The student participants for this research were purposefully selected as those who had completed all PBL curriculum requirements within the target PA education program. The

student participant sample included 15 second-year PA students currently in the last semester of their clinical phase of training. The average age of the student participant sample was 27-years-old of which 11 were female and four were male. As graduate level PA students, each of the participants had a minimum of a Bachelor's level education and have completed the didactic phase of their PA education. The student participant sample included 12 Caucasians, no African Americans, two Hispanic, and one who classified as "other ethnicity." Students were surveyed using an anonymous online instrument which provided both qualitative and quantitative data. The quantitative data were provided in the form of open-ended questions regarding their experiences with PBL in PA education. For the reporting of this data, specific student pseudonyms will be used to reflect responses which support identified themes. The researcher will identify specific responses as being provided by Student A through Student O.

Results

Data for this research were collected through personal, semi-structured interviews with five faculty members, surveys of 15 second-year PA students, and exam scores from PAEA End-of-Rotation Exams and PACKRAT. Faculty interviews were conducted confidentially, and student data from both surveys and archival data were kept anonymous. The student data were solicited, collected, and presented with the assistance of the program administrative staff to ensure the anonymity of participants. The faculty interviews and student open-ended survey questions were organized into themes which were then supported with quantitative data represented by Likert-type survey scores and student assessment results. These results are identified to examine responses to the research sub-questions.

Sub-question 1

Sub-question one asks, "How would PA education faculty in an interview solve the problems of problem-based learning at a university in eastern South Carolina?" Interviews were conducted with PA faculty members at the university in eastern South Carolina to find themes related to PBL in PA education and the problems and potential solutions which may enhance student outcomes as related to clinical acumen and standardized exam scores. Interview responses were coded for themes by applying open and axial coding techniques (see Table 1). These themes were then itemized by frequency to determine the prevailing themes which impact sub-question one (see Table 2). The major themes which unfolded from the qualitative interview data improving the alignment of content across the program courses, while taking learning style and adult learning theory into account, improving faculty facilitation through formal and informal faculty development and improved facilitation strategies, and restructuring the peer interactions to include more small group and role playing activities along with increased use of high-fidelity patient simulators.

Table 1

Open and axial coding of Themes, Faculty Interviews

Open coding	Axial Coding	Examples of Faculty Comments
Broad clinical experiences with patient teaching, precepting students, guest lecturer and adjunct teaching; PAEA Faculty development workshops and conferences; Peer mentorship and informal faculty development; Love of medicine, teaching, students (highly motivated); academia	Faculty clinical and academic experience and training	"So one of the things the university did early on was provide a faculty resource for us, a professor who's earned tenure, who has a lot of experience in curriculum design, as well as utilization of our learning management system. So, she worked with faculty individually to really help us get up to speed early on, and then faculty have the opportunity to attend different workshops on campus" (Faculty One,

melding clinical practice and administration		personal communication, November 20, 2019). " …the students kind of come in sometimes with very narrow focus, like they've only ever been exposed to a doctor. They haven't been exposed to a physical therapist, an occupational therapist, and a PA, and all of these other options that are out there" (Faculty Three, personal communication, November 20, 2019). "Yeah, so definitely, going to the PAEA Faculty Skills 101 workshop was really helpful to kind of reframe, or re-prioritize, or maybe put in perspective, you know, some of the pedagogical things that I had learned five or 10 years ago" (Faculty Four, personal communication, November 21, 2019).
Curriculum design based on adult learning; content driven; active learning; improve student engagement; curriculum organized horizontally and vertically across courses; median knowledge base for cohort; student feedback; bridging content across courses; lecture as a "necessary evil"; understanding the "why" of theoretical and evidence-based instruction; use PBL as a model of real life through experiential learning; fusion of lecture and active learning; foundation of standardized content across a broad and deep content pool; intertwine PBL content throughout the curriculum	Blending instructional techniques with content and learner	"…a collective experience of kind of all the course content kind of crystalizing" (Faculty Two, personal communication, November 20, 2019). "…they kind of have that base knowledge of the disease process…but it's more refining their skills…and incorporating all of those skills into a problem or PBL session" (Faculty Three, personal communication, November 21, 2019). "…the way our curriculum is formulated, they get to then expand upon and more critically think about the diseases in the other courses as they're laid out…"(Faculty Five, personal communication, November 22, 2019. "…important to design a curriculum that allowed us to deliver the content in the most appropriate way for that

		content, but also that appealed to…the generation of students that we're teaching and their learning style" (Faculty One, personal communication, November 20,2019).
Active learning in the classroom; require critical thinking; comprehension over memorization; deep, reflective learning; need more use of simulators, learning in a simulated environment; PBL as practical assessment of applied knowledge, a barometer of knowledge foundations; progressive complexity of content and application	Modeling practical application in active, experiential learning	"…I think that's why we have problem-based learning. Because it is an opportunity for us to assess their knowledge and their acquisition of knowledge in these smaller group settings and ultimately individual settings that isn't a multiple-choice assessment, which is more closely aligned, I think, with what they do in clinical practice" (Faculty One, personal communication, November 20, 2019). "They definitely have to grapple with real world scenarios and real-world problems that may or may not have a right answer" (Faculty Four, personal communication, November 21, 2019).
Provide a variety of assessment tools; set clear and consistent student expectations; manage student expectations well; teach for clinical competence not passing tests; early and on-going preparation through repetition and practice with PANCE like MCQs; present well-organized material; MCQ proficiency based on solid foundation of knowledge; PBL as supplemental approach to boost confidence and build on concepts; create emotional experiences to enhance learning; strong advising, tutoring, counseling services; proactive stress mitigation; realistic understanding that	Enhance students' academic, clinical, professional confidence and motivation to succeed Managing expectations	"(we) really wanted students to leave the didactic year feeling very comfortable talking to patients, doing physical exams on patients, and presenting to either their faculty, their preceptor, or eventually their supervising physician" (Faculty One, personal communication, November 19, 2019). "There's something about that that really connects. Then you can be asked that in multiple ways. Whether it was on a board test, or you saw it again in the clinic, it seemed like, 'Okay, I can never miss that again.'" (Faculty Two, personal communication, November 20, 2019). "We have a really strong advising program here…we've got counseling services…(and) setting realistic

medicine may have multiple correct answers to a problem		expectations with the students" (Faculty Three, personal communication, November 21, 2019).
More faculty; higher faculty-student ratio; more simulator use; increase simulated environment; promote PBL content throughout the curriculum; view as supplemental assessment modality through practical application; barometer of progression; alignment of course topics as assessed on the PANCE	Content alignment and resource utilization	"I think…ensuring the course topics align with the topics that are assessed on the blueprint…(while giving) students another opportunity to kind of practically apply those things as well" (Faculty One, personal communication, November 19, 2019). "…bridging the gap between…Clin(ical) Med(icine) and then the practical application of…real life patient education in clinical scenarios" (Faculty Three, personal communication, November 21, 2019). "…having more faculty available…You could get through each student…debrief…and dissect the case" (Faculty Five, personal communication, November 22, 2019). "…incorporating more simulation…make the situations all the more realistic" and "students…given information up front…" (Faculty Four, personal communication, November 21, 2019).

Table 2

Frequency of Codes, Faculty Interviews

Codes	Frequency
Faculty clinical and academic experience and training	16
Blending instructional techniques with content and learner	56
Modeling practical application in active, experiential learning	45
Enhance students' academic, clinical, professional confidence and motivation to succeed	56
Managing expectations	28
Content alignment and resource utilization	28

The collation of the six codes most frequently reported through the interviews were combined to reveal three main themes which represented the context of these codes. These themes were improving the alignment of content across the program courses, while taking learning style and adult learning theory into account, improving faculty facilitation through formal and informal faculty development and improved facilitation strategies, and restructuring the peer interactions to include more small group and role playing activities along with increased use of high-fidelity patient simulators.

　　　Theme #1: Alignment of content across the program courses. The theme which was most prevalent among the faculty participants the alignment of content across the program courses, while taking learning style and adult learning theory into account. The interview participants provided comments related to blending instructional techniques based on content and student learning styles with a frequency of 56 unique responses. The blending of content, referring to using PBL to apply content taught throughout the PA curriculum utilizing student interactions and faculty-peer discussion, to solidify concepts, with student learning focused on primarily adult, active or experiential, learning. One faculty member commented that the curriculum was thoughtfully designed, with specific sequencing, in multiple types of coursework where student expectations, as adult learners, could be transparently managed (Faculty One, personal communication, November 19, 2019). The blending curriculum and student learning styles was identified as a key to PA education by Faculty Four who stated:

　　　　They definitely have to grapple with real world scenarios and real-world problems that

　　　　may, or may not, have a right answer. I think it's challenging, and I think it's important

　　　　to have a rigorous and challenging curriculum, but you also want to make sure that it's

　　　　not too challenging, so much so that they look at a set of questions or look at a case

they're given and immediately give up…The challenges are sort of scaffolded in and

progressively get more difficulty, so students are constantly drawing on their prior

knowledge and prior experiences to…face the next level of challenges (personal

communication, November 21, 2019).

The blending of instructional methods, PBL, team-based learning (TBL), case-based learning

(CBL), drawing from knowledge and skill within other courses within the curriculum, in concert

with active adult learning, was identified by Faculty 5 who commented that, "…it's kind of a

combination. It (is) fishbowl learning where everybody else is watching you…putting them in

that sort of clinical situation ahead of time and allowing them to formulate their thoughts…"

(personal communication, November 22, 2019). This faculty member went on to discuss the

students using the PBL course to practice physical exams, apply core knowledge, and critically

think through case vignettes (Faculty Five, personal communication, November 22, 2019). The

takeaway from this blending can be summed up in a comment by Faculty Three, "Here, PBL is

more of like a supplement…refining their skills of…history taking and thinking...on their feet

about the differentials, the diagnostic methods and delivering patient education… (personal

communication, November 20, 2019).

Faculty members commented that there may be a disparity between the assessment of

medical knowledge and skill using standardized MCQ examinations and the actual assessment of

clinical practice (Faculty One, personal communication, November 20, 2019; Faculty Five,

personal communication, November 22, 2019). Practical experience reinforces and solidifies

knowledge taught through traditional lecture-based instruction which may, therefore enhance

exam scores. Faculty Five stated, "Even as a newbie PA, you're still going to be very green

compared to someone who's been practicing 10, 15, or 20 years. So, I think that there is a way

to mesh it…" (personal communication, November 22, 2019). By blending instructional

techniques within the curriculum, utilizing active learning techniques employed in PBL with

traditional LBL, the medical knowledge and skill may be reinforced improving standardized

exam scores. "Ultimately, I think with the generation of students that we are teaching

currently…I think a more active learning approach is a more efficacious approach" (Faculty One,

personal communication, November 20, 2019)

       Theme #2: Improving faculty facilitation. A second theme was revealed, with equal

frequency within the interview data, related to enhancing students' academic, clinical, and

professional confidence and motivation to succeed through improved faculty facilitation. Each

of the faculty members interviewed commented on the importance of managing student

motivation and confidences academically, clinically, and professionally. The faculty participants

mentioned these concepts with a frequency of 56 responses throughout the interviews. Faculty

Two commented that the PBL curriculum allowed students a venue to identify strengths and

weaknesses where their clinical confidence could be strengthened, in turn, increasing motivation.

"…PBL…should not be an artificial exercise…because that's what you're actually going to be

doing…students finally start to see it come together…like, 'Oh, yeah, this is how it works…I'm

actually learning it…(personal communication, November 20, 2019). Faculty Five identified

that MCQ examinations offer students an opportunity to answer clinical questions; however,

passing an MCQ does not always equate to clinical competency, and PBL facilitators offer

students the experiential learning to discover more clinical confidence. "Maybe gauge from

there how they're kind of synthesizing data…but kind of conceptualizing" (Faculty Five,

personal communication, November 22, 2019).

The interviewees commented on the concept of student confidence and motivation focused around academics, clinical skills, and professional practice as unified constructs for both clinical practice and PANCE success. Key factors to PANCE success were identified as the students' mental preparation not only academically, but in confidence with preparedness and endurance for the exam (Faculty Four, personal communication, November 21, 2019). "I think that's why we have PBL…it is an opportunity for us to assess their (the students') knowledge and their acquisition of knowledge in these smaller groups and ultimately individual settings that isn't a MCQ assessment (Faculty One, personal communication, November 20, 2019). Regarding PANCE success, Faculty Three commented, "Mental stamina? Being able to think for hours. Knowing the content…you just have to…trust yourself and not second guess yourself. So, have confidence in your knowledge" (personal communication, November 20, 2019).

Theme #3: Restructuring the peer interactions. The third theme revealed in faculty interviews was restructuring the peer interactions to include more small group and role playing activities along with increased use of high-fidelity patient simulators.. This theme was generated around concepts provided in the interviews related to active learning, development of critical thinking, comprehension versus memorization, and a progressive approach to applying the practical implications of medical knowledge and skill in a safe, simulated environment. The faculty provided 45 unique response related to this theme throughout the five interviews.

Faculty One commented that utilizing PBL to assess practical application is, "more closely aligned…with what they do in clinical practice" (personal communication, November 20, 2019). As mentioned, a problem within the pedagogy is preparing students for standardized exams while also preparing them for clinical practice. The modeling of practical application through active, experiential learning introduces students to the realities that "they definitely have

to grapple with real-world scenarios and real-world problems that may or may not have a right answer" (Faculty Four, personal communication, November 21, 2019). Employing PBL as an approach to enhancing fundamental, foundational medical knowledge and skill may solidify retention, recollection, and application. By applying these concepts students may be able to use experiences to recall and link information. Faculty Two commented:

> If you don't get the concept, then you can kind of see it and it's just that's just a weird thing you saw (with) that weird guy. I don't know what that was, but yet, you got the concept, and you see it, and you can make this link, and the real person, especially if you've seen it from their first encounter in the clinic, and sort of get to follow them maybe through multiple visits. 'Hey, they're back again,' or 'this is the test we saw and these are the results.' They're coming back for the follow up after we begin treatment. The bigger the scope that they've seen of a process, I think there's the more that the brain makes connections. The brain does love to see and make up the connections, and sort of get the whole set the whole picture (personal communication, November 20, 2019).

Therefore, by applying the information in practical application, Faculty Two identified that the students may associate a connection between concepts and applications through the modeled process which will reinforce recall and future application of those concepts.

