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# A Mixed-Methods Investigation of a Comprehensive Clinical Examination in an Accredited Athletic Training Program

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# A Mixed-Methods Investigation of a Comprehensive Clinical Examination in an Accredited Athletic Training Program

by

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This dissertation has been approved in partial fulfillment of the requirements for the degree of

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Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work here at Lindenwood University and that I have not submitted it for any other college or university course or degree here or elsewhere.

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## Abstract

This study aimed to examine the impact and potential benefits of a comprehensive skills-based clinical examination within an accredited athletic training program. It was hypothesized that a comprehensive clinical examination could accurately assess student preparedness for the BOC examination and support the students' continued academic and clinical development. The clinical examination was developed and adapted over several years, and it consisted of multiple psychomotor skills assessments and scenario-based modules with standardized models. The validity of the clinical examination was examined retrospectively, using historical academic data representing four academic cohorts from a single institution. Student demographic profiles and academic data were also evaluated as possible predictor variables of first-time success on the BOC examination.

A quantitative analysis of student performance on the two examinations revealed the following: students who passed the clinical examination on their first attempt were much more likely to pass the BOC examination on their first attempt; students who passed the BOC examination on their first attempt achieved a higher overall score on the clinical examination; students requiring more than two attempts to successfully complete the clinical examination were much less likely to pass the BOC examination on their first attempt; and cumulative GPA was determined to be the best predictor of first-time success on the BOC examination. From a qualitative perspective, an electronic survey was incorporated to better understand student perceptions of the clinical examination and how the examination may have impacted their readiness for the BOC examination and entry-level practice. Students overwhelmingly agreed the clinical examination had a

positive impact on their academic and professional development, and students believed their preparation process for the comprehensive clinical examination simultaneously prepared them for the BOC examination. Furthermore, students believed the comprehensive clinical examination motivated them to study and utilize high-impact practices that promoted critical thinking and clinical reasoning. The findings from this research suggests a well-designed, comprehensive clinical-based examination can be implemented in an athletic training program and provide numerous benefits to both the program and the students.

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# Chapter One: Introduction

## Background of the Study

Athletic training is recognized by the American Medical Association (AMA) as an allied health care profession, similar to physical therapy, occupational therapy, and physician assistant. Traditionally, athletic trainers have worked under the supervision of a physician and functioned as a part of a health care team to improve the quality of life for active members of the population. Athletic trainers receive a specialized education in the prevention, assessment, and treatment of emergency and non-emergency acute and chronic medical conditions and disabilities. This includes orthopedic conditions, such as fractures, dislocations, and sprains; and it also includes general medical conditions affecting the other major body systems. The athletic training profession has continued to evolve since its inception in the 1950's, and there are considerable differences in the education, scope of practice, and job outlook for individuals graduating in 2020, when compared to individuals who began practicing as an athletic trainer in 1950. In 2020, an individual wanting to practice as an athletic trainer was required to complete an accredited athletic training education program at the undergraduate or graduate level, successfully complete the Board of Certification (BOC) examination for athletic training, and in most states, become registered or licensed to practice by the state boards. These requirements were significantly different from the early years in the profession, when there was not a defined athletic training curriculum or a standardized professional examination.

Beginning in 2004, all athletic training programs preparing students for the BOC examination were required to be accredited on an ongoing basis by the Commission on

Accreditation of Athletic Training Education (CAATE; Craig, 2003). This resulted in the need for all athletic training programs to follow a well-defined competency-based educational curriculum that had been shown in previous studies to result in improved student outcomes on the BOC examination when compared to the internship route (Brett et al., 2009). Prior to 2004, colleges and universities were able to prepare students to take the BOC examination by offering an accredited athletic training program or an internship program. The accredited programs required 600 to 800 hours of clinical experience, and the internship programs required a minimum of 1500 clinical hours (Weidner & Henning, 2002). The internship programs allowed students the opportunity to attend a non-accredited athletic training program that still offered courses in athletic training and prepared students to take the BOC examination. Over time, education reform and program accreditation requirements decreased program dependency on clinical hour requirements and shifted program focus toward providing a structured, competency-based didactic education.

The development and implementation of the BOC examination and the changes in the accreditation requirements for athletic training programs proved to be significant contributions to the advancement of the profession and the overall preparedness of the professional athletic trainer. These calculated changes within the athletic training profession were promoted by joint task forces that involved representatives from the BOC, the CAATE, the NATA, the medical community, and the public. Working together, these organizations and their previously recognized entities defined the role of the athletic trainer, determined the educational content needed to assume the role of an athletic trainer, and validated an assessment tool used to evaluate the knowledge and

skills of an entry-level athletic trainer. While the BOC and the NATA used slightly different terminology to illustrate the body of knowledge necessary for professional athletic trainers, the 'competencies' associated with each NATA content area could be cross-referenced with 'tasks' identified by each domain recognized by the BOC (see Table 1).

**Table 1**

*Crosswalk for Education Content in Athletic Training Program (2019)*

| *NATA Education Competencies* Content Areas | BOC *Practice Analysis, 7th Edition* Domains |
|---|---|
| EBP = Evidence Based Practice | I. Injury and Illness Prevention and Wellness Promotion |
| PHP = Prevention and Health Promotion | II. Examination, Assessment and Diagnosis |
| CE = Clinical Examination and Diagnosis | III. Immediate and Emergency Care |
| AC = Acute Care of Injuries and Illnesses | IV. Therapeutic Intervention |
| TI = Therapeutic Interventions | V. Healthcare Administration and Professional Responsibility |
| PS = Psychosocial Strategies and Referral | |
| HA = Healthcare Administration | |
| PD = Professional Development and Responsibility | |
| CIP = Clinical Integration Proficiencies | |

Upon successful completion of the certification examination, athletic trainers were required to become licensed, registered, or certified by most states where they intended to practice. In 2020, 46 states required licensure to practice as an athletic trainer, two states required certification, one state required registration, and one state (California) had no regulation (NATA, n.d.-d). Of the 49 states providing some form of regulation, Texas was the only state that allowed for licensure without the successful completion of the BOC examination. Within the state of Texas, individuals pursuing athletic training licensure from the state were required to successfully complete the BOC examination or

the Texas Athletic Trainers' Examination. Texas also remained the only state that provided routes to licensure that did not involve the completion of a CAATE-accredited athletic training program (Texas Department of Licensing and Regulation, 2020, para. 2). Rather than evolving the standard and remaining consistent with all other states, the eligibility requirements for the Texas Athletic Trainers' Examination included alternate routes similar to the apprenticeship programs previously permitted by the NATABOC (National Athletic Trainers' Association Board of Certification; Texas Department of Licensing and Regulation, 2020, para. 3).