Modeling practical application through active, experiential learning, also evokes an emotional aspect to learning where students incorporate those emotions into the learning process (Faculty Four, personal communication, November 21, 2019). Bridging the gap between content delivered through traditional methods and improving exam scores through PBL may be enhanced by the evoking of more sensorial approaches including those emotions. "Experiences help it all come together" (Faculty Two, personal communication, November 20, 2019).

Sub-question 2

Sub-question two asks, "How would students in a survey solve the problems of problem-based learning at a university in eastern South Carolina?" Fifteen students surveyed responded to open-ended questions related to experiences with PBL in PA education. These questions related to students' impression of PBL related to their educational experiences and their ability to successfully pass the PANCE. These responses were also coded using open and axial coding for themes (see Table 3). These themes were then analyzed for frequency to determine the most prevalent themes among student participants (see Table 4). The codes which unfolded from the qualitative portion of the student survey data included content alignment and resource utilization, enhancing students' academic, clinical, and professional confidences and motivation to succeed, and use of a progressive peer learning experience.

Table 3

Open and axial coding of Themes, Student Survey Responses

Open coding	Axial Coding	Examples of Student Comments*
Application of clinical knowledge; modeled real life application,	Modeling practical application in active, experiential learning	"Provided some of the first real applications of clinical knowledge…" "It gave me the opportunity to not just memorize information but see how it would be used practically."
Allowed for practice of clinical skills; critical thinking; building on foundational instruction; barometer of knowledge acquisition, retention, and application; more varied clinical settings;	Practicing clinical skills and applying comprehension	"The PBL experience allowed the opportunity to practice our skills." "It gave the opportunity to practice interview skills, diagnosis and treatment plans, and even patient counseling."

		"An essential course for growth as a future clinician…practice interview, physical exam, and A/P formulation that we do daily on rotations before starting rotations."
Enhanced, or supported, theoretical and evidence-based medical knowledge concepts; bridging coursework content across the curriculum; align content with PANCE blueprint; early utilization of audio-visual technology; more simulation; more small groups; organization, or format, with stronger history and physical emphasis	Content alignment and resource utilization	"The PBL course was very formative as it allowed students to combine and implement clinical skills, reasoning, and knowledge learning in each of the other courses in mock clinical scenarios." "I felt like this style of teaching did a really good job of bringing everything together." "PBL helped bring together the information from all of the other classes." "I would include more time with models in the simulation lab." "…do two scenarios a week. Splitting the class into two or three large groups in order to do individual problems was brilliant." "The individual assessments, which were televised to our peers, motivated us to study and practice more."
Building therapeutic relationships and patient rapport; application of	Enhanced students' academic, clinical, professional confidence and motivation to succeed	"I was less nervous going into clinical year about patient interactions,

knowledge; barometer of application		documentation, and oral presentations." "…pushed us all as students and got us out of our comfort zones." "…remembering things so much better because I remember who it was applied in the PBL class." "…it can serve as a metric for how prepared one is for the exam…"
Progressively building on prior knowledge and experience; building upon course content; progressive; peer learning; peer interactions strengthened experiences	Progressive peer learning experience	"Progressive" "Experiences differed as the didactic year progressed. In the beginning…team based…As students became more accustomed to this…changed formats to individual assessments." "I enjoyed the progression of the class and how it built on itself." "The group cases also allowed us to get to know one another and learn from each other."
Addition of review questions; more diagnostic interpretation; differential diagnosis building; pre-case questions	Add assessment variations	"…the course may include reflection questions or questions prior to the PBL case in order to practice more exam style questions." "Incorporate more diagnostic interpretation…" "…incorporating additional review questions related to

		the topic at the end of each case."

Notes: * students' anonymously reported comments from open-ended survey questions

Table 4

Frequency of Codes, Student Survey Responses

Codes	Frequency
Modeling practical application in active, experiential learning	6
Practicing clinical skills and applying comprehension	5
Content alignment and resource utilization	12
Enhanced students' academic, clinical, professional confidence and motivation to succeed	11
Progressive peer learning experience	7
Add assessment variations	4

The six codes which were most frequently noted were collated into three main themes

which captured the content of each of the six codes. These themes were improving the

alignment of content across the program courses, while taking learning style and adult learning

theory into account, improving faculty facilitation through formal and informal faculty

development and improved facilitation strategies, and restructuring the peer interactions to

include more small group and role playing activities along with increased use of high-fidelity

patient simulators.

Theme #1: Alignment of content across the program courses. The theme which was

most prevalent among the student participants was the content alignment and resource utilization

to enhance success on the PANCE and in clinical practice. There were 12 responses throughout

the qualitative survey responses related to this theme where students identified concepts such as

enhancing, or supporting, theoretical and evidence-based medical concepts through application;

bridging coursework throughout the PA program curriculum; alignment of coursework with the

PANCE blueprint; and utilizing multiple technological and logistical resources to enhance delivery of content. One student wrote, "the PBL course was very formative as it allowed students to combine and implement clinical skills, reasoning, and knowledge learned in each of the other courses in mock clinical scenarios." Another student wrote that the approach used in the current PBL course "forced me to think critically and develop a systematic approach to assure that all the information needed was collected." However, students did reply that the course could be improved through emphasis on more key PANCE blueprint concepts, increasing the pace of learning through more cases and progression into smaller groups sooner in the course, and possibly assessing students through review questions relevant to cases.

Although students replied that the coordination and alignment of content was beneficial, areas for improvement were noted regarding implementation of resources to enhance the curricular content. Students reflected on the use of audio-visual monitoring of peer groups, which has been historically used later in the course. One student commented that this technology should be implemented sooner in the curriculum. Other students advocated for more use of simulation technology. Yet, the resource most commonly discussed was people. Students felt that they got the most benefit from breaking into smaller groups, which requires more faculty oversight in group facilitation. "Splitting the class into two or three large groups in order to do individual problems was brilliant."

Theme #2: Improving faculty facilitation. The second most prevalent theme within the student survey data was enhancing faculty facilitation to improve students' academic, clinical, and professional confidences and motivation to succeed. Similar to comments reflected in the faculty interviews, students' academic, clinical, and professional confidence and motivation were prevalent within the survey qualitative responses. Of the narrative survey

responses, 11 were related to enhancing students' confidence and motivation. One student

wrote, "I was less nervous going into clinical year about patient interactions, documentation, and

oral presentations." Another student reflected on PBL "motivated us to practice more" as "…a

very successful way to teach." The dynamics of peer interaction and modeling practical

application of content from across the program curriculum "pushed us all as students and got us

out of our comfort zones."

     As Faculty Three commented during the faculty interview, "…(students) have to…trust

yourself and not second guess yourself" (personal communication, November 20, 2019). The

students also reflected on PBL experiences which affected their confidence and motivation in

academics as well as professional clinical practice. One student who also commented on

additional use of simulation technology wrote, "I did not feel as comfortable as I hoped with

hospital bedside procedures and pressure." Another student replied, "…I can tell that the

stressful moments of performing exams in front of others has allowed me to be more confident

during clinical year." This student went on to write, "It did prepare me for the certifying exam in

that I was building differentials and having to think through a problem."

     Theme #3: Restructuring the peer interactions. The third theme revealed in student

surveys was the restructuring of a progressive peer learning experience to enrich their potential

for academic and clinical success. The students' qualitative survey comments revealed seven

responses related to the progression of the peer learning experience in PBL. These comments

were centered on concepts of progressively building on prior knowledge and experience,

building on content from other PA program courses, and the impact of peer learning with faculty

facilitation. "PBL allowed us the space and opportunity to work through the information and

bring it together cohesively…" These experiences improved retention, recollection, and

application as one student wrote, "I found myself throughout the year remembering things so much better because I remember who it was applied in the PBL class." This student continued by saying, "It gave me the opportunity to not just memorize information but see how it would be used practically." The students appreciated how the course was developed progressively and built on prior experiences and knowledge.

Areas for improvement related to this theme were suggested by students' comments. One student wrote, "more small groups activities" where "a sole practitioner" can collaborate with methods of individual student improvement. Students' replies for improvement focused around increasing the number of cases presented, breaking into more small group activities earlier in the course, and providing varied clinical settings for students to interact in such as emergency rooms, inpatient settings, specialty clinics, and urgent care.

Sub-question 3

Sub-question three asks, "How would data from student surveys and standardized multiple-choice question instruments provide information related to the problems of problem-based learning at a university in eastern South Carolina?" The fifteen second-year PA students also answered a series of five Likert-type questions related to experiences with PBL in PA education. These responses represent how the student valued the organization, implementation, and impact of PBL related to their PA education related to both clinical practice and preparation for taking the PANCE. A mean value was calculated for each of the questions and outliers were identified for consideration against other variables (see Table 5).

Table 5

Student Responses to Likert-type Survey Questions

| | | Question Theme | | | |
Student	Organization of PBL curriculum	Impact of PBL on preparation for clinical practice	Impact of PBL on PANCE preparation	Use of technology in PBL courses	Overall impact of PBL on PA education
A	5	5	4	5	5
B	3	3	3	4	4
C	4	5	3	3	5
D	3	5	4	5	5
E	3	4	3	4	4
F	3	3	3	3	3
G	3	5	3	3	5
H	4	5	3	3	5
I	4	5	3	5	5
J	5	5	3	4	5
K	5	5	5	5	5
L	5	5	5	5	5
M	4	3	4	5	4
N	4	4	3	4	4
O	4	4	3	4	4
Mean	3.93	4.4	3.53	4.13	4.47

Archival data of student PACKRAT and PAEA EOR Examination scores were also obtained to examine student outcomes performance on standardized MCQ examinations. The scores were obtained anonymously by the PA program administrative staff for each of the student participants and compared against the national average of all PA program students who took the same exams. Exam data was divided into first-time and second-time test takers for the PACKRAT. PAEA EOR Examinations were broken down by specialty field, Family Medicine, Internal Medicine, Emergency Medicine, Surgery, Women's Health, Pediatrics, and Psychiatry. Mean scores for participant students were identified against scores for all program takers for

each specific examination. For all standardized examinations, scores were broken down into content and task categories. The data breakdown for each examination can be seen in Tables 6 through 14.

Table 6

Student Participants' First Year PACKRAT Scores

	Student Participants	All First-time Takers	*SD*	All Second-time Takers	*SD*
Overall Score	140.40	134.5	19.6	153.9	18.7
Content Area	% Correct	% Correct		% Correct	
Cardiology	65.00	64.01		71.74	
Dermatology	52.87	55.57		65.94	
Endocrinology	63.33	66.98		75.98	
ENT/Ophthalmology	71.93	67.81		76.40	
Gastrointestinal/Nutrition	62.40	63.39		73.16	
Hematology	30.40	28.62		35.90	
Infectious Disease	68.87	65.47		75.92	
Neurology	59.20	59.95		67.92	
Obstetrics/Gynecology	58.13	52.78		62.60	
Orthopedics/Rheumatology	78.20	68.69		75.76	
Psychiatry/Behavioral Medicine	61.47	62.34		69.61	
Pulmonology	53.33	48.51		57.45	
Urology/Renal	60.13	50.90		60.40	
Task Area					
Clinical Intervention	67.67	63.46		71.88	
Clinical Therapeutics	52.13	51.02		62.10	
Diagnosis	72.60	67.96		76.12	
Diagnostic Studies	58.33	56.43		66.88	
Health Maintenance	63.07	62.44		71.10	
History and Physical	66.93	62.11		68.08	
Scientific Concepts	57.20	54.31		61.16	

Table 7

Student Participants' Second Year PACKRAT Scores

	Student Participants	All First-time Takers	*SD*	All Second-time Takers	*SD*
Overall Score	153.93	131.6	19.1	154.2	14.9
Content Area	% Correct	% Correct		% Correct	

Cardiology	67.53	57.81	67.32
Dermatology	47.72	47.72	54.71
Endocrinology	54.09	54.09	64.96
ENT/Ophthalmology	63.53	63.53	73.66
Gastrointestinal/Nutrition	53.64	53.64	68.18
Hematology	57.90	57.90	68.49
Infectious Disease	56.06	56.06	66.28
Neurology	58.65	58.65	66.31
Obstetrics/Gynecology	60.69	60.69	71.87
Orthopedics/Rheumatology	59.19	59.19	66.46
Psychiatry/Behavioral Medicine	65.96	65.96	72.72
Pulmonology	63.21	63.21	72.34
Urology/Renal	54.30	54.30	62.44
Task Area			
Clinical Intervention	66.87	58.74	67.03
Clinical Therapeutics	57.80	46.95	57.14
Diagnosis	73.80	64.59	74.08
Diagnostic Studies	71.87	62.17	74.13
Health Maintenance	65.47	57.71	65.32
History and Physical	73.40	61.91	72.01
Scientific Concepts	62.33	58.58	66.15

Table 8

Student Participants' Family Medicine EOR Exam Scores

	Student Participants	All Programs	*SD*
Overall Score*	403	403	25
Content Area*			
Cardiology	424	400	
Dermatology	409	399	
Endocrinology	391	397	
ENT/Ophthalmology	391	404	
Gastrointestinal/Nutrition	409	404	
Hematology	396	395	
Infectious Disease	394	397	
Neurology	392	403	
Obstetrics/Gynecology	405	404	
Orthopedics/Rheumatology	420	403	
Psychiatry/Behavioral Medicine	397	400	
Pulmonology	420	405	
Urgent Care	353	396	
Urology/Renal	402	400	

Task Area*		
Clinical Intervention	400	398
Clinical Therapeutics	401	408
Diagnosis	406	408
Diagnostic Studies	395	403
Health Maintenance	406	398
History and Physical	413	403
Scientific Concepts	415	401

Note: *Averages taken for Family Medicine EOR versions 6 and 7

Table 9

Student Participants' Internal Medicine EOR Exam Scores

	Student Participants	All Programs	SD
Overall Score*	409	405	23
Content Area*			
Cardiology	424	407	
Critical Care	416	403	
Endocrinology	403	404	
Gastrointestinal/Nutrition	405	404	
Hematology	387	402	
Infectious Disease	400	399	
Neurology	408	406	
Orthopedics/Rheumatology	409	403	
Pulmonology	409	408	
Urology/Renal	408	402	
Task Area*			
Clinical Intervention	402	405	
Clinical Therapeutics	404	406	
Diagnosis	411	404	
Diagnostic Studies	412	405	
Health Maintenance	418	406	
History and Physical	421	406	
Scientific Concepts	406	404	