Excluding Texas, the BOC examination remained the primary method for athletic trainer certification throughout the nation, and it was a critical component used in the overall assessment of athletic training education programs. According to Standard 11 of the 2012 CAATE Standards, all programs were required to achieve a three-year aggregate first-time passing rate of at least 70% on the BOC examination to remain in good standing with accreditation (CAATE, 2012, p. 3). This resulted in a significant number of programs being placed on probation and other programs choosing to withdraw from accreditation, due to poor performance on this single metric. Meeting this program outcome required programs to identify and select strong academic students, provide a high quality academic and clinical experience, and identify ways to ensure BOC preparedness. Identifying students who were not prepared for the BOC examination allowed programs the opportunity to provide early and effective remediation to improve student performance and program outcomes.

The program involved in this study utilized a comprehensive clinical examination (CCE) as a method for assessing professional readiness and BOC preparedness. The

design for this examination came from the original version of the BOC examination that included three separate components, including a written examination (multiple choice), a written simulated examination (scenario-based), and an oral-practical examination. However, the previously used oral-practical examination offered by the NATABOC only included student demonstrations of basic psychomotor skills necessary to practice as an athletic trainer. This section of the examination did not assess critical thinking, decision-making, or communication skills. The comprehensive clinical examination investigated in this study was designed to test both behavioral and holistic aspects of clinical practice, and these types of performance assessments are essential to identifying competence in athletic training education (Thompson et al., 2014). The researcher hypothesized that students who achieved greater success on a performance assessment that emphasized the application of knowledge through clinical demonstrations would also perform better on a standardized written examination that focused solely on cognitive abilities. There had been continued debate on best practices for standardizing and implementing practical examinations, in addition to establishing validity, and one of the primary goals of this study was to establish criterion-based validity for the comprehensive clinical examination through its relationship with the BOC examination.

The implementation of the comprehensive clinical examination was also intended to evaluate professional preparedness from a clinical perspective. Previous survey-based research indicated that many athletic training programs had not effectively advanced their educational curriculum with the requirements of the CAATE and the expectations of the BOC (Massie et al., 2009). There was a concern among athletic training educators and professionals that many new graduates were not prepared with the necessary clinical

skills, reasoning ability, communication skills, and confidence necessary for successful transition into professional practice (Brett et al., 2009).

**Purpose of the Study**

The purpose of this study was to investigate the potential benefits of a comprehensive clinical examination (CCE) as a requirement for students graduating from an undergraduate accredited athletic training program at a Midwestern university. The study reviewed four years of historical performance data from the university with regard to the CCE, as well as student performance on the Board of Certification (BOC) examination. At the time of the study, there were no accreditation requirements mandated by the Commission on Accreditation of Athletic Training Education (CAATE) to conduct a comprehensive clinical examination as a graduation requirement, and the university involved in the study was the only university known by the researcher to be using this type of comprehensive examination. The study's primary objective was to determine the relationship between student performance on the comprehensive clinical examination and the BOC examination. Additionally, the study aimed to identify other possible predictor variables for BOC examination performance. These variables included initial enrollment status (i.e., first-time freshman or transfer), grade point average, ACT score, and various student demographics.

Athletic training education programs rely on the combination of a rigorous curriculum that integrates didactic preparation with clinical experiences, and both aspects must be adequately assessed to ensure graduates meet professional expectations of clinical practice. The BOC assumes the responsibility for ensuring candidates have the cognitive abilities to practice as an athletic trainer, and the CAATE establishes the

standards and expectations for all athletic training education programs. With regard to assessing clinical competency, the CAATE provided autonomy for individual programs to ensure students had the necessary skills to effectively perform the duties of a licensed health care practitioner, and clinical competency assessment was the responsibility of the program. Research has shown that performance assessments used in clinical education, such as simulations, standardized patient examinations, and critical thinking exercises are extremely effective teaching tools, and these performance assessments are essential for health care programs to evaluate student competency (Armstrong & Jarriel, 2016). Competency was defined by Kane (1992) as the "degree to which the individual can use the knowledge, skills, and judgments associated with the profession to perform effectively in the domain of possible encounters defining the scope of professional practice" (p. 166). This definition of competency is made even more complex when determining how it is best assessed. Within health care programs, educators commonly used a blend of assessments to evaluate the student from both behavioral and holistic perspectives (Thompson et al., 2014). Behavioral assessments are intended to measure critical skills needed within the field, and this approach typically utilized a standardized rubric or checklist to evaluate the skills demonstrated by the student (Thompson et al., 2014). These evaluation methods are commonly used in health care education, they are promoted as being unbiased and objective, and they are easy to implement. However, these evaluations are based on observations of simple psychomotor skills, and many performance assessments based on this approach do not require the student to think critically, adaptively, or strategically.