Note: *Averages taken for Internal Medicine EOR versions 6 and 7

Table 10

Student Participants' General Surgery EOR Exam Scores

	Student Participants	All Programs	SD
Overall Score*	404	407	24

Content Area*		
Cardiology	407	408
Dermatology	406	404
Endocrinology	414	409
Gastrointestinal/Nutrition	412	410
Hematology	388	396
Neurology/Neurosurgery	388	406
Pre-Operative/Post-Operative Care	398	402
Pulmonology	379	399
Urology/Renal	401	401
Task Area*		
Clinical Intervention	404	408
Clinical Therapeutics	396	403
Diagnosis	406	408
Diagnostic Studies	417	413
Health Maintenance	396	393
History and Physical	418	413
Scientific Concepts	377	400

Note: *Averages taken for General Surgery EOR versions 6 and 7

Table 11

Student Participants' Emergency Medicine EOR Exam Scores

	Student Participants	All Programs	SD
Overall Score*	412	408	21
Content Area*			
Cardiology	425	405	
Dermatology	427	407	
Endocrinology	403	405	
ENT/Ophthalmology	419	404	
Gastrointestinal/Nutrition	399	407	
Hematology	411	402	
Neurology	414	405	
Obstetrics/Gynecology	414	405	
Orthopedics/Rheumatology	412	408	
Psychiatry/Behavioral Medicine	405	404	
Pulmonology	401	407	
Urology/Renal	399	403	
Task Area*			
Clinical Intervention	413	405	
Clinical Therapeutics	414	409	
Diagnosis	418	407	
Diagnostic Studies	405	406	

Health Maintenance	410	404
History and Physical	409	405
Scientific Concepts	416	406

Note: *Averages taken for Emergency Medicine EOR versions 6 and 7

Table 12

Student Participants' Women's Health EOR Exam Scores

	Student Participants	All Programs	*SD*
Overall Score*	406	404	24
Content Area*			
GYN – Disorders of the Breast	424	408	
GYN – Infections	399	409	
GYN – Menstruation	414	405	
GYN – Neoplasms	387	405	
GYN – Other	398	397	
GYN – Structural Abnormalities	407	400	
OB – Labor and Delivery Complications	405	399	
OB – Postpartum Care	400	403	
OB – Pregnancy Complications	412	407	
OB – Prenatal Care/Normal Pregnancy	416	403	
Task Area*			
Clinical Intervention	402	407	
Clinical Therapeutics	416	409	
Diagnosis	402	407	
Diagnostic Studies	399	402	
Health Maintenance	421	400	
History and Physical	407	402	
Scientific Concepts	395	403	

Note: *Averages taken for Women's Health EOR versions 6 and 7

Table 13

Student Participants' Pediatric EOR Exam Scores

	Student Participants	All Programs	*SD*
Overall Score*	415	409	25
Content Area*			
Cardiology	409	416	
Dermatology	419	410	
Endocrinology	400	397	
ENT/Opthalmology	421	408	

Gastrointestinal/Nutrition	436	411
Hematology	398	394
Infectious Disease	440	414
Neurology/Developmental	411	407
Orthopedics/Rheumatology	396	400
Psychiatry/Behavioral Medicine	404	405
Pulmonology	405	414
Urology/Renal	409	403
Task Area*		
Clinical Intervention	408	409
Clinical Therapeutics	427	410
Diagnosis	411	414
Diagnostic Studies	417	411
Health Maintenance	417	404
History and Physical	415	406
Scientific Concepts	415	407

Note: *Averages taken for Pediatrics EOR versions 6 and 7

Table 14

Student Participants' Psychiatry EOR Exam Scores

	Student Participants	All Programs	*SD*
Overall Score*	415	409	24
Content Area*			
Anxiety Disorders: Trauma- and stress-related disorders	437	414	
Depressive Disorders: Bipolar and related disorders	411	411	
Disruptive, impulse-control and conduct disorders: Neurodevelopmental disorders	411	407	
Feeding or eating disorders	390	408	
Paraphilic disorders: Sexual dysfunctions	451	405	
Personality disorders: Obsessive-compulsive and related disorders	434	414	
Schizophrenia spectrum and other psychotic disorders	436	411	
Somatic symptom and related disorders: Nonadherence to medical treatment	420	410	
Substance-related disorders	483	410	
Task Area*			
Clinical Intervention	412	412	
Clinical Therapeutics	419	417	
Diagnosis	413	417	
Diagnostic Studies	411	406	
Health Maintenance	415	406	
History and Physical	424	410	

		418	407
Scientific Concepts			

Note: *Averages taken for Psychiatry EOR versions 6 and 7

Table 15

Summative Exam Using Family Medicine EOR Version 7

	Student Participants	All Programs	*SD*
Overall Score	413	403	25
Content Area			
Cardiology	417	408	
Dermatology	407	403	
Endocrinology	404	405	
ENT/Ophthalmology	414	405	
Gastrointestinal/Nutrition	425	412	
Hematology	393	397	
Infectious Disease	390	402	
Neurology	407	406	
Obstetrics/Gynecology	414	405	
Orthopedics/Rheumatology	407	405	
Psychiatry/Behavioral Medicine	399	406	
Pulmonology	425	414	
Urgent Care	409	402	
Urology/Renal	411	400	
Task Area			
Clinical Intervention	404	407	
Clinical Therapeutics	413	410	
Diagnosis	422	408	
Diagnostic Studies	411	409	
Health Maintenance	401	410	
History and Physical	406	408	
Scientific Concepts	425	408	

The quantitative data presented by the student survey Likert-type responses, PACKRAT, and PAEA EOR were examined for correlations and implications against the themes provided by the faculty interviews and qualitative student survey data.

Mean Likert scores were calculated across the survey topics related to the organization of PBL curriculum, the impact of PBL on students' preparation for clinical practice, the impact of PBL on PANCE preparation, the use of technology in PBL courses, and the overall impact of

PBL on students' PA education. Students answered that the overall impact of PBL on their PA education fell between partially exceeding expectations to exceeding expectations with a mean Likert score of 4.47. Students reported that PBL's impact on their preparedness for the PANCE met their expectations with a mean Likert score of 3.53. The mean Likert scores revealed students' expectations of PBL impact on clinical preparation and use of technology in PBL were partially exceeded with scores of 4.40 and 4.47 respectively. Students communicated that the organization of the PBL curriculum partially exceeded their expectations with a mean Likert score of 3.93. These scores reflect that students felt PBL had impacted their PA education with the greatest implications on that impact being the preparation for clinical practice and the use of technology.

Academic preparation for the PANCE was represented in their exam scores on the PACKRAT and PAEA EOR exams. As previously noted, these exams have been identified as predictors of PANCE success (Buchs et al., 2019). PACKRAT scores for the student participants were collected from two attempts, once at the end of their didactic year of the program and the second in the final semester of their clinical year of training. These attempts are identified as first-time test takers and second-time test takers, respectively. As first-time test takers, a mean score of student participants exceeded the national mean of all PACKRAT first-time takers (140.40 for participants, 134.5 for all takers, $SD = 19.6$). Second time means for student participants did not exceed the national mean; however, were very closely aligned with the national mean (153. 93 for participants, 154.2 for all takers, $SD = 14.9$). These results would suggest that student participants were well prepared for the PACKRAT exams through the PA program curriculum, including their experiences in PBL courses; however, the implication of PBL pedagogy cannot be specifically identified with this data alone.

To aid the researcher in understanding specific areas where students either struggled or flourished, PAEA EOR exam results were also examined. Standardized exam scores were collected for student participants against exam takers from all PA programs nationally who utilize the PAEA EOR exams to assess students. Student participants scores exceeded the national means on the Internal Medicine (participants 409, all programs 405, $SD = 23$), Emergency Medicine (participants 412, all programs 408, $SD = 21$), Women's Health (participants 406, all programs 404, $SD = 24$), Pediatric (participants 415, all programs 409, $SD = 25$), and Psychiatry (participants 415, all programs 409, $SD = 24$) EOR exams. The student participants scored equally with all program takers on their initial Family Medicine EOR exam (participants and all takers 403, SD 25).   Students were given a subsequent Family Medicine EOR exam at the end of the PA program, after completing both didactic and clinical training, where the student participants exceeded the national mean (participants 413, all programs 403, $SD = 25$). Student participants scored below the national mean on the General Surgery EOR exam (participants 404, all programs 407, $SD = 24$).

In examining the quantitative data, including student survey results along with PACKRAT and EOR exam scores, correlations may be made against the major themes produced in the faculty interviews and student survey responses.

Theme #1: Alignment of content across the program courses. The most prevalent theme across the study, based on faculty and student responses, is focused around curriculum design and delivery. Theme one identified improving the alignment of content across the program courses, while taking learning style and adult learning theory into account. The generated theme reflects a need to have curriculum aligned by blending content across the courses and delivered in a manner specific to adult learning. Faculty and student participants

commented on the melding of course content between classes within the curriculum to enhance

retention, recollection and application. The quantitative results of the PACKRAT and EOR

exams provide a breakdown of PANCE content areas where faculty may enhance the curriculum

and implement changes within the PBL coursework to improve overall academic success. As an

example, student participants scored below the national average in Dermatology, Endocrinology,

and Gastrointestinal/Nutrition as first-year PACKRAT takers. This provides faculty insight into

which areas of medicine to improve content delivery and enhance student learning through

stronger, more focused attention between courses, including PBL.

      Theme #2: Improving faculty facilitation. The second theme, improving faculty

facilitation, was generated through the data which focused on codes related improving student

confidence and motivation to succeed through faculty facilitation. This Faculty and students

both identified the importance of enhancing students' academic, clinical, and professional

confidences and encourage motivation to succeed. Student comments in the narrative responses

within the survey noted how PBL can enhance confidences and improve their motivation. The

student participants scoring above the national mean on the initial PACKRAT and majority of

EOR exams reflects a foundation of knowledge and confidence that was gained through their

experiences in the program. PBL facilitation may be improved to continue to enhance these

confidences and student motivation. Implementing curricular changes conceptualized by theme

one, offering more immediate constructive feedback through more small group activity, and

increasing opportunities to apply the foundational knowledge may bolster their academic success

as measured in the PACKRAT, EOR exams, and ultimately the PANCE.

      Theme #3: Restructuring the peer interactions. The third theme produced within the

results was to enhance learning through restructuring peer interactions with opportunities to

model practical application by progressively implementing active, experiential peer learning experiences. Areas of improvement opportunity for PBL utilizing this theme may be found in the progression of the delivery. Experiences in the first semester of PBL may be less interactive, with less peer interaction, as students are only in the beginning of their medical education journey. Each student brings unique prior medical experience; however, the experiences they are modeling as health care providers is new to all students at this stage. The quantitative data reflected areas such as Dermatology and Gastroenterology as content areas students did not perform as well on with their first PACKRAT exam. These topics are introduced in the initial semester; therefore, an assumption may be that improvements may be made earlier in the curriculum to enhance active, experiential learning in small groups earlier in the program.

Discussion

The data in this research supports the conclusions drawn by previous researchers related to the pedagogy of PBL as well as academic success in medical education, specifically in PA education. This results both confirm and support empirical and theoretical research previously discussed.

Empirical Literature

In examining the results and developing themes which address the research question, three major concepts emerge. Each of these concepts, and potential solutions, may be supported through previous research. The themes enhance PBL learning through improved content alignment across the courses blending content, instruction, and learning styles; improving students' academic, clinical, and professional confidence and motivation; and enhance learning through opportunities to model practical application by progressively implementing active, experiential peer learning experiences are similar to those found in other research. Burgess et al.

(2018) wrote of themes generated by data which were "better preparation, immediate feedback on progress, and smaller group sizes" (p. 6).

Theme #1: Alignment of content across the program courses. PBL enhances learning through active, experiential modalities designed to bring students towards successfully meeting specific learning outcomes and objectives (Midla & Coryell, 2010). A challenge in PA education, is effectively utilizing a PBL pedagogy to enhance learning outcomes which are measured through a standardized MCQ assessment, the PANCE. The curriculum content in PA education is typically derived from the PANCE blueprint provided by the NCCPA as well as professional competencies provided by the AAPA and accreditation standards provided by the ARC-PA (NCCPA, 2018; AAPA, 2012; ARC-PA, 2018). PBL may enhance the academic success of PA students by blending all of the content across the curriculum into a forum where students actively apply knowledge in modeled practical application. For example, if each of the courses within a PA program are teaching topics related to Endocrinology, then all of the content being discussed for a particular day, week, or other block of time, may be collated into case presentations where students apply this content practically. Zahid et al. (2016) wrote about the PBL format requiring students utilize prior knowledge to expand their ability to develop differential diagnoses, diagnostic test plans, therapies and plans for patients in clinical vignettes. The initial theme within the research suggests that to ensure optimal utilization of this process, the content across the curriculum must align where students have an introduction to basic fundamental knowledge where they can expound upon it to develop clinical tools and solidify concepts through experience.

Although the quantitative data reflects that students' expectations of PBL curricular organization were partially exceeded, some commented that content could be improved by

"incorporating more diagnostic interpretation" and by aligning closer to the PANCE blueprint. These recommendations may be implemented by a more thorough mapping of curriculum across the program as recommended by Kassab et al. (2016). The data also provides where enhancements may be made to curriculum alignment in content areas reflected in PACKRAT content breakdown and individual EOR exams. Previous research in PBL on academic success in PA education revealed that certain content area may not be strongly enforced by PBL where other content areas are (Wardley et al., 2013).

In a blended LBL and PBL curriculum, PBL may be used to support the content delivered through LBL and reduced burdens to traditional courses through effective organization of content (Miles et al., 2017). An examination of curricular content across courses, aligned with the PANCE blueprint and other resources, may provide insight into the progression of PBL with content blended across courses. By mapping content across the curriculum, targeting content areas where PBL may not align closely with the PANCE blueprint, and enhancing the progression of active learning, student academic success may be improved. Sroufe and Ramos (2015) identified cross-discipline benefits in a graduate business program which may be produced through the alignment of coursework across a PA curriculum.