A more complete method of assessing competency involved the use of simulations and standardized patients that provided a more realistic, authentic environment that challenged the student to adapt to the current situation. Performance assessments that focused on a more holistic aspect of the student's demonstration were more difficult to evaluate, as there was not a prescribed checklist or simple rubric that clearly identified exactly what or how the student should perform (Thompson et al., 2014). Holistic performance assessments recognized that students may use different skills and methods in a given situation and achieve similar outcomes. These assessments required more subjectivity and interpretation in the grading process, as students were required to think critically and provide their own professional judgement in addressing a situation (Thompson et al., 2014). Despite the inherent concerns regarding subjectivity, professionals within the field who were properly trained to model simulations and assess student performance could provide reliable and valid evaluations (Thompson et al., 2014). At the time of this study, there was limited evidence to support a connection between the BOC examination and clinical performance assessments in athletic training education programs, but other health care professions, such as physical therapy, have been able to identify statistically significant relationships between student performance on standardized written examinations and performance assessments (Luedtke-Hoffmann et al., 2012).

The proposed benefits of the CCE were also linked to the experiential learning theory. There have been several different perspectives published on the experiential learning theory, but they are all based on the belief that experiential learning can be used to connect the didactic element of education with the application of knowledge. Thus, it

was plausible to assume that the student preparation process for the comprehensive clinical examination would be an effective way for the student to develop a deeper, more meaningful understanding of the knowledge, skills, and abilities associated with the discipline. According to Kolb's (1984) theory on experiential learning, "learning is the process whereby knowledge is created through the transformation of experience" (p. 38), and this process included reflection, conceptualization, and application. Throughout the athletic training curriculum, students were required to participate in a variety of clinical experiences, and courses associated with these clinical experiences required the student to reflect on their observations, performance, and clinical development. These experiential learning opportunities may have led to higher levels of cognition and improved student outcomes on the BOC examination. Similarly, the review of academic written materials combined with hands-on clinical practice and reflection, both commonly used by students to prepare for the comprehensive clinical examination, may have also positively influenced student performance on the BOC examination.

The student's preparation process for the CCE and its potential impact on the BOC examination was examined in this study using data from surveys and questionnaires. These tools were also used to investigate each student's perceived entry-level confidence and professional preparedness. These two areas have been consistently discussed in the research as being deficient in recent graduates of athletic training programs (Carr & Volberding, 2011), and there was interest in gaining a better understanding of the relationship between student perceptions of professional preparedness and student performance on the CCE.

The outcomes of the study could support the continued implementation of a comprehensive clinical examination and provide further support for the use of performance assessments throughout a program to improve cognitive abilities, clinical decision-making, and self-confidence. Additionally, the identification of predictor variables for the BOC examination would assist athletic training programs in appropriately screening, selecting, and retaining students with the greatest likelihood of success. Furthermore, these predictor variables could also be used to identify students who may need additional academic, clinical, and personal support throughout the program.

**Rationale**

The National Athletic Trainers' Association (NATA) was developed in 1950 to provide opportunities for members to grow in their profession, provide professional representation, and improve professional recognition. As defined by the NATA, athletic trainers were "health care professionals who rendered service or treatment, under the direction of or in collaboration with a physician, in accordance with their education and training and the states' statutes, rules and regulations" (NATA, n.d.-b, para. 2). The profession continued to evolve over the past 50 years, and a large part of this progress has been related to the offering of approved educational curricula, mandated accreditation of athletic training programs, and the implementation of a national certification examination as a professional requirement to practice (Craig, 2003; Delforge & Behnke, 1999).

The national certification examination and accreditation standards have been reviewed and updated on multiple occasions over the past several decades to further improve and promote the profession and development of the professional athletic trainer

(Craig, 2003; Delforge & Behnke, 1999). The original certification examination was first offered in 1969 and consisted of 150 multiple-choice questions, as well as several oral questions that required candidates to demonstrate clinical skills in a practical setting (Delforge & Behnke, 1999; Grace, 1999). This examination was monitored over time, and eventually, the examination became a three-part test consisting of a multiple-choice examination, a simulated examination based on multiple scenarios, and a practical assessment with multiple evaluators and a standardized model. While the content of the examination changed over the next several decades to reflect the expanding knowledge, skills, and responsibilities expected of an entry-level athletic trainer, the examination remained in a three-part format until 2007. In 2007, the BOC implemented a new computerized test that attempted to combine the written simulation and practical examination components into several hybrid questions, and the test remained in that format from 2007 to 2020 (Castle Worldwide Inc., 2008). The new test format fueled significant debate from professionals in the field, and a majority of the criticism was associated with the decision to remove the practical component. Many believed that without a comprehensive clinical component, the BOC examination was unable to assess the application of theory and knowledge through the demonstration of psychomotor skills, communication skills, and clinical decision making in authentic scenarios (Moore, 2014). Some research supported this notion and showed that athletic training graduates and employers of athletic trainers believed there were several common deficiencies of entry-level professional athletic trainers (Carr & Volberding, 2011). For example, in a study by Carr and Volberding (2011), recent athletic training graduates, as well as their employers, believed they were lacking skills in interpersonal communication and

initiative; and more importantly, they lacked professional confidence and clinical decision-making skills when working autonomously. Additional criticism surfaced in the following years, as first-attempt pass rates on the BOC examination rose significantly following the 2007 test transition. The first-time pass rate for the three-part examination was 26.2% in 2005-2006 and 31.5% in 2006-2007 (Castle Worldwide Inc., 2008, p. 4), and this pass rate increased significantly over the next decade. The first-time pass rate from the 2018-2019 testing period was 77.8% (Board of Certification [BOC], 2019, p. 3).

While the 2018-2019 first-time pass rate was significantly higher than those achieved 10 years ago, the 2018-2019 pass rate was similar to certification examination outcomes in other health care fields, including physical therapy and nursing (NCSBN, 2019; The Federation of State Boards of Physical Therapy, 2019). According to The Federation of State Boards of Physical Therapy (2019), the first-time pass rate in 2018 for physical therapists was 91%, and the first-time pass rate for physical therapy assistants was 83%. The first time pass rate on the National Council Licensure Examination (NCLEX) for nurses in the United States in 2019 was 88.18% (NCSBN, 2019, p. 1).

Despite athletic training examination first-time pass rates becoming more consistent with other allied health care programs, there was a population of professional athletic trainers and athletic training educators who believed the current examination was inadequate for ensuring entry-level preparedness (Moore, 2014). Moore's (2014) research concluded that many veteran athletic trainers believed students were academically prepared to pass an examination, but new graduates did not possess the same psychomotor skills, critical thinking abilities, and self-confidence as earlier graduates

who completed the three-part examination. However, there were several other significant changes that occurred within athletic training education during that time that must be considered in addition to the changes made on the certification examination. Most notably, beginning in 2004, any student seeking to become a certified athletic trainer was required to complete an athletic training program accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP; Delforge & Behnke, 1999). Prior to this time, students had different options for becoming eligible to take the national examination, including an internship route that was not associated with an accredited academic program or competency-based curriculum (Delforge & Behnke, 1999).

As previously stated, athletic training students have demonstrated increased performance on the national certification examination over the past decade when compared to previous years (BOC, 2019). The increase in candidate performance occurred alongside many changes, including changes to the certification examination, changes to accreditation and education standards, and changes to candidate eligibility. This study was not designed to evaluate the individual effects of these variables. Rather, the purpose of this study was to evaluate the impact and potential benefits of a comprehensive clinical examination in an athletic training undergraduate program. This research aimed to determine if there was a relationship between student performance on the CCE and student performance on the BOC examination. A significant positive correlation between these two variables could lead to expanded use that may benefit the students, the athletic training programs, and the profession.

From a student perspective, the study sought to explore student perceptions regarding the clinical examination and the impact it may have had on their perceived preparedness for the BOC examination and professional practice. Students were asked to consider both the results of the clinical examination and their process for preparing for the clinical examination. The results from the study had the potential to identify alternative methods for preparing for the BOC examination through continued psychomotor skill development and other essential elements of experiential learning.

Athletic training programs also stood to benefit from the study's results. Student outcomes on the BOC examination were increasingly important as this information was provided to the public as a means of demonstrating program quality, and more importantly, this single metric was essential in maintaining program accreditation. As part of the standards for athletic training education programs released in 2012 by the Commission on Accreditation of Athletic Training Education (CAATE), programs were required to demonstrate compliance with first-time pass rates on the BOC certification (CAATE, 2012). Specifically, Standard 11 of the 2012 CAATE *Standards* stated that all "programs must meet or exceed a three-year aggregate of 70% first-time pass rate on the BOC examination" (CAATE, 2012, p. 3). Programs that failed to demonstrate compliance with this standard were placed on probation by the CAATE, and ultimately, were at risk of losing their CAATE-accreditation (CAATE, 2012). At the beginning of the 2019-2020 academic year, there were a total of 367 professional athletic training programs, and 93 (25%) of these programs had a three-year aggregate first-time pass rate less than 70% on the BOC examination (CAATE, 2019). Standard 11 was a significant concern for programs, and faculty members were increasingly motivated to review their

application requirements, student retention criteria, student assessment methods, and many other program-related requirements to ensure ongoing compliance with this standard.

At this time of this study, there were no known studies on the possible relationship between a comprehensive clinical examination and the current BOC examination. Additionally, there were no available studies on the relationship between a comprehensive clinical examination and a student's perceived preparedness for clinical practice as an entry-level athletic trainer.

**Hypotheses**

*Hypothesis 1:* Students who pass the comprehensive clinical examination on their first attempt (>75%) have a higher likelihood of passing the BOC examination on their first attempt when compared to students who do not pass the comprehensive clinical examination on their first attempt.

*Hypothesis 2:* There will be a significant correlation between first-attempt student scores on the comprehensive clinical examination and first-time pass rates on the BOC examination.

*Hypothesis 3:* There will be a significant correlation between student passing scores on the comprehensive clinical examination and first-time pass rates on the BOC examination.

*Hypothesis 4:* There will be a significant correlation between student grade point average (core classes only) and first-time pass rates on the comprehensive clinical examination.

*Hypothesis 5:* There will be a significant correlation between student grade point average (core classes only) and first-time pass rates on the BOC examination.

**Research Questions**

*Research Question 1:* What is the student preparation process for the comprehensive practical examination?

*Research Question 2:* What is the student preparation process for the Board of Certification examination?

*Research Question 3:* How do students perceive the value of the comprehensive clinical examination as a preparation tool for the BOC examination?

*Research Question 4*: How do students perceive the value of the comprehensive clinical examination as a tool for improving professional preparedness?

**Definition of Terms**

*Athletic Trainer:*

> Health care professionals who render service or treatment, under the direction of or in collaboration with a physician, in accordance with their education and training and the states' statutes, rules and regulations. As a part of the health care team, services provided by athletic trainers include injury and illness prevention, wellness promotion and education, emergent care, examination and clinical diagnosis, therapeutic intervention, and rehabilitation of injuries and medical conditions. (CAATE, 2018b, p. 18)

*Athletic Training Education Competencies*: "Minimum requirements for a student's professional education" (NATA, 2011, p. 4). The competencies include subject matter in the following content areas: evidence-based practice, prevention and health

promotion, clinical examination and diagnosis, acute care of injury and illness, therapeutic interventions, psychosocial strategies and referral, health care administration, and professional development and responsibility (NATA, n.d.-a, Education Overview section, para. 3).

*Board of Certification* (BOC): Previously known as the National Athletic Trainers' Association Board of Certification, the BOC is a not-for-profit credentialing agency responsible for the national certification program for the athletic training profession (Henderson, 2015).

*Board of Certification (BOC) Examination:* test designed "to identify for the public those individuals who possess proficiency at a level that is required for entry to the athletic training profession" (Henderson, 2015, p. 6).

*Clinical Education*: "A broad umbrella term that includes three types of learning opportunities to prepare students for independent clinical practice: athletic training clinical experiences, simulation, and supplemental clinical experiences" (CAATE, 2018b, p. 18).

*Clinical Proficiency*: For the purpose of this study, clinical proficiency describes a level of development that allows one to perform clinical skills accurately, effectively, and autonomously without the need for intervention.