Theme #2: Improving faculty facilitation. The second theme produced within the research is enhancing students' academic, clinical, and professional confidences and encourage motivation to succeed through improved faculty facilitation. Ungaretti et al. (2015) wrote about PBL providing students opportunities that are enhanced through behavior and attitude as much as cognition. PBL has been shown to improve student confidence and motivation in other research. Gould et al. (2015) wrote about the equivocal impact of PBL on academic success while significantly improving student motivation. In researching PBL in medical school education,

Bunting (2016), concluded that PBL not only improved academic success, but also increased student motivation to learn and bolstered student engagement.

Methods to further build upon student confidence and motivation in a PBL may be enhanced through strong faculty support, providing timely assessment feedback with constructive criticism, and reflection on growth through peer interactions. Faculty support, enthusiasm and focus on student-centered learning has been shown to increase student confidence and motivation (Reddy & McKenna, 2016). Positive reinforcement through faculty facilitation of student-centered learning may improve motivation, confidence, and therefore, academic and professional success. Midla and Coryell (2010) wrote about PBL faculty facilitation being influential in overall success of student outcomes. Through this facilitation, faculty may provide feedback using either direct or indirect assessments. Indirect assessment allows for students to gain deeper insights through experiential reflection through peer discussion as a form of focus group after case participation. Adding direct assessment methods through MCQs based on PBL case content, aligned with the PANCE blueprint, was suggested by both faculty and student participants and may provide tools to improve confidence and motivation. As well, opening the course to more peer interaction focused on constructive feedback may also benefit confidence and motivation levels. Cuevas (2015) wrote that providing students a collaborative venue for learning reduces stressors across a population of diverse learning styles. Improving the dynamics within PBL in these manners may also improve academic outcomes comparable to findings reported by Zahid et al. (2016) where PBL taught students' academic achievements and motivation were better than non-PBL students.

Theme #3: Restructuring the peer interactions. The third theme revealed in the data is to restructure the peer interactions to enhance learning through opportunities to model practical

application by progressively implementing active, experiential peer learning experiences. PA

students have performed better academically and clinically through active, experiential learning

when foundational medical knowledge is compounded with clinical application (Parkhurst,

2015). This concept was reinforced by Faculty Four who stated, "I think the research supports

this, that the simulated environment, role-playing, and really having the students act things out is

extremely valuable" (personal communication, November 21, 2019). Improving the PBL

curriculum at the target PA program with more unique clinical application opportunities

supported by content information aligned throughout the program may reinforce concepts for

improved retention, recollection, and future application. Korin et al. (2014) wrote that

restructuring curriculum similarly with a multiple session dynamic with student role-playing

strengthened cognitive critical thinking.

The PBL curriculum currently utilizes these concepts; however, much of the role-playing

and small group activity occurs later in the didactic year once students have been guided through

critical thinking and clinical application. To improve the curriculum, the implementation of

modeling practical application through role-playing and small group interactions may be

restructured to occur earlier in the course. One challenge to the implementation of this plan lies

in faculty availability to facilitate these activities. AlBuali and Khan (2018) recommended that a

faculty to student ratio of 1:10 may be required for effective facilitation. The current faculty to

student ratio for PBL at the target university fluctuates between 1:6 to 1:12 with the ideal

facilitation ratio being 1:10 or below. Faculty availability is only one challenge, though.

Hawkins et al. (2018) also identified that faculty experience in PBL facilitation also influences

MCQ exam results. Therefore, faculty development and improving faculty facilitation

experience is also an important variable in enhancing student learning through adding more interactive peer experiences to the curriculum.

Theoretical Literature

The research also confirms or supports the theoretical literature related to PBL in PA education. The theories represented through the pedagogy of PBL and this research were previously identified as social constructivism theory, adult learning theory, and model theory. The data collected and analysis of the data relates to these theories with support of the problems and potential solutions to the problems.

Social constructivism theory. In analyzing the data which collected to identify problems and formulate potential solutions to those problems, the correlations within social constructivism become apparent. Social constructivism offers theory related to educational experiences as social through an active, creative process where students interact both independently and as a social group to discover deeper meaning to concepts, often with facilitation, to build on evolving knowledge foundations (Paris, 2011). PBL epitomizes this theory in the nature of content delivery and student learning. Faculty and student input both reflect the nature of PBL as an effective means to adapt foundational knowledge into practical application by searching, manipulating, exploring, and investigating complex medical problems to gain deeper understanding which enhances retention and recollection (Schunk, 2016). Students commented that PBL "..forced me to think critically…," "allowed me the space and opportunity to work through information and bring it together cohesively…," and "…to not just memorize information but see how it would be used practically." These comments reflect the core of Prihatiningsi and Oomariya's (2016) conceptualization of exposing students to real-life scenarios to engage students' cognitive and creative processes. Enhancing alignment of content,

instruction, and learning styles, as well as building on PBL curriculum to improve the progressive, peer learning experience by implementing more social dynamics within the coursework is supported by social constructivism theory.

Adult learning theory. Adult learning theory, based on self-concept, utilizes learners' experiences and motivations to orient the discovery of new information based on a foundation of previously acquired knowledge (Leigh et al., 2015). The first theme identified, improved content alignment across the courses blending content, instruction, and learning styles, may be supported through adult learning theory. As the theory poses, adults learn optimally through experiential processes which is student-centered and collaborative in nature (Halalau et al., 2016). Faculty One identifies active learning, as posed in adult learning theory, as "a more efficacious approach" to student learning (personal communication, November 20, 2019). Enhancing PBL by improving student confidences and motivation through faculty and peer feedback, experienced faculty facilitation, and constructive peer interactions are supported through the principles Rashid (2017) identified in a conglomeration of theories including experiential learning, situated learning, transformative learning, and reflective practice. Taking these principles into consideration offer theoretical support for the concepts discussed previously throughout themes one and two.

Model theory. Seel (2017) wrote that model theory allows implications and impacts of a phenomenon to be ascertained through a basic representation of a sample of that phenomenon. This theory is supported as students reflect on their experiences in PBL, where case vignettes served as a sample of the phenomenon presented in actual patient care cases. Improving PBL in PA education seemingly relies heavily on the assumptions in model theory where students are introduced to representation of actual clinical practice through modeling real-life application in

simulated settings. Gilkey et al., 2016 wrote about model theory being implemented to analyze

finite problems with infinite possibilities for solutions. This concept is reflected in one comment

provided in a faculty interview. Faculty Four reflected on this learning stating, "they definitely

have to grapple with real world scenarios and real-world problems that may or may not have a

right answer." Students commented on the nature of PBL as "formative as it allowed students to

combine and implement clinical skills, reasoning, and knowledge learned in each of the other

courses in mock clinical scenarios."

Concepts for improving PBL in PA education, as reflected in the three themes, can be

supported through model theory particularly related to student confidences and motivation and

modelling practical application. By modelling the practical application of content, students in

simulated environments, utilizing role-play of real-world medical issues, will be better able to

draw connections between academic learning and real-life application (Kment, 2016). Model

theory promotes analysis of relationships between variables within a system (Arazim, 2016).

Students in PBL activities, utilizing model theory principles, will be better equipped to identify

relevancies across variables when interacting with patients; identifying relevant history and

physical exam findings; determining diagnostic studies; and identifying risks, benefits, and

alternatives to therapeutic interventions; due to their experiences in simulation.

Summary

This applied research study sought to solve the problem of designing and delivering a

PBL curriculum where students are prepared for clinical practice and pass a the PANCE. The

researcher initially identified a potential where there may be a disparity between application of

medical knowledge taught in PA education with student outcomes measurement through

standardized MCQ exams, and there may be improvements required within PBL to bridge this

disparity. The research began with the central question, "how can the problems of problem-based learning be improved in PA education at a university in eastern South Carolina?" This chapter revealed the results of research including faculty interviews, qualitative narrative responses to student survey questions, qualitative responses to student survey questions, and archival data in the form of PACKRAT and PAEA EOR standardized exams. Through analysis of this data, three themes emerged. The three themes identified a need to improve the alignment of content across the courses blending content, instruction, and learning styles; improving students' academic, clinical, and professional confidence and motivation; and enhance learning through opportunities to model practical application by progressively implementing active, experiential peer learning experiences. Proposed solutions built around these themes include mapping content across the curriculum to ensure alignment between courses as well as with the PANCE blueprint, enhancing content based on PACKRAT and EOR exam content breakdown scores, and improving faculty facilitation and student feedback methods focused on bolstering confidence and motivation. Other improvement potentials revealed through the identified themes include creating more opportunities for peer-to-peer interactions and increasing small group and role-playing by implementing these principles earlier in the PBL curriculum. These themes and proposed solutions support findings reflected in both empirical and theoretical literature.

CHAPTER FIVE: CONCLUSION

Overview

In this applied research study, the researcher sought to identify problems within PBL curriculum in PA education. The purpose of the study was to solve the problem of designing and delivering a PBL curriculum which enhances students' critical thinking and prepares PA students to pass a national certifying examination at a small university in eastern South Carolina. In this chapter, the researcher details the problems identified through the research and proposes solutions to these problems. These solutions include the improved alignment of curriculum content across the program, improved faculty facilitation of PBL coursework, and restructuring the peer interactions providing more small group, role-playing, and use of patient simulators. The chapter documents the resources and funds needed to implement these solutions, the roles and responsibilities of those involved, and a proposed timeline needed to resolve the problems. The author identified potential social implications and an evaluation plan to assess the effectiveness of the solutions on the problems.

Restatement of the Problem

In PA education, students are trained to become health care providers responsible for the diagnosis and treatment of patients in multiple health care settings (U. S. Dept of Labor, 2014). PA student academic success is measured through a standardized MCQ examination, the PANCE (NCCPA, 2018). One pedagogy utilized throughout medical education, including PA programs, is PBL, an active, experiential learning dynamic that provides an opportunity for students to sharpen clinical skills and critical thinking (Ungaretti et al., 2015). The problem with PBL in PA education lies in development of curriculum that leads towards the honing of the clinical acumen required in patient care while ensuring students' academic success as measured

by the PANCE. In the student surveys, quantitative data reflected that PBL met the students'

expectations regarding PANCE preparation; however, this category scored lowest across the

survey items. In a narrative response on the student survey, one student wrote that PBL prepared

them for clinical practice but not for the PANCE. Therefore, to examine this problem, the

researcher began with a central question, "How can the problems of PBL be improved in PA

education at a university in eastern South Carolina?"

Proposed Solutions to the Central Question

In search of solutions that would answer the central question, the researcher interviewed

five PA faculty members, surveyed 15 PA students who completed all PBL curriculum and were

well into their clinical year of training, and analyzed standardized exam (PACKRAT and PAEA

EOR exams) scores of student participants to identify themes reflecting the underlying nature of

the problem and potential solutions. These themes provided a guide to developing solutions

including the alignment of curriculum content, improving faculty facilitation, and restructuring

opportunities for peer interactions through role-playing, additional simulation use, and more

small group activities.

Alignment of Curriculum Content

The didactic year curriculum, which includes the PBL course content, at the target

university PA program is organized by major organ system and taught using multiple

pedagogical platforms including LBL, PBL, and laboratory settings (Anonymous South Carolina

University, 2019). Course objectives are each mapped across the curriculum based on the

PANCE blueprint. The main body of the didactic year is encompassed in the following courses:

Basic Science, Clinical Medicine, Patient Assessment and Diagnostic Methods (PADM),

Pharmacology, and Problem-Based Learning (Anonymous South Carolina University, 2019).

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about upcoming PBL experiences. The non-PBL faculty may then intertwine aspects of the PBL

cases into their lecture material. In turn, during PBL courses, facilitators may ask students to

reflect back on specifics drawn in other courses to enhance the PBL learning. Regarding the

content on diabetes, faculty teaching Basic Science and Clinical Medicine may focus material on

the specifics of Type Two Diabetes Mellitus (T2DM), Pharmacology faculty may coordinate

specific medication instruction around those which may benefit the modeled PBL patient case,

and the PADM course faculty may introduce specific diagnostic strategies which meet with the

skills students will need to apply in the PBL case.

The courses could also coordinate assessment items across the curriculum based on PBL

cases students are presented with. In the narrative comments provided through the student

surveys, some students noted that PBL may be improved by interjecting MCQ style questions,

modeled after PANCE questions, based on the content discovered through the PBL experiences.

Faculty across the curriculum may be able to augment their assessments to include test items

which are formulated from PBL cases. This strategy is supported through both reformulation

and transcendence. Reformulation allows students to demonstrate understanding and interpret

knowledge and skill through assessment to reinforce what has been learned. Transcendence is

when students advance to conceptualization and practical application (VanBrummelen, 2002).

These principles reinforce what Faculty Four state, "…reliving and repetition as the way that

people learn how to do things, and so, the more time that they have to build those skills, the

better…" (personal communication, November 21, 2019).

Along with more closely aligning the specifics of content between courses, the PBL

curriculum may be more closely aligned with student PACKRAT and PAEA EOR content

breakdown scores. There are approximately 20 content and task areas assessed by these exams

(some EOR exams vary) where student achievement may be measured according to major organ system or clinical tasks. The ARC-PA (2019) requires programs maintain self-inspection programs where this data is routinely collected. With each cohort of students who take these exams, the faculty may review the breakdown of scores to identify areas of weakness in the curriculum. Where a statistical significance is noted across student scores, faculty may reexamine curriculum for areas which may be enhanced to strengthen these content and task areas. Nilson (2016) wrote about critics of PBL who note that curriculum content introduced becomes too broad to cover all the necessary objectives. By utilizing the PACKRAT and EOR exams, PBL faculty may identify where content areas need to be strengthened. For example, the student participants' PACKRAT exam for first-time takers reflect scores below the national average in Dermatology, Endocrinology, and Gastrointestinal/Nutrition. PBL faculty may then examine the curriculum during the timeframe these subjects were introduced to enhance the delivery of that specific content.

Improving Faculty Facilitation

The foundation for improving faculty facilitation within PBL coursework was driven by concepts presented in the second theme which emerged from the research data. The data reflected that student academic, clinical, and professional confidence and motivation was influential in their overall academic success which is to be measured through the PANCE. This data is consistent with Bickerstaff, Barragan, and Rucks-Ahidiana (2017) who reported "research has found that self-efficacy and confidence, or the belief in one's capabilities to organize and successfully complete a task, are tied in important ways to students' academic identity, aspirations, motivation, achievement, and ultimately persistence" (p. 501). Literature has revealed that faculty involvement, motivation, and encouragement, along with direct and indirect

assessment feedback with constructive criticism and on-going reflection on growth are key components of improving student motivation and confidence (Ashwini, Shah, Vinay, & Shetkar, 2017); Bickerstaff et al., 2017; Nilsen, 2009). This implies that faculty facilitation may greatly impact the confidence and motivations that students have which will in turn affect academic success.

Facilitation of PBL courses in PA education requires faculty have a solid foundation of clinical knowledge but also have to ability to productively coordinate group functioning where students are guided through both clinical experiences and learning processes (Hawkins et al., 2018). Improving on these skills will consist of more than simply gaining experience in PBL dynamics, but also involve enhancing interpersonal relationship skills, group dynamics, and a deeper understanding of how adult learners acquire and retain information. Hawkins et al. (2018) wrote that experience level, being measured in various methods based on either clinical expertise or academic experiences, may not correlate with student outcomes. With this in mind, faculty facilitation improvements should be focused on a multifaceted faculty development plan including moderating small group activities with effective communication skills, guiding critical reflection including effective feedback, and understanding adult learning theory (Cianciolo, Kidd, & Murray, 2016; Hawkins et al., 2018; Zaidi et al., 2010).

Moderating small group activities. PBL employs learning through simulated real-world problems through peer-to-peer interactions in small group settings (Midla & Coryell, 2010). As one student in a survey response stated, these small group activities allow students to "get to know one another and learn from each other." Moderating these activities includes faculty supporting students through a collaborative process where students build on each other's knowledge and skill, modelling effective feedback techniques, and encouraging all students to

participate in the experience (Goh, 2014). As not all students are equal, each with their own

unique personality, character, prior experiences, learning styles, cultural backgrounds, and

beliefs, when interacting in small groups, it is important that faculty are able to moderate

effectively to balance the interactions, ensuring each student has an equal opportunity to succeed.

In one faculty interview, Faculty Five commented on presenting a standardized approach in

moderating discussion and time-management within the patient care experiences where students

were encouraged to participate in not only the formative and summative discussion of medical

care but also provide constructive guidance and self-reflection (personal communication,

November 22, 2019). This concept is supported by Cianciolo et al's. (2016) social congruence

within PBL encouraging interpersonal interactions which allow students the comfort and

confidence to take risks.

Guiding critical reflection. One key component to PBL is the learning through self- and

peer-lead interactions. Facilitators in PBL are tasked with facilitating this interaction towards an

effective dialogue where discovery of information through experience builds on prior knowledge

(Zahid et al., 2016). Improving on this facilitation requires that faculty have the skills to lead

students towards a reflective process by setting clear criteria, identifying strengths and

weaknesses, misconceptions, and improper critical thinking; as well as providing constructive

feedback regularly (Goh, 2014). Within the student survey data, one student commented about

critical reflection in small groups as being an effective tool to find ways to improve as a health

care provider; however, another student noted that they realized the small group interactions, at

times, "allowed me to rely on other people too much and not realize my weaknesses." Through

faculty facilitation, discussion and guidance of critical reflection should reveal these types of

revelations at the time of the experience, providing students' insight towards self-improvement.

Bickerstaff et al. (2017) wrote, "The evidence suggests that faculty members can structure experiences of both destabilization and earned success for students by making the results of students' efforts transparent to them" (p. 508).

Understanding adult learning theory. Van Wyk and McLean (2007) wrote that some educators who are accustomed to traditional learning approaches may have difficulty transitioning to PBL as a student-centered pedagogy. As mentioned, PA students, as adult learners, prefer learning environments which employ a collaborative, experiential strategy with student-centered experiences (Halalau et al., 2016; Leigh et al., 2015). Facilitators who teach LBL curriculum and assist with PBL facilitation may find it difficult to transition between pedagogical approaches. Faculty One, in an interview, commented, "Ultimately, I think with the generation of students that we're currently teaching…a more active learning approach is a more efficacious approach" (personal interview, November 20, 2019). Faculty may take opportunities within LBL settings to employ more adult learning theory; however, the dynamics of PBL require that adult learning be a central tenet of the design (Van Wyk & Mclean, 2007).

There have been studies on strategies to improve PBL facilitation skills, some of which have noted that many attributes that make effective PBL facilitators cannot be taught but must be developed through experience (Goh, 2014). Therefore a multifaceted faculty development plan would be recommended which would encompass instruction of principles and techniques and adding to faculty experience. This multifaceted plan would focus on a stronger development of a professional congruence that Cianciolo et al. (2016) identified as an integration of social and cognitive congruencies within the learning environment. Faculty members would be encouraged to attend PBL facilitator workshops hosted by academic organizations who provide PBL expertise and experience. There are several academic and commercial organizations who

provide training in PBL facilitation which may be accessed through a simple internet data search. Faculty facilitation improvement is also recommended through regular formal and informal faculty meetings where all facilitators responsible for PBL content meet to discuss methodology and student interactions, case content, main discussion points, and a unified vision for achieving student learning outcomes. Hawkins et al. (2018) wrote "Programs using PBL as a pedagocial method would likely benefit from consistent training and observation of facilitators, as well as frequent facilitator meetings to avoid 'drift' in technique" (p. 8). A final method to improving the facilitation in PBL courses is through applying principles gained by accepting regular student feedback as this "provides more specific direction for individual facilitator reflection and can direct faculty efforts at staff development" (VanWyk & Mclean, 2007, p. e30). Implementing the proposed solution to improve the effectiveness of PBL facilitation may lead to student confidence and motivation enhancement and, in turn, lead to overall academic success.

Restructuring Peer Interactions

The final area of improvement to enhance student academic success, as measured by the PANCE, utilizing PBL, was identified in the themes as a need to restructure opportunities for peer interactions through role-playing, additional simulation use, and more small group activities. In the initial stages of the PBL curriculum at the target university's PA program, there is an introductory period where students are instructed on clinical application, establishing differential diagnoses, and critical thinking through case vignettes and large group activities. The small group breakdown is typically scheduled in the latter weeks of the first semester and progressively develops throughout the year (Anonymous South Carolina University, 2019). The data obtained through faculty interviews and student surveys identified that a restructuring of this timeline to add more small group experiences, including more use of high-fidelity patient

simulators and role playing may be more beneficial. One student survey response included a comment, "I think in the beginning of the year things just moved a little slower but that's cause we were all new to the process."

In the initial curriculum design, the introduction of critical thinking and critical reasoning, which PA students may not have a firm foundation in prior to matriculation into the program, may have been a consideration leading to utilizing larger group activities to assure standardization of processes within the course. However, restructuring the introductory modules of the curriculum may be enhanced by adding small group activities earlier to not only build on the foundational concepts but also initiate group dynamics and small group interpersonal skills sooner in the curriculum. Although the groundwork in medical decision making and critical thinking takes place as core processes in PBL, students may also find advantages in starting small group activities from the very beginning of the coursework by honing social dynamics which Parkay et al. (2014) described as student learning through experiences building time and resource management, avoiding predetermined or predictable outcome expectations, and becoming accustom to allowing the discovery of knowledge through unfolding case information.

Restructuring the curriculum employing high-fidelity patient simulators was also identified in the themes through the data analysis. Although students' survey results revealed a Likert score of four out of five, reflecting students' recognition that the use of technology in the existing PBL course partially exceeded their expectations, comments were provided in the narrative indicating more simulation time would benefit the course outcomes. A student responded to the survey, "I would include more time with the models in the simulation lab." Utilizing simulation and additional technologies may enrich the students' experiences as another student commented on revisions that could be implemented using simulator technology by

"incorporating more diagnostic interpretation during the encounters to complete the patient visit with the mock patient versus (just) documenting assessment and plan in the physical." These recommendations were reinforced through recommendations of faculty. Faculty Four commented that learning in the simulated environment, role playing, and evoking emotional responses are proven methods of improving on student success and recommended "incorporating more simulation" (personal communication, November, 21, 2019). The benefits of additional use of simulation technology may reach beyond critical thinking and clinical knowledge formulation to also improve students' "communication skills, professionalism, teamwork, and clinical skills" not only in PBL, but throughout the program (Smith, 2014).

The data analysis and subsequent themes also identified that restructuring the peer interactions within the PBL curriculum also consider including more role-playing. Again, the current curriculum design allows for role-playing with the students as patient actors as well as clinical roles; however, this is also not incorporated until later in the curriculum (Anonymous South Carolina University, 2019). Role-playing case scenarios would be critiqued by students in large and small group settings through the use of audiovisual surveillance which one student in a survey response wrote was "very helpful." Including more role-playing may therefore build on academic success as students felt that the current course organization partially exceeded their expectations in organization and impact on their PA education.

Nilson (2016) wrote that "the higher percentage of the class involved in a role play, the more activity takes on the characteristics of a simulation" (p. 170). This concept could enhance students recommended changes where scenarios could play out in multiple patient care environments such as emergency departments, urgent cares, outpatient clinics, and inpatient clinics (Student Survey, 2019). By including more students in the role-playing scenarios, faculty

could add to the realistic experiences and build not only on medical knowledge and skills but also on interprofessional team dynamics. "…we know that the PANCE is evolving to include more topics related to professionalism and professional issues. We can incorporate those also into (PBL) to give students another opportunity to…practically apply those things as well" (Faculty One, personal communication, November 20, 2019). As the ARC-PA, AAPA, and NCCPA all include concerns for interprofessional development and team-based medical approaches, inclusion of more students in role-playing may aid in advancing academic success in these areas as well (AAPA, 2012; ARC-PA, 2018; NCCPA, 2018).

Resources Needed

The research data analysis, leading to themes identifying problems and leading to potential solutions drew the researcher to recommend improving the alignment of curriculum content, improving faculty facilitation, and restructuring opportunities for peer interactions through role-playing, additional simulation use, and more small group activities. The literature reveals that resources related to delivering curriculum through PBL included time, properly trained faculty availability, and technology. These resources, which have been noted as weakness areas, are necessary for the implementation of the proposed solutions to improving students' academic success, as measured by the PANCE.

Time

The time commitment required of faculty to develop and facilitate PBL course has been reportedly higher than for traditional learning modalities (Dadd, 2009; Ghufron & Ermawait, 2018; Hogan & Lundquist, 2006; McLaughlin et al., 2014). The current PBL courses at the target university are held twice weekly for two hours each session over three consecutive 12-week semesters (Anonymous South Carolina University, 2019). This provides faculty a total of

48 hours to deliver curriculum over 36 weeks covering all PANCE blueprint content and assessing outcomes. Maldonado (2011) researched effects of multimedia case scenarios on faculty workload and reported that mean facilitator time commitment per case was between 6 and 8 hours with traditional text-based cases.

The time requirement for implementing proposed solutions to the problems may vary based on course content and previous curricular alignment. Aligning curriculum content as previously outlined will require faculty to take time to sit together and coordinate coursework. As the curriculum content is currently aligned both horizontally and vertically by PANCE blueprint topic, the detailed alignment of the content specific to PBL cases will require faculty facilitators, most of which are currently involved in teaching non-PBL courses, meet regularly to discuss content and methods of delivery which will coordinate case vignette content across the courses. The time burden required for these meetings could occur concurrently with other course preparation time allotments as all course directors will be involved in the discussions. In a study examining PBL in medical school education after five years of implementation, Oda and Koizumi (2008) wrote that lecture and laboratory work decreased by 30% after implementing PBL into the curriculum. As faculty collaborate across courses to ensure appropriate alignment of courses according to the PANCE blueprint to include the most up-to-date evidence-based medical practices, they may also coordinate content alignment with PBL case experiences.

PBL Faculty Development

Methods of faculty development as facilitators of PBL may be employed through formal training and informal experiences. Hawkins et al. (2007) wrote about novice PBL facilitators gaining experience and expertise in PBL facilitation through facilitator case guides, daily meetings with other facilitators, as well as mentorship with constructive feedback from more

experienced facilitators. It is proposed that frequent facilitator meetings to discuss case progress, standardize approached to students, situations, and patient scenarios, and regular feedback among faculty may enhance development of facilitation skills and improve students' academic success. One study identified student preferences on standardized, structured guidance through group activities to enhance academic outcomes (Burgess et al., 2018). Meeting weekly to discuss the PBL case scenarios and academic content will enable conversations among faculty to bring cohesiveness and unity. Bringing unity and cohesiveness through frequent collaboration reduces conflict areas, particularly those reported by Aziz, Iqbal, & Zaman (2014) such as basic science and clinical medicine. These meetings will also afford faculty an opportunity to discuss standardized approaches to the situations which may need to be improvised as the scenarios unfold based on student participation. Nilson (2016) wrote about these situations as additional points of frustration for students in a PBL environment.

Along with informal mentorship and meetings with faculty facilitators, PBL faculty development may take place through more formal training venues. It is recommended that faculty members who facilitate PBL coursework attend formal training through workshops, conference events, or other structured continuing education programs related to PBL, adult learning, small group moderation, interpersonal relations, or team-building. One venue for this type of training may be in a PA program faculty retreat. Faculty retreats offer an opportunity to address issues related to admissions, accreditation, curriculum development and integration, and faculty development (Parkhurst, 2015). During a faculty retreat, PBL educators from other programs, or PBL experts from other public or private institutions, may be invited to provide training on facilitation and PBL execution. As well, opportunities exist across multiple continuing education conferences and workshops which could benefit in bolstering faculty

facilitation skills for PBL. By attending formal PBL faculty development, facilitators will have the opportunity to experience learning from the strategies they will employ (Dysart & Weckerle, 2015).

Technology

A recommended solution to the problems in PBL at the target university related to increased use of simulator technology as well as more small-group and role-playing experiences. The technology currently exists at the target university to include high-fidelity patient simulation to the PBL course activities; however, the employment of this technology is limited by the two resources previously mentioned, time and training. Students and faculty identified the current technology in interview and survey responses by commenting on the use of audiovisual surveillance and patient simulators. These technologies offer valuable resources to educators in PBL scenarios (Smith, 2014). A concern with employing simulators and technology in any academic environment, other than funding equipment, is having the time and training to create effective learning opportunities.