*Clinical Site*: "A facility where a student is engaged in clinical education" (CAATE, 2018b, p. 18).

*Commission on Accreditation of Athletic Training Education (CAATE)*: A non-profit organization recognized as an accrediting agency by the Council of Higher

Education and responsible for the accreditation of athletic training education programs (CAATE, n.d.-c, para. 1).

*Competence*:

> Professional competence is the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and community served. Competence builds on a foundation of clinical skills, scientific knowledge and moral development. (Epstein & Hundert, 2002, p. 226)

*Domains*: Based on the seventh edition of the *Practice Analysis* (Henderson, 2015), a panel of experts identified five core content areas that best encompassed the expectations of a newly certified athletic trainer. The domains were as follows: (I) Injury and Illness Prevention and Wellness Promotion; (II) Examination, Assessment, and Diagnosis; (III) Immediate and Emergency Care; (IV) Therapeutic Intervention; (V) Healthcare Administration and Professional Responsibility (Henderson, 2015).

*National Athletic Trainers' Association* (NATA): "The National Athletic Trainers' Association (NATA) is the professional membership association for certified athletic trainers and others who support the athletic training profession. Founded in 1950, the NATA has grown to more than 45,000 members worldwide" (NATA, n.d.-a, para. 1).

*National Athletic Trainers' Association Board of Certification* (NATABOC): Prior to the Board of Certification existing as a separate entity, the National Athletic Trainers' Association Board of Certification established standards for certification and supervised the development, implementation, and evaluation of the certification process (Grace, 1999).

*Practice Analysis,* 7th Edition: Document produced by the Board of Certification Practice Analysis Task Force and the BOC staff that identifies the necessary skills,

knowledge and abilities for the entry-level athletic trainer. This information was the foundation for the five domains expected of newly certified athletic trainers (Henderson, 2015).

*Preceptor*: "A certified/licensed professional who teaches and evaluates students in a clinical setting using an actual patient base" (CAATE, 2012, p. 14).

**Summary**

The athletic training profession and professional preparation of future athletic trainers underwent significant changes through the past 50 years. The scope of practice for athletic trainers continued to expand, and the NATA, BOC, and CAATE collaborated to guide athletic training education programs on developing highly qualified entry-level health care practitioners. The BOC examination continued to serve as the primary means for certification throughout the country, and with the elimination of the practical component on the BOC examination, individual athletic training education programs have been responsible for ensuring students have the necessary clinical competency for entry-level practice. Additionally, in an effort to ensure quality education within all accredited programs, the CAATE created specific standards pertaining to student outcomes. Most notably, Standard 11 required that all programs must maintain a three-year first-time pass rate of 70% to remain in compliance, and this has placed additional pressure on programs to emphasize BOC outcomes, which may have inadvertently decreased program emphasis on clinical experience.

The changes to the BOC examination and elimination of the internship route to certification raised concern regarding professional preparedness of new graduates, and the rapid rise in first-time pass rates on the BOC examination had also raised concern.

The purpose of this study was to evaluate the benefits of a comprehensive clinical examination and the potential impact it could have for athletic training students and athletic training education programs. The comprehensive clinical examination had the potential to advance student learning, improve BOC examination performance, and assist athletic training programs with determining BOC preparedness. Furthermore, a comprehensive clinical examination may help ensure the professional preparedness and clinical competency of graduates from an accredited athletic training program.

# Chapter Two: The Literature Review

## Introduction

Despite more than 50 years of education reform and professional advancements in the field of athletic training, graduates of athletic training programs have continued to face many challenges for successfully entering the field and transitioning to practice. Additionally, higher education in America has been under scrutiny throughout the past several decades, and while there is substantial data to support the long term financial and social benefits of a college education, concerns over the quality of higher education and academic programs have continued to be a significant topic of interest (Abel & Deitz, 2014). All colleges and universities will continue to encounter various challenges, and measurements of quality will most definitely be of increasing importance, especially as higher education institutions struggle to increase enrollment, improve retention, and produce qualified graduates (Peer, 2000). This is especially important in health care professions. Graduates of health care programs undoubtedly face many challenges as they transition to practice, and it will remain the responsibility of academic program directors, teaching faculty, clinical instructors, and preceptors to ensure these future professionals are properly prepared with not only the psychomotor skills and foundation knowledge to perform the requirements of the job, but also the critical thinking and interpersonal skills to be successful (Carr & Volberding, 2011).

## History of Athletic Training Education

The National Athletic Trainers' Association (NATA) was founded in 1950 to develop, strengthen, and promote the profession of athletic training (Delforge & Behnke, 1999). Five years later, William E. Newell was appointed as the National Secretary of the

NATA, and he was charged with the difficult task of creating more national and international recognition for the athletic training profession (Delforge & Behnke, 1999). Newell began this task by creating the Committee on Gaining Recognition, and in 1956, this committee determined the best way to move the profession forward involved the development of a national certification and a structured curriculum for the profession (Delforge & Behnke, 1999). A few years later in 1959, the first curriculum model in athletic training was approved by the NATA Board of Directors. This model typically represented a unique delivery of existing coursework offered by a university that would prepare individuals for athletic training practice, but these original curricula were not designed to produce an individual whose sole professional responsibility would be providing athletic training services (Delforge & Behnke, 1999). In most cases, these early curricula were primarily designed to prepare students for a teaching position at the secondary-level, specifically within health or physical education (Delforge & Behnke, 1999). At the time, this was considered to be a positive combination for employment preparedness as there was a significant need for athletic trainers in the secondary school setting (Delforge & Behnke, 1999). Universities also commonly offered an athletic training curriculum in combination with an existing pre-physical therapy curriculum. This was easily accomplished in a pre-physical therapy program by adding a few courses specific to the athletic training profession (Delforge & Behnke, 1999).

There were few developments over the next decade, but several significant developments came in 1969. First, the NATA developed the Professional Education Committee (PEC) and the NATA Certification Committee; and second, the first authentic undergraduate athletic training curricula were approved by the NATA Board of Directors,

giving rise to the curriculum review and approval process (Delforge & Behnke, 1999). Up to this point, the current athletic training programs were not well-established or designed with the primary intent of preparing graduates to primarily function as an athletic trainer (Delforge & Behnke, 1999). However, this process took time, and formal athletic training clinical and didactic educational programming were not developed until the 1970's (Delforge & Behnke, 1999). During this planning period, the NATA PEC identified 11 specific courses and a list of key learning outcomes that best represented the body of knowledge necessary to function as a professional athletic trainer (Weidner & Henning, 2002). A complete list of these courses can be found in Table 2.

**Table 2**

*Athletic Training Curriculum Course Requirements in Mid-1970's*

| |
|---|
| Anatomy |
| Physiology |
| Physiology of Exercise |
| Applied Anatomy and Kinesiology |
| Psychology (2 courses) |
| First Aid and Safety |
| Nutrition |
| Remedial Exercise |
| Personal, Community, and School Health |
| Basic Athletic Training |
| Advanced Athletic Training |

The learning objectives identified by the NATA PEC were not necessarily met within the early athletic training curricula. Most of these required courses were already offered by the college or university, and each individual institution could determine the content of each course (Weidner & Henning, 2002). This original model was far from the competency-based model that was developed several decades later, and significant steps were necessary to standardize curricula and ensure student outcomes were being met.

In addition to the required curriculum courses in the earliest programs, athletic training students were required to complete a minimum of 600 to 800 hours of clinical experience (Weidner & Henning, 2002). The clinical experience hour requirement was satisfied through a combination of time spent in clinical education in a laboratory setting as well as authentic field experience, and both types of experiences were expected to be completed under the supervision and instruction of a NATA-certified athletic trainer (Weidner & Henning, 2002).

In 1971, just two years after the NATA approved the first undergraduate athletic training programs, the NATA offered its first national certification examination. The development of NATA-approved programs and a national certification examination was critical to gaining acceptance and respect from major leaders in the health care community, such as the American Medical Association (AMA; Delforge & Behnke, 1999). Student eligibility for the examination was not limited to those graduating from NATA-approved curriculums, but rather, students were required to complete one of the four main routes to certification eligibility outlined in Table 3.

**Table 3**

*Eligibility Criteria for NATA Certification Examination (1970)*

| | |
|---|---|
| Route 1 | Individuals are actively engaged within the profession but not yet certified (Grace, 1999). Athletic trainers actively engaged within the profession but not yet certified were required to provide proof of five years of athletic training experience beyond that as a student (Grace, 1999). |
| Route 2 | Students graduated from an NATA-approved program (Grace, 1999). These students had to acquire a minimum of 800 clinical experience hours in no fewer than two years under the supervision of NATA-approved supervisors (Grace, 1999). |
| Route 3 | Students graduating from a physical therapy degree program (Grace, 1999). These graduates needed to acquire two years of athletic training experience beyond that as a student at the secondary school level under direct NATA-approved supervision (Grace, 1999). |
| Route 4 | Participating in a professional apprenticeship with more than 1800 hours under the supervision of a certified NATA member (Grace, 1999). |

The national certification examination was created by the Certification Examination Subcommittee of the Professional Advancement Committee, and questions were developed following a survey of NATA members that focused on the knowledge and skills necessary to perform the duties of an entry-level athletic trainer (Grace, 1999). The first certification examination included 150 written questions and three oral practical exercises (Grace, 1999). Upon successful completion of the examination, it was determined these individuals would be called ‘athletic trainer, certified’ (ATC), and in 1987, the certification marks ‘ATC’ and ‘CAT’ were registered with the United States Patent Office (Grace, 1999).

During the same period of time when the certification examination was being introduced, the NATA PEC revised the didactic and clinical curriculum requirements to ensure the athletic training curriculum became much more specialized and established itself as a unique, separate program from education, physical education, physical therapy,

and any other program (Grace, 1999). In order to best guide colleges and universities to develop high-quality consistent curricula, the NATA PEC created a list of learning outcomes and a competency checklist for athletic training skills (Delforge & Behnke, 1999).

Then, in 1980, the NATA mandated all approved athletic training programs were to be identified by their respective college or university as a separate academic major or specialization, such as athletic training, sports medicine, or another equivalent title. This mandate faced opposition from many college and university administrations, and although the NATA did extend the deadline for compliance to 1990, the NATA remained committed to this requirement for any approved program. Thus, beginning in 1990, all universities preparing athletic training students for certification were required to have an established athletic training major, or be in the process of adding the major to their list of academic programs (Delforge & Behnke, 1999). These approved programs were also required to utilize the list of learning outcomes and competency checklists created by the NATA PEC (Delforge & Behnke, 1999). These learning outcomes were not embedded into the earliest programs, as these curricula were largely based on academic majors, programs, and courses that previously existed and were already being offered at colleges and universities (Delforge & Behnke, 1999).

Another accomplishment of the NATA in the early 1980's involved gaining accreditation with the National Commission for Health Certifying Agencies (NCHCA; Grace, 1999). This step was initiated as a response to many state-level athletic training associations petitioning for state licensure, and at the time, most state licensing acts recognized the NATA certification examination as the requirement for professional

licensure (Grace, 1999). Thus, the goal with NCHCA accreditation was to ensure quality and impartiality of the certification examination, and it was also intended to gain recognition for the certification process (Grace, 1999). The NATA filed for NCHCA accreditation in 1981 (Grace, 1999). One of the primary requirements for accreditation was independent oversight of the certification process. Since the current process was developed and implemented by the NATA without external involvement, the NCHCA mandated that governance of the Board of Certification had to be independent of the NATA Board of Directors. This led to the formation of the National Athletic Trainers' Association Board of Certification (NATABOC), and this organization maintained sole authority to establish, implement, and oversee the certification process (Grace, 1999). To satisfy all requirements from the NCHCA, a role delineation study was performed to ensure the examination was consistent with expectations of knowledge, skills, and abilities (KSAs) for entry-level athletic trainers (Grace, 1999). The earliest approved programs were based on learning objectives and competency checklists, but this new study culminated in a much more substantial document that continued to evolve over the next 40 years. Furthermore, the original role delineation study identified and illustrated a direct connection between the certification examination and the KSAs expected of an entry-level certified athletic trainer. This connection was required by the NCHCA, as criterion 4a stated, "the certifying agency shall utilize a reliable testing mechanism to evaluate individual competence that is objective, fair to all candidates, job-related, and based on the knowledge and skills needed to function in the discipline" (Grace, 1999, p. 289).