One solution to the constraints of time and level of faculty training with technology lies in hiring a technology, or simulation lab, assistant to maintain technology, aid in development of delivery constructs, and train faculty. This assistant may serve as a central focus for technology within the program offering faculty the support and expertise to "build technological proficiency" (Dysart & Weckerle, 2015, p. 256). Many faculty members in higher education work approximately 40 to 50 hours weekly and PBL course development often requires more time and effort to prepare (Ghufron & Ermawati, 2018; Hinrichsen et al., 2002; McLaughlin et al., 2014; Van Rossem, 2018; Ungaretti et al., 2015). By hiring a simulation, or technology, assistant for the program, the time and training limitation should be mitigated and the use of

technology, including high-fidelity patient simulators, would be increased. This would also benefit faculty workloads in other areas of course coordination. McLaughlin et al. (2014) identified that preparation of a non-traditional, flipped classroom took 127% more time than a traditional LBL class and that by hiring a teaching assistant, the faculty time burden was significantly improved. The addition of a technology, or simulation assistant, would allow faculty to reallocate the time spent in preparing simulation experiences, using it more effectively to prepare and align content across the program.

Funds Needed

Of the proposed solutions to the central problem, many do not require any additional program funding where a few of the solutions will require additional budgetary adjustments. The two primary fund requirements would be to pay for formal faculty development training and to hire an additional staff member as the simulation, or technology, assistant. Often higher education institutions offer professional, or faculty development, as an item within the annual fiscal budget. The ARC-PA (2018) standards are that sponsoring institutions of PA education programs must provide financial resources for maintenance of certification and licensure as well as professional development relevant to PA education. The faculty development related to PBL could possibly be funded through currently allocated professional development funds, or an addition of funds would need to be made available to accommodate the training. The PAEA (2018) reported a mean expenditure for faculty development among PA programs as $19,915 (84.3% of programs reported, $N = 198$). The total dollar amount necessary to provide training in PBL related content may be variable depending on the type of training program.

The creation and hiring of a technology assistant to aid with simulation and technology across the program but particularly with the PBL course would also add a budgetary burden to

the university. The PAEA (2018) notes that PA programs' budget for staff salaries was

$181,549 (83.4% of programs reported, $N = 196$) excluding fringe benefits. This researcher

performed a web search of medical simulation technician salaries, and based on data provided

through three websites (Glassdoor, HealthySimulation.com, and Salary.com) the current salary

for medical simulation technicians is between $34,000 and $66,000 annually.

      This additional funding may come from a number of sources. The PAEA (2018)

identifies sources of financial support for PA programs as the sponsoring institution, clinical

practice income, endowments, grands, private donations, and tuition and fees paid directly to the

program. The institutional budget is often driven by tuition and enrollment, and as university

enrollment statistics have shown a decline in admission nation-wide, asking for additional

funding may meet with resistance (U. S. Dept. of Ed., 2019). The program may need to advocate

in the support of proven academic success strategies, such as PBL, as a means of "maximiz(ing)

budget dollars" (White, 2018). Another option to consider would be through obtaining a grant or

endowment to initiate the solutions while assessing the impact of change and value added to the

students' education. Once the solutions are in place and impact on the problem has been

established, the university may then find it more feasible to add the additional funds to the

annual budget, allowing time to adjust revenue streams with expenditures to allocate funds for

continuing the solutions within the program.

      The final, and usually least palatable, solution as a fund source would be through

increasing student tuition or fees for the program. The mean cost of tuition for PA education in

the 2017-2018 reporting cycle at a private university was approximately $91,630 (PAEA, 2018).

The mean cost of student fees was reported at $6,419 (PAEA, 2018). The tuition and fees at the

target university is $94,630 including (Anonymous South Carolina University, 2019). The

funding to add an additional staff member to assist with the technology and simulation laboratory would increase tuition and fees $1,000 to $1,500 per student per cohort. Although increasing tuition is typically not a popular option, as recruitment and retention advocates may feel this increase will negatively affect the number and quality of applicants, this may not be the case. Financial factors, including tuition have been shown to not be as significant to PA program applicants as PANCE pass rates, or faculty and staff quality and morale (Sierra, Forbes, Mirly, & Domenech-Rodriguez, 2018).

Roles and Responsibilities

The implementation of the solutions, including the alignment of curriculum content, improving faculty facilitation, and restructuring peer interactions, will take a coordinated effort from multiple people. The roles and responsibilities required to enact the proposed improvements to the PBL courses will include the university's Vice President for Academic Affairs (VPAA), the PA Program Director, and faculty members who not only teach within the program but also comprise committees which oversee the operation of the program. Two of the committees which will be involved in the process include the Curriculum Committee and the Academic and Professionalism Progress Committee. The ARC-PA (2018) outlines that the program director must be responsible for the organization, administration, planning, continuous review and analysis, and development of the program. Each faculty member must actively participate in designing, implementing, coordinating, and evaluating curriculum (ARC-PA, 2018). The curriculum, and significant changes to curriculum content or delivery, is to be vetted and approved by the Curriculum Committee comprised of a committee chair and principle program faculty. The assessment and analysis of student achievement and progress is analyzed and adjudicated by the Academic and Professionalism Progress Committee who maintain records

of student progress through assessment modalities (Anonymous South Carolina University, 2019). These committees will be instrumental in the evaluation of the efficacy regarding the proposed solutions to the stated problem. These evaluation processes will be detailed later in this chapter.

The responsibility for aligning curriculum content between PBL and the rest of the courses within the program would lie with the course director for each PBL course. It would be this faculty member's responsibility to arrange meeting times, place, and agenda. This person would also serve as the meeting host, moderating the discussion and recording the final content alignments. The PBL course director would also be responsible for creating and maintaining a curriculum map of aligned content across the courses and share this map with the program faculty. This curriculum map would provide more detailed objectives and goals and promote assessment of PBL content throughout the program (Essary & Statler, 2007). It would be the responsibility for each course director to attend the meetings, review the curriculum alignment map, and provide constructive discussion input related to his or her respective course. As many faculty members act as both course directors for courses within the program and PBL facilitators, it would be the responsibility of each faculty facilitator to agree on a unified strategy to PBL moderation. This collaboration between facilitators will enhance the alignment of content and improve how ambiguous problems that have no obvious right or wrong answer will be dealt (Ungaretti, 2015).

The responsibility for improving faculty facilitation will lie with the Program Director (PD) and the Director of Didactic Education (DDE). These individuals will coordinate a method of faculty mentorship between less experienced PBL facilitators and experienced facilitators. The PD and the DDE will also coordinate opportunities throughout the didactic year of the

program for facilitators to discuss strategies that worked well, those that did not, and difficult

discussions in PBL experiences where the faculty may learn from each other's experiences. The

DDE will be responsible for researching and acquiring formal PBL opportunities for facilitators

which will then be forwarded to the PD for final approval. Any professional development

opportunity which requires additional funding will also need the approval of the universities

VPAA.

Faculty development, as previously mentioned, and improved alignment of the

curriculum should lead to enhancement of peer interactions through role-playing and more small

group scheduling; however, the improvement through use of high definition simulation and

technology may lead to the hiring of a simulation and technology assistant. This staff position

will be responsible for the set-up, operation, maintenance, and training related to simulator and

audiovisual technology in the program. This person will be required to have all simulator

equipment prepared, programmed, and available for student learning at the scheduled times. He,

or she, will also be required to operate the technology during simulated patient care experiences

and then maintain the equipment with appropriate cleaning and calibration. The PD, with

approval from the VPAA, will hold the responsibility for posting an appropriate job

advertisement, coordinating the search of candidates, hiring, and supervising the individual in

this position.

<div align="center">**Timeline**</div>

The approximate timeline for implementing and evaluating the proposed solutions to the

central problem is projected as 26 months from the date of implementation (see Appendix P). To

effectively assess the impact on the implementation of the solutions, the researcher will need to

consider the time for hiring a qualified technologies technician; however, the proposed actions

will not be delayed while this process is taking place. Upon approval from the PD, the PBL

course director will begin coordination between faculty members to establish an optimal meeting

time where all faculty can come together to discuss optimal content alignment across courses.

PBL cases have already been created for some content; however, realignment may necessitate

the creation of new cases throughout the didactic year. This content will be developed as the

year progresses to not delay implementing the improvement plan until all alignment and content

has been agreed upon. Ideally, the initial coordination and planning for the alignment of

curriculum and creation of PBL experiences will begin in January at the beginning of the

didactic year for the newest cohort of students. During the first five weeks of the didactic year,

referred to as Unit One, students are involved in an intense Human Anatomy course and

Diagnostic Sciences course, allowing alignment of content that begins in the following unit

(Anonymous South Carolina University, 2019). This initial five week unit will provide time for

initial content alignment discussions, coordination of PBL small group activities, and creation of

case vignettes or exercises. The Curriculum Committee will also have an opportunity to meet at

this time, discuss the changes, and either approve or make recommendations for augmentation.

Throughout the didactic year of the program, a weekly, or bi-weekly, meeting will be

established where PBL facilitators may meet to discuss content alignment, previous week student

interactions, and PBL experiences. This will also be a time when mentorship and training

between experienced and non-experienced facilitators may occur. The weekly meeting format

will also include time for discussion regarding PBL observations of both faculty and students.

Hawkins et al. (2015) wrote that weekly meetings for faculty may improve facilitation past the

significance on student achievement weighed through faculty experience. Also, during the

didactic year, faculty will be given opportunities to go to formal training at conferences and

workshops offered by organizations such as the PAEA, AAPA, and the South Carolina Academy of Physician Assistants (SCAPA). Formal training in PBL related concepts will also be provided at the faculty retreats held in May and December of each year.

Three PBL courses will run consecutively from February through November, and the students will be assessed utilizing the PACKRAT in November. In December, clinical year students will graduate the program and didactic year students will move into their clinical year. In October of the second year, the clinical year of the program, students will be assessed once again through the PACKRAT. All throughout the clinical year, students will be assessed using the PAEA EOR exams. Upon completion of all graduation requirements, students will be allowed to schedule the PANCE (NCCPA, 2018). Therefore, indicators for success of implemented changes cannot be fully measured until the students complete the 24-month PA program and take the PANCE.

<div align="center">

Solution Implications

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The implications for the proposed solutions to improve PBL at the target university involve many stakeholders in a variety of ways. The stakeholders, including PA students and families, faculty, the supporting institution administration, prospective health care employers, future patients, community members, and other academic professionals may all be impacted by the results of this research and the effective employment of the solutions. For the purposes of this research, the author will identify the stakeholders as first- and second-degree stakeholders. First-degree stakeholders include the PA students and their families, faculty members, and the supporting institutions administration. Second-degree stakeholders include prospective health care employers, future patients, community members, and other academic professionals who employ PBL as a pedagogy.

First-Degree Stakeholders

The first-degree stakeholders are impacted by directly by the solutions proposed in this chapter. The implications of each aspect of implementation will have an immediate impact on these stakeholders related to the resources and funding, roles and responsibilities, timeline, and evaluation of the results.

Resources and funding. The implication on the first-degree stakeholders related to the resources and funding may be significant. Many researchers have identified that PBL preparation requires more time of both faculty and students for preparation and execution (Ghufron & Ermawait, 2018; Hogan & Lundquist, 2006; Ungaretti et al., 2015; Wardley et al., 2016). As PA education encompasses a large amount of medical knowledge and skill content to be delivered in a relatively short span of time, the effects of time management for faculty and students may be more relevant than in other academic settings (DeOliveira, Volk, & Hopp, 2014; Maldonado, 2011).

The solutions include faculty allotting time to meet regularly to align details within curriculum content between non-PBL and PBL courses, develop facilitation guidelines while improving mentoring skills, and coordinating more small group activities which were not previously in the curriculum schedule. The addition of content alignment, including assessment items, and the addition of small group and role-playing activities will require a larger time commitment for facilitators who previously were not expected to participate during these times. However, the positive impact on this time investment should benefit student outcomes as reflected in student survey responses such as, "…providing questions to the student regarding the case…," "…incorporate more diagnostic interpretation…," "…include more time with the models in the simulation lab…," and "more small group activities." Other positive implications

for faculty include providing students with a better quality educative experience which will become less time intensive once the initial implementation stage has been accomplished.

First-degree stakeholder implications related to the resources and funding needed to implement the solutions also involve the university administration and faculty due to the budgeting of time and funds required to establish faculty development and hire a simulation and technology assistant. Leading curriculum change that requires additional resources can be difficult in most institutions, especially when funding is required which may or may not have been previously budgeted. Cooper (2017) wrote, "University systems at all levels need to be sufficiently flexible to encourage on-going curriculum renewal and experimentation with alternative curriculum approaches" (p. 126). The PA program, by ARC-PA (2018) standards, maintains a budget for professional development which may be utilized for the recommended facilitation improvements, and sources of revenue are available to consider for the addition of the simulation and technology assistant. However, the impact to the students and their families may be significant if the university opts to raise tuition and fees to supplement the funds needed to implement the solutions.

Roles, responsibilities, and timeline. The implications of the roles and responsibilities, along with the timeline, primarily affect the program faculty and university administration. Many of these roles and responsibilities are already established within the program and will not be greatly impacted. The course director for the PBL courses will take on extra responsibility by ensuring that faculty responsible for content in each of the other courses are available and meet regularly to align content and discuss PBL experiences for informal faculty development. A key implication does lie on the university administration's approval of the additional funding mentioned previously. If this funding or the new staff position is not approved, it will negatively

impact the effectiveness of the solution by limiting the amount of simulator experience students receive in PBL. The denial of funding for professional development may be less impactful as a budget currently exists for this; however, the amount and type of training may be impacted.

The implications within the timeline are affected by the university administration and PD related to hiring someone for the simulation and technology assistant position. Complete implementation of the solutions includes the addition of this staff position, and the effects of the solutions cannot be properly measured within the timeline if the position is not filled in a timely manner. For example, the timeline reflects a 26-month implementation, execution, and evaluation period. If the position is not filled within a 12-month period, then the entirety of the didactic year will be completed, including all PBL curriculum, and the data for that cohort will not reflect the full effects of the proposed solutions. If the position is filled prior to the beginning of the second unit of instruction (February 2021), then the data will give a more accurate reflection of the efficacy of all solution implementation.

Evaluation. The implications of the evaluation plan, detailed later in this chapter, involve the students, PA program, and university. The main implication to these stakeholders is through the students' PANCE results. Students must successfully pass the PANCE to obtain state licensure and NCCPA certification (NCCPA, 2018). A student who fails to pass the PANCE may retake it up to three times; however, PA programs must publish first time PANCE pass rates their websites as a condition of accreditation (NCCPA, 2018; ARC-PA, 2018). The university and PA program are often assessed by prospective students by these published PANCE pass rates (Sierra et al., 2018). Therefore, the university, PA program, and student are all impacted by the evaluation of the effectiveness of the solutions on the central problem of improving PBL to affect student success on the PANCE.

Second-Degree Stakeholders

Second-degree stakeholders include prospective health care employers, future patients, community members, and other academic professionals who employ PBL as a pedagogy. The solutions to the central problem hold implications for this population related to resources, funding, and evaluation of the effectiveness of the solution on the problem. Second-degree stakeholders, including community members and businesses, may be involved in providing endowments or grants for additional funding sources to the program. Philanthropy through endowments and grants from businesses and individuals has been increasing with increased giving for social and biomedical sciences that impact the greater good of a society (Bernstein, 2013). Potential employers and patients will receive the benefits of students' enhanced clinical and academic success through higher quality health care, improved interpersonal relationship skills, and heightened professionalism taught through a PBL experience (Zahid et al., 2016).

Implications also exist within application of PBL in other academic fields. PBL was initially constructed by medical educators to improve clinical practice skills; however, the use has permeated into other academic realms including other health care professions, business, education, and social sciences (Blundell & Berardi, 2016; Chen, 2016; Dadd, 2009; Hogan & Lundquist, 2006; Ungaretti et al., 2015). Improvement in student outcomes through standardized MCQ may be improved through the solutions within this study which may benefit educators in other fields. Evaluation of the solutions' outcomes related to the resources and funds needed to execute them may be weighed by other educators for use within their curriculum models.

Evaluation Plan

The proposed solutions are designed to address the problems within PBL in PA education to enhance students' academic achievement as measured by the PANCE. An outcomes-based

evaluation of this improvement plan will encompass multiple assessments of student achievement throughout their PA education including PACKRAT, PAEA EOR exams, and culminating in the PANCE. Evaluation of the efficacy of each solution will be based on a comparison of student assessment scores through each assessment instrument but focusing heavily on PANCE scores. A comparison of PANCE scores between students who matriculated prior to implementing the changes with those who underwent the revised PBL curriculum will aid the researcher in understanding the effectiveness of the solutions that evolved from the themes within the research data. Student survey and faculty surveys obtained through the program's self-assessment processes will also guide the researcher, the PD, and faculty in determining the impact of the revised PBL curriculum on student outcomes.

The ARC-PA (2018) requires that PA programs maintain an ongoing process of self-assessment and process improvements. These accreditation requirements require that programs evaluate the "curricular and administrative aspects of the program," document "self-identified program strengths and weaknesses," and "results of critical analysis from ongoing self-assessment" (ARC-PA p. 47). Programs must also maintain a record and report PANCE results for each graduating cohort (ARC-PA, 2018). The PD, DDE, and course directors are all provided with both qualitative and quantitative feedback from students regarding course content and faculty performance. Faculty feedback will also be solicited to determine the effectiveness of the proposed solutions in conjunction with the PANCE scores and student feedback.

This research is limited to the findings for one institution's PA program and the representation that the data has upon the PBL curriculum related to student academic outcomes. The PA program in eastern South Carolina was selected due to the familiarity the researcher has with the program and that it is a relatively new program with an openness to explore new

methods of instruction. In being a new program, the study was also limited in that at the time of

the research, the first cohort of students to matriculate had not taken the PANCE. Data was

therefore only collected on the PACKRAT and PAEA EOR exams. Although the PACKRAT

and PAEA EOR exams have been identified as indicators for PANCE outcomes, as the goal of

the research was to identify methods of improving PANCE success, those scores would have

been beneficial (Buchs et al., 2019; Cavanagh, et al., 2015). Another potential limitation to the

study is understanding the implications of PBL alone within a multifaceted educational system

such as PA education. Without analyzing the differences between cohort data of students

impacted by the changes in the PBL curriculum with those prior to the changes, the implications

of the pedagogy will not be clearly revealed. The efficacy of the proposed changes to the target

university's PBL curriculum will need to be measured by analyzing assessment data across

multiple cohorts who were and were not influenced by the changes. Although, as this study is

isolated to only one PA program, the results may not be a global representation of the impact

PBL may have on students' academic success as measured by the PANCE. A potential for

future research lies in studying the impact of PBL on both clinical acumen and student academic

success across multiple institutions who utilize only LBL, only PBL, or a mixed LBL and PBL

methodology.

Summary

This applied research study focused around the central question of how the problems of

PBL be improved in PA education at a university in eastern South Carolina. The problem was

identified as the need to improve the development and delivery of the PBL curriculum in a

manner that would improve students' academic success as measured by the PANCE. PBL has

been identified as an effective means of discovery learning where students build on clinical skills, critical thinking and reasoning, and problem solving which may not benefit overall performance on standardized MCQ examinations (Blundell & Berardi, 2016; Wardley et al., 2013; Ungaretti et al., 2015). The researcher utilized faculty interviews, qualitative and quantitative data from student surveys, and students' PACKRAT and PAEA EOR exam scores to identify themes leading to solutions to the problem. The themes produced concepts for solutions which included improving the alignment of content across the program courses, while taking learning style and adult learning theory into account, improving faculty facilitation through formal and informal faculty development and improved facilitation strategies, and restructuring the peer interactions to include more small group and role playing activities along with increased use of high-fidelity patient simulators. This chapter detailed the implementation of these solutions, the resources needed, the funds needed, a timeline for employment, implications of the solutions, and an evaluation plan to determine overall efficacy of the solutions on the problem.

The solutions provide positive influences to an existing PA program as well as the PBL course. The improved alignment of content, the bolstering of faculty facilitation skills, and the enhanced peer interactions reflect the vision of stakeholders towards an improved pedagogy. Students receiving instruction through well-blended alignment of curriculum across all program courses will receive instruction benefitting them through the repetition of content (Parkay et al., 2014). Faculty development leading to improved faculty facilitation will guide stronger student interactions through effective moderation of guided critical thinking using adult learning theory. The restructuring of peer interactions with more small group interactions, role-playing, and use of patient simulators will strengthen content retention, recollection, and application as commented by one student in a survey response who said, "I found myself throughout the year

remembering things so much better because I remember(ed) who it was applied (to) in the PBL class." The solutions provided through the research should improve students' success as measured by the PANCE while honing their clinical skills, critical thinking, interpersonal skills, and fund of knowledge giving them the ability to provide high-quality, compassionate health care to their future patients.

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APPENDICES

APPENDIX A

IRB Approval Letter

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

November 11, 2019

Marvin Scott Wade
IRB Exemption 3941.111119: Problem-Based Learning in Physician Assistant Education at a University in Eastern South Carolina: Improving an Active Learning Pedagogy

Dear Marvin Scott Wade,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under exemption category 46.101(b)(2), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:101(b):

> (2) Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
>
> > (i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

Please note that this exemption only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.
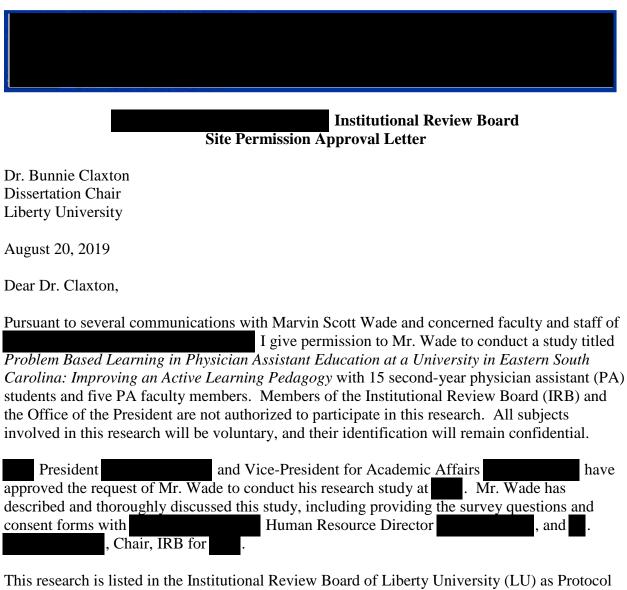
If you have any questions about this exemption or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

APPENDIX B

Site IRB Approval Letter

███

██████████████████████ **Institutional Review Board**
Site Permission Approval Letter

Dr. Bunnie Claxton
Dissertation Chair
Liberty University

August 20, 2019

Dear Dr. Claxton,

Pursuant to several communications with Marvin Scott Wade and concerned faculty and staff of
████████████████████████ I give permission to Mr. Wade to conduct a study titled
*Problem Based Learning in Physician Assistant Education at a University in Eastern South
Carolina: Improving an Active Learning Pedagogy* with 15 second-year physician assistant (PA)
students and five PA faculty members. Members of the Institutional Review Board (IRB) and
the Office of the President are not authorized to participate in this research. All subjects
involved in this research will be voluntary, and their identification will remain confidential.

██ President ██████████ and Vice-President for Academic Affairs ██████████ have
approved the request of Mr. Wade to conduct his research study at ██. Mr. Wade has
described and thoroughly discussed this study, including providing the survey questions and
consent forms with ████████████ Human Resource Director ██████████, and ██.
██████████, Chair, IRB for ███.

This research is listed in the Institutional Review Board of Liberty University (LU) as Protocol
ID # 3941, with FWA # 00016439, and IORG # 006023. SurveyMonkey online survey software
platform will be utilized during this research from September 2019 until December 2019. ██████
IRB will fully support LU's IRB protocol during this research. This research will analyze
*Problem Based Learning in Physician Assistant Education at a University in Eastern South
Carolina: Improving an Active Learning Pedagogy* involving students and faculty at ██.

I attest that I am authorized to approve this research and may be contacted via
██████████████ for additional questions or clarification.

Respectfully,

APPENDIX C

Physician Assistant Program Participation Approval

████████████████████

September 13, 2019

Physician Assistant Program Director

█████████████

Liberty University Institutional Review Board
1971 University Blvd
Lynchburg, VA 24515
(434) 522-0506

Dear Institutional Review Board Members,

Marvin Scott Wade is employed at ██████████████████ as an Assistant Professor of Physician Assistant Studies and the Director of Didactic Education for the Physician Assistant Program. Mr. Wade is also a doctoral student at Liberty University proposing research on problem-based learning in physician assistant education. He has received permission from the ██████████████████ IRB and myself to conduct this research utilizing faculty and students of the ████ PA Program. As a part of his research, he has asked for assistance in the collection of student information related to students' Physician Assistant Education Association (PAEA) End-of-Rotation Exam and Physician Assistant Clinical Knowledge and Assessment Tool (PACKRAT) scores. He has also asked that the program assist in communicating with students through email for the purpose of recruitment as participants in his study.

The ██████████████████ Physician Assistant Program administrative staff will be able to assist in email solicitation of student participants and providing PACKRAT and PAEA End of Rotation Examinations results. All personally identifiable information (PII) will be removed from all requested documentation. The requested information will be provided by administrative staff ensuring student anonymity. At no time may any PII be made public or released within any of the published work.

If there are any questions or concerns regarding Professor Wade's research assistance, I may best be reached through e-mail at ████████████.

██████████████████
████████████████

Program Director

APPENDIX D

Faculty Participation Email

Dear Physician Assistant Education Faculty Member:

As a doctoral candidate in the School of Education at Liberty University, I am conducting an applied research study as a requirement for a Doctorate of Education in Curriculum and Instruction. The purpose of my research is to solve the problem of educating physician assistant students in a problem-based learning environment at a university in eastern South Carolina and to formulate a solution to address the problem. This letter is my invitation to you to participate in this study.

Participants in the study must be physician assistant education faculty at a university in eastern South Carolina. The participants must have first-hand experience with a problem-based learning curriculum. Participation will include a face-to-face interview with the researcher, lasting approximately one hour where participants will be asked a series of open-ended questions related to problem-based learning and student learning outcomes. Your participation will be completely confidential and all responses will remain anonymous. No personally identifying information will be used in any aspect of the research nor will it be released in any manner to anyone other than the researcher. Interview responses will be documented in writing and will be audio recorded to ensure accuracy of content.

Participation in this study is completely optional. There will be no negative repercussions or impacts to individuals who decline to participate. If you choose to participate in the study, please reply affirmatively to this email. A consent document will be provided to you and will need to be completed prior to scheduling an interview. The consent document will detail information related to the research, the research procedures, privacy assurances, any potential risks or benefits, and the voluntary nature of participation.

Thank you for your consideration in participating in this research to benefit physician assistant education as well as furthering my educational goals. If you have any questions, comments, or concerns, please notify me. I may be reached by email at mswade@liberty.edu.

Sincerely,

Marvin S. Wade
Liberty University

APPENDIX E

Student Participation Email

Dear Physician Assistant Student:

As a doctoral candidate in the School of Education at Liberty University, I am conducting an applied research study as a requirement for a Doctor of Education in Curriculum and Instruction degree. The purpose of my research is to solve the problems of educating physician assistant students in a problem-based learning environment at a university in eastern South Carolina and to formulate a solution to address the problems. The research will examine potential issues with the curriculum delivery designed to enhance clinical practice, critical thinking, application of medical skills and knowledge to improve student outcomes as measured by standardized exam instruments and identify potential solutions to these problems. This email is my invitation to you to participate in this study.

If you are 18 years of age or older, a physician assistant student at Charleston Southern University, currently in the clinical year of training or beyond, and willing to participate, you will be asked to complete an online survey consisting of a series of Likert-type and open-ended questions related to problem-based learning and student learning outcomes. It should take approximately 15 minutes to complete the survey. All survey responses will remain anonymous. By agreeing to participate in the study, you will also allow the researcher to obtain data from your Physician Assistant Clinical Knowledge and Rating Assessment Tool (PACKRAT) and End-of-Rotation (EOR) examinations. This data will be provided to the researcher anonymously by the Charleston Southern University Physician Assistant Program administrative staff without personally identifying information. No personally identifying information will be used in any aspect of the research nor will it be released in any manner to anyone other than the researcher.

Participation in this study is completely optional. There will be no negative repercussions or impacts to individuals who decline to participate. If you choose to participate in the study, please reply affirmatively to this email. A consent document will be provided to you and will need to be completed prior to completing the survey. The consent document will detail information related to the research, the research procedures, privacy assurances, any potential risks or benefits, and the voluntary nature of participation. Once the consent forms are received from all participants, you will receive an email with a link to the survey.

Thank you for your consideration in participating in this research to benefit physician assistant education, as well as furthering my educational goals. If you have any questions, comments, or concerns, please notify me. I may be reached by email at mswade@liberty.edu.