In 1982, the first role delineation panel identified the following performance domains to help define the profession: (I) prevention of athletic injuries; (II) recognition and evaluation of athletic injuries; (III) management, treatment, and disposition of athletic injuries; (IV) rehabilitation of athletic injuries; and (V) organization and administration within athletic training (Grace, 1999). Following development of the five performance domains, specific tasks were developed and linked to each domain (Grace, 1999). The finished document in 1982 was titled the *Role Delineation Study for the Entry-Level Athletic Trainer Certification Examination*, and the content presented in the document served as the basis for the certification examination (Grace, 1999). One year later, the NATA PEC utilized the content of the role delineation study to prepare a separate document titled, *The Competencies in Athletic Training* (Weidner & Henning, 2002). This document provided the foundation and framework for all athletic training education programs and curricula (Grace, 1999). With the completion of the role delineation study, the NATA had completed all requirements set by the NCHCA, and in 1982, the NCHCA granted the NATABOC accreditation (Grace, 1999).

Nearly one decade later, the profession reached one of its most important milestones. In 1990, the American Medical Association (AMA) determined that athletic training would be officially recognized as an allied health care profession. Recognition from the AMA was critical for improving the reputation of the profession within the health care community and the overall public; but more importantly, from an academic perspective, it was also a prerequisite for gaining accreditation from the Committee on Allied Health Education and Accreditation (CAHEA; Delforge & Behnke, 1999). Accreditation within athletic training was essential for standardizing academic programs

and facilitating efforts to ensure the preparedness of graduates, and it was believed this step would have a positive impact on promoting and improving the entire athletic training profession (Peer, 2000). One of the most important professional outcomes for accreditation within athletic training education programs was best summarized by Ray, as he wrote,

> When [the public and other members of the health care community] work with an athletic trainer, they are always going to be working with a person of high quality and a person who has been educated to a very rigorous standard. (Peer, 2000, p. 189)

Numerous changes occurred within the oversight of the accreditation process over the next decade, but nonetheless, the combination of an accreditation process for athletic training education programs and a standardized certification operating outside the influence of the NATA were landmark accomplishments for the athletic training profession.

As previously stated, the initial approval process for all athletic training education programs were conducted internally by the NATA PEC (Peer, 2000). Then, in 1991, the Joint Review Committee on Educational Programs in Athletic Training (JRC-AT) was created from members of the CAHEA, NATA PEC, AMA, American Academy of Family Physicians, and American Academy of Pediatrics (Delforge & Behnke, 1999). The JRC-AT assumed sole responsibility for the review and approval of all athletic training education programs (Delforge & Behnke, 1999). The previously used *Guidelines for Development and Implementation of NATA Approved Undergraduate Athletic Training Programs*, developed by the NATA PEC, were reformatted under the CAHEA

and titled, *Essentials and Guidelines for an Accredited Educational Program for the Athletic Trainer* (Peer, 2000). These new standards were also approved by the AMA Council on Medical Education (Delforge & Behnke, 1999). Then, in 1994, the AMA proposed the need to establish a new, free-standing agency for accreditation of allied health education programs, and the CAHEA was disbanded (Peer, 2000). The Commission on Accreditation of Allied Health Education Programs (CAAHEP) was created to assume the duties once held by the CAHEA, and *Essentials and Guidelines for an Accredited Educational Program for the Athletic Trainer* was retitled, *Standards* (Peer, 2000). The JRC-AT remained unchanged and continued to function under the newly formed CAAHEP.

Another pivotal event within athletic training education occurred in the mid-1990's when the NATA Board of Directors established an Education Task Force to discuss educational issues and determine best practices that would continue to progress the profession and the education of future professionals (Peer, 2000). In 1996, the NATA approved recommendations from the Education Task Force, stating that in 2004, only those students graduating from a CAAHEP-accredited program would be eligible to take the certification examination (Delforge & Behnke, 1999). This decision resulted in the dissolution of the internship route. The internship route was still being used by many colleges and universities, as it was a way to prepare students to sit for the Board of Certification examination without seeking formal program accreditation through the CAAHEP. Other previously used routes for certification, such as graduating from a physical therapy program, were previously discontinued and prohibited by the NATABOC in the early 1980's (Delforge & Behnke, 1999). From that point forward, all

non-accredited athletic training education programs were required to seek and maintain accreditation from the CAAHEP, and all accredited programs were required to undergo a periodic comprehensive review process to maintain accreditation. The decision to eliminate internship-style programs as a route to certification ultimately resulted in the closure of many programs. Graduates of these programs were no longer eligible to sit for the certification examination, and many of these institutions did not have the necessary resources or ability to acquire such resources to meet the accreditation requirements.

The decision to identify accredited programs as the only route to certification was made for a variety of reasons. First, having only one route to certification was believed to improve the legitimacy of the certification process (Craig, 2003). Second, most other allied health care professions required individuals to complete a health care program accredited by the CAAHEP or another similar accrediting agency (Craig, 2003). Third, it was believed that standardizing the academic preparation for future athletic trainers would have a positive impact on the reputation of the profession (Craig, 2003). Most importantly, required accreditation would improve program quality and equality, allow for ongoing feedback and guidance, and ultimately, it would recognize only those colleges and universities that met the standards and guidelines provided by the CAAHEP and the JRC-AT (Peer, 2000, p. 189). When comparing the two different routes to certification, there were consistently identified differences in student abilities and professional preparedness, and these inconsistencies could be viewed as a liability to the entire certification process and the profession (Craig, 2003).