Sincerely,

Marvin S. Wade
Liberty University

APPENDIX F

Faculty Informed Consent Form

CONSENT FORM

Problem-Based Learning in Physician Assistant Education at a University in Eastern South
Carolina: Improving an Active Learning Pedagogy
Marvin S. Wade
Liberty University
School of Education

You are invited to be in a research study on experiences in problem-based learning and the discovery of improvements that may bolster the academic principles to enhance learning outcomes. You were selected as a possible participant because of your experience in problem-based learning as a full-time faculty member with a physician assistant education program at Charleston Southern University. Please read this form and ask any questions you may have before agreeing to be in the study.

Marvin Scott Wade, a doctoral candidate in the School of Education at Liberty University, is conducting this study.

Background Information: The purpose of this study is to better identify and examine solutions to the problems of educating physician assistant students in a problem-based learning environment at a university in eastern South Carolina. The research will examine curriculum designed to enhance clinical competencies, critical thinking, and application of medical knowledge and skill for improvements in student academic success as measured by standardized exam instruments. This research will seek to discover a deeper understanding of the implications of problem-based learning on student outcomes and examine solutions to problems within the pedagogy. The study focus will be to answer the following research questions:

      Central Question: How can the problems of problem-based learning be improved in PA education at a university in eastern South Carolina?

      Sub-question 1: How would PA education faculty in an interview solve the problems of problem-based learning at a university in eastern South Carolina?

      Sub-question 2: How would students in a survey solve the problems of problem-based learning at a university in eastern South Carolina?

      Sub-question 3: How would data from student surveys and standardized multiple-choice question instruments provide information related to the problems of problem-based learning at a university in eastern South Carolina?

Procedures: If you agree to be in this study, I would ask you to do the following things:

1. Take part in a one-hour personal interview with the researcher. Interviews will be audio recorded and transcribed to ensure accuracy of data collection and analysis.
2. Upon completion of data collection and transcription of interview content, the participant will be given an opportunity to review their interview transcripts, conclusions, and narratives to provide the researcher feedback towards the accuracy of that data and interpretations. The anticipated time for participants to review and comment on this data is approximately one hour.

Risks: The risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

Benefits: Participants should not expect to receive a direct benefit from participating in this study.

Benefits to society include a contribution to the existing research related to problem-based learning in multiple fields, including physician assistant education. The research is targeted towards problem-based learning in physician assistant education where physician assistant educators may gain a deeper understanding of the pedagogy and the methods for enhancing students' critical clinical thinking preparing students for the national certification exam.
Compensation: Participants will not be compensated for participating in this study.
Confidentiality: The records of this study will be kept private. In any sort of report, I might publish, I will not include any information that will make it possible to identify a subject. Research records will be stored securely. The researcher, researcher's faculty chair, and researcher's dissertation committee member will have access to the records. However, the researcher will not disclose confidential, personally identifiable information with anyone. Any data, records, or information shared with the faculty chair or dissertation committee members will be coded to remove all personally identifiable information. I may share the data I collect from you for use in future research studies or with other researchers; if I share the data that I collect about you, I will remove any information that could identify you, if applicable, before I share the data.

- The interviews will be conducted at a time and place which adds assurances to confidentiality and others will not overhear the conversation.
- Interviews will be recorded and transcribed. Recordings will be stored on a password locked computer for three years and then erased. Only the researcher will have access to these recordings.
- Interview participants will be identified by pseudonyms. The list of participant names with associated pseudonyms will be kept in a password protected electronic document which only the researcher will have access.
- Electronic data will be stored on a password protected digital storage device in password protected documents. All non-electronic documentation, including all personally identifying data will be secured in a key-locked file cabinet at the researcher's residence office that only the researcher will have access. No personally identifiable information will be disclosed to anyone and all data shared with the faculty chair and dissertation

members will have all personally identifying information removed. After three years, all electronic and non-electronic data will be destroyed.

Conflicts of Interest Disclosure: The researcher serves as Director of Didactic Education and Assistant Professor of Physician Assistant Education at Charleston Southern University. To limit potential conflicts, the researcher is identifying he has no administrative or personnel authority over any of the participants. The researcher's roles and responsibilities within the program are limited to the oversight of curriculum development and implementation. This disclosure is made so that you can decide if this relationship will affect your willingness to participate in this study. No action will be taken against an individual based on his or her decision to participate in this study.

Voluntary Nature of the Study: Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Liberty or Charleston Southern University. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

How to Withdraw from the Study: If you choose to withdraw from the study, please contact the researcher at the email address/phone number included in the next paragraph. Should you choose to withdraw, data collected from you will be destroyed immediately and will not be included in this study.

Contacts and Questions: The researcher conducting this study is Marvin Scott Wade. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact him at ▮▮▮▮▮▮▮▮ or by email at mswade@liberty.edu. You may also contact the researcher's faculty chair, Dr. Bunnie Claxton, at blclaxton@liberty.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu.

Please notify the researcher if you would like a copy of this information for your records.

Statement of Consent: I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

☐ The researcher has my permission to audio-record me as part of my participation in this study.

_____

Signature of Participant   Date

_____

Signature of Investigator   Date

APPENDIX G

Student Informed Consent Form

CONSENT FORM

Problem-Based Learning in Physician Assistant Education at a University in Eastern South
Carolina: Improving an Active Learning Pedagogy
Marvin S. Wade
Liberty University
School of Education

You are invited to be in a research study on experiences in problem-based learning and the discovery of improvements that may bolster the academic principles to enhance learning outcomes. You were selected as a possible participant because you are 18 years of age or older, a physician assistant student at Charleston Southern University, and are currently in the clinical year of training or beyond. Please read this form and ask any questions you may have before agreeing to be in the study.

Marvin Scott Wade, a doctoral candidate in the School of Education at Liberty University, is conducting this study.

Background Information: The purpose of this study is to better identify and examine solutions to the problems of educating physician assistant students in a problem-based learning environment at a university in eastern South Carolina. The research will examine curriculum designed to enhance clinical competencies, critical thinking, and application of medical knowledge and skill for improvements in student academic success as measured by standardized exam instruments. This research will seek to discover a deeper understanding of the implications of problem-based learning on student outcomes and examine solutions to problems within the pedagogy. The study focus will be to answer the following research questions:

Central Question: How can the problems of problem-based learning be improved in PA education at a university in eastern South Carolina?

Sub-question 1: How would PA education faculty in an interview solve the problems of problem-based learning at a university in eastern South Carolina?

Sub-question 2: How would students in a survey solve the problems of problem-based learning at a university in eastern South Carolina?

Sub-question 3: How would data from student surveys and standardized multiple-choice question instruments provide information related to the problems of problem-based learning at a university in eastern South Carolina?

Procedures: If you agree to be in this study, I would ask you to do the following things:

1. Complete an online survey related to experiences in a problem-based learning environment and the impacts of this environment on learning outcomes. It is anticipated that survey completion will take 15 minutes. Only fully completed survey responses will be included in the research data.
2. Archival data from participants' Physician Assistant Clinical Knowledge and Rating Assessment Tool (PACKRAT) and End-of-Rotation (EOR) examinations will be anonymously provided by program administration to the researcher for analysis with participants' survey responses. The data collected from all sources will be anonymous to the researcher and no direct link between participant and responses or scores will be made.

Risks: The risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

Benefits: Participants should not expect to receive a direct benefit from taking part in this study.

Benefits to society include a contribution to the existing research related to problem-based learning in multiple fields, including physician assistant education. The research is targeted towards problem-based learning in physician assistant education where physician assistant educators may gain a deeper understanding of the pedagogy and the methods for enhancing students' critical clinical thinking preparing students for the national certification exam.

Compensation: Participants will not be compensated for participating in this study.
Confidentiality: The records of this study will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject. Research records will be stored securely. The researcher, the faculty chair, and dissertation committee members will have access to the records; however, no personally identifying information will be made available. I may share the data I collect from you for use in future research studies or with other researchers; if I share the data that I collect about you, I will remove any information that could identify you, if applicable, before I share the data.

- Participant responses will remain anonymous.
- No personally identifying information will be requested within the survey, and participants are asked not to reveal any personally identifying information within any of the responses.
- Each participant in this study will be assured complete anonymity throughout the collection, analysis, and reporting of data.
- All electronic data will be secured in a password protected environment. All "hard copy" communications will be stored in a locked storage container. The researcher, the faculty chair, and the dissertation committee members will have access to this data. No data will be provided to any other outside sources for any purpose.

Conflicts of Interest Disclosure: The researcher serves as Director of Didactic Education and Assistant Professor of Physician Assistant Education at Charleston Southern University. To limit potential conflicts the researcher will know the identities of participants; however, the submission of survey data will be entirely anonymous where the researcher will not have access to who provided which responses. The researcher has no administrative or grading authority over any of the participants in this study. This disclosure is made so that you can decide if this relationship will affect your willingness to participate in this study. No action will be taken against an individual based on his or her decision to participate in this study.

Voluntary Nature of the Study: Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Liberty or Charleston Southern University. If you decide to participate, you are free to not answer any question or withdraw at any time, prior to submitting the survey, without affecting those relationships.

How to Withdraw from the Study: If you choose to withdraw from the study, please exit the survey and close your internet browser, or inform the researcher that you wish to discontinue your participation prior to submitting your study materials. Your responses will not be recorded or included in the study. Should any student feel discomfort related to this research, Charleston Southern University provides confidential counseling service at no charge. These services may be scheduled by appointment or by walk-in at Russell West, second floor. Counseling services may also be reached at (843) 863-8010.

Contacts and Questions: The researcher conducting this study is Marvin Scott Wade. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact him at ▮▮▮▮▮▮▮▮ or by email at mswade@liberty.edu. You may also contact the researcher's faculty chair, Dr. Bunnie Claxton, at blclaxton@liberty.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu.

Please notify the researcher if you would like a copy of this information for your records.

Statement of Consent: I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

_____

Signature of Participant   Date

_____

Signature of Investigator   Date

APPENDIX H

Interview Questions Guide

Date and Time of interview:

Place:

Interviewer:

Interviewee:

Questions to interviewees:

1. How would you describe your professional experience as a physician assistant?

2. How would you describe your experience as a teaching faculty in physician assistant education?

3. What formal education or academic experience do you have, including any college degrees in education, formal workshops, faculty development, or on-the-job training?"

4. What pedagogy do you espouse in delivering content to students in your current coursework, such as lecture-based, problem-based, laboratory and active student learning activities, or blended online and in-class teaching?

5. Why do you choose these methods of teaching?

6. What types of resources do you implement in your instructional methodology?

7. How would you describe the nature or formatting of the problem-based learning curriculum in physician assistant education at your institution?

8. What approaches to student learning do you feel are most efficacious?

9. What type of preparatory course or program does your program offer to students to enhance their readiness to take the Physician Assistant National Certifying Examination (PANCE)?

10. What do you believe are the least effective approaches to student learning in PA education?

11. How would you describe the methods employed by yourself or your program to ease student stress?

12. What factors have the most impact on PANCE scores?

13. How would you recommend improving problem-based learning at your institution?

APPENDIX I

Student Survey Questions

Survey Questions for Physician Assistant Students

1. How would you characterize the organization of the problem-based learning curriculum?

    ( ) 1 - Did not meet expectations
    ( ) 2 - Partially met expectations
    ( ) 3 - Met expectations
    ( ) 4 - Partially exceeded expectations
    ( ) 5 - Exceeded expectations
    ( ) 0 - Not applicable

2. How would you characterize the impact of problem-based learning on your preparation for clinical practice?

    ( ) 1 - Did not meet expectations
    ( ) 2 - Partially met expectations
    ( ) 3 - Met expectations
    ( ) 4 - Partially exceeded expectations
    ( ) 5 - Exceeded expectations
    ( ) 0 - Not applicable

3. How would you characterized the impact of problem-based learning on your preparation for the Physician Assistant National Certifying Examination?

    ( ) 1 - Did not meet expectations
    ( ) 2 - Partially met expectations
    ( ) 3 - Met expectations
    ( ) 4 - Partially exceeded expectations
    ( ) 5 - Exceeded expectations
    ( ) 0 - Not applicable

4. How would you characterize the use of technology in your problem-based learning courses?

    ( ) 1 - Did not meet expectations
    ( ) 2 - Partially met expectations
    ( ) 3 - Met expectations
    ( ) 4 - Partially exceeded expectations
    ( ) 5 - Exceeded expectations
    ( ) 0 - Not applicable

5. How would you characterize the overall impact of problem-based learning on your physician assistant education?

      ( ) 1 - Did not meet expectations
      ( ) 2 - Partially met expectations
      ( ) 3 - Met expectations
      ( ) 4 - Partially exceeded expectations
      ( ) 5 - Exceeded expectations
      ( ) 0 - Not applicable

Survey Questions for Physician Assistant Students (open-ended questions)

6. How would you describe your experiences in problem-based learning during the didactic year of your physician assistant education?

7. How would you improve the problem-based learning curriculum to enhance your preparation for the Physician Assistant National Certifying Examination?

APPENDIX J

Timeline

December 2020 – Review proposed PBL changes with Curriculum Committee and Program

Director; Submit for approval to hire new staff position: Simulation/Technology

Assistant

January 2021 – New didactic year cohort matriculates into program

Unit One begins with Human Anatomy and Diagnostic Sciences

Implement proposed improvement plan

Schedule weekly meetings with faculty to align content, coordinate small groups and

role-playing activities

February 2021 – November 2021 – Units Two, Three, and Four of program including PBL

PBL course conducted Tuesdays and Thursdays from 1:30 PM to 3:30 PM

Continue weekly PBL facilitator meetings

Increase high-fidelity patient simulator use upon Simulation/Technology Assistant hire

November 2021 – Students take the first PACKRAT exam

December 2021 – Didactic year students transition into clinical year

January 2022 – New cohort of didactic year students matriculate

Continue with proposed improvement plan

February 2022 – November 2022 – Continue with proposed improvement plan

Clinical year students are assessed with PAEA EOR exams

October 2022 – Clinical year students take second PACKRAT

November 2022 – Clinical year students assessed with summative written examination

December 2022 – Clinical year student graduation; students begin taking PANCE

January – February 2023 – Assess PACKRAT, PAEA EOR scores, and PANCE scores for

evaluation of the efficacy of proposed changes per the noted evaluation plan in Chapter

Five