This decision was not made without considerable debate within the academic and professional communities. While the accreditation requirement was intended to provide

programs with guidance on establishing standards and learning objectives, some universities experienced difficulties in meeting these standards with their current curriculum, faculty, and resources. Additionally, many professionals, especially those who completed an internship-style program, believed some of the accreditation standards and guidelines limited the overall professional preparation and clinical experiences of athletic training students (Mazerolle & Bowman, 2017). Early research found that most employers of entry-level athletic trainers who completed an internship program did believe they were adequately prepared for professional practice (Brett et al., 2009). However, when conducting similar research on student perceptions, the students from accredited programs did report significantly higher levels of perceived preparedness for the BOC examination and professional practice (Craig, 2003).

For nearly 10 years, the JRC-AT continued to review athletic training programs as part of the CAAHEP, and in 2006, the JRC-AT received approval to operate as an independent accrediting agency and changed its name to the Commission for Accreditation of Athletic Training Education (CAATE; n.d.-a, para. 1). The American Academy of Family Physicians, the American Academy of Pediatrics, the American Orthopaedic Society for Sports Medicine, and the NATA have continued to partner with the CAATE to determine the standards for entry-level athletic training programs; and in 2018, the CAATE adopted and released the *2020 Standards for Accreditation of Professional Athletic Training Programs* (CAATE, n.d.-b). These standards were designed to ensure continued consistency and quality within athletic training education programs, and they aligned with the 7th edition of the *Practice Analysis* (Henderson, 2015) and the 5th edition of the *Athletic Training Education Competencies* (published by

the NATA). The *2020 Standards for Accreditation of Professional Athletic Training Programs* were intended to guide the next major milestone in athletic training education: the transition of all undergraduate athletic training programs to graduate programs. This decision was made in 2015 after several years of research, discussion, and debate. Ultimately, it was the decision of the Strategic Alliance (BOC, CAATE, NATA, and NATA Foundation) that it was in the best interest of the athletic training profession and all respective stakeholders to require all education programs to transition degree level and offer an updated curriculum. The Strategic Alliance believed this decision would best position future athletic training students for successful employment in the ever-changing health care system. Under this mandate, no colleges and universities would be permitted to admit students into an undergraduate athletic training program after the beginning of the Fall 2022 Semester.

**History of the Board of Certification Examination**

The certification process in athletic training preceded program accreditation, and it was the first attempt to systematically evaluate and standardize the process for becoming professionally titled (Grace, 1999). Since its inception in 1969, the examination changed significantly in content, delivery, and oversight throughout the next 50 years, but it continued to provide the only avenue for national certification as an athletic trainer (Grace, 1999).

The first certification examination in athletic training was developed and offered by the NATA to a group of 15 recent graduates in 1971 (Grace, 1999). The NATA was the national organization of professional athletic trainers, and this organization was founded in 1950, at a time when athletic training education programs, national

certification examinations, and accreditation had yet to exist. With the profession emerging through the 1970's and gaining recognition in the field of health care, the NATA understood the potential issues with continuing to sponsor the certification examination for its members. For this reason, the NATA sought accreditation by the National Commission for Health Certifying Agencies (NCHCA) in 1981 (Grace, 1999). The NCHCA was established to evaluate the psychometric properties of certification examinations and ensure the organization responsible for preparing, conducting, and evaluating the examination met specific requirements and legal guidelines (Grace, 1999). "The NATA was the first allied health organization in sports medicine to achieve this recognition by the NCHCA" and "by achieving NCHCA recognition, the NATA could provide state licensing agencies the assurance these agencies required to recognize NATA-certified athletic trainers for licensing purposes" (Grace, 1999, p. 289). To ensure compliance, the NATA was required to develop a new diverse committee, representing all districts of the NATA and consisting of not only athletic trainers, but also individuals representing the consumers of athletic training services (Grace, 1999). Additionally, a medical physician was required to serve as the medical director of the board (Grace, 1999). This committee was known as the NATABOC, and under the requirements set forth by the NCHCA, the NATA Board of Directors were required to provide the Board of Certification with complete independence and autonomy with the development, delivery, and evaluation of the certification exam (Grace, 1999). The NATABOC continued to operate independently within the NATA's governance structure until it was determined there was the continued potential for the appearance of impropriety between the NATA and the Board of Certification, and this could have legal ramifications (Grace,

1999). Furthermore, as more states began to increase their regulatory efforts of certified athletic trainers, there was concern regarding the fact that a membership organization was still involved in the administration and oversight of the certification program (Grace, 1999). Thus, in 1989, the NATA Board of Directors voted in agreement to end all involvement on the part of the NATA with the certification process (Grace, 1999). At that time, a new NATABOC was created as a completely separate not-for-profit organization outside the NATA, and this organization assumed total authority and responsibility for all aspects involving the initial and continued certification of all athletic trainers (Grace, 1999). Since that time, the NATABOC simplified its name to the BOC (Board of Certification), which also served to further distance this organization from any suspicion of influence from the NATA.

Throughout the past 50 years, the committees managed by the NATA and Board of Certification have been responsible for ensuring the certification test reflected the changing competencies and expectations of an entry-level athletic trainer (Grace, 1999). The first examination in 1969 was based on the work of the Certification Examination Subcommittee and the Professional Advancement Committee, both committees of the NATA. The Certification Examination Subcommittee created a questionnaire for all current NATA members to evaluate and rank the perceived importance of certain topics and content for the examination (Grace, 1999). After reviewing the results, the Certification Examination Subcommittee proposed to the Professional Advancement Committee a two-part examination that consisted of 150 written questions and several questions provided in an oral-practical format. The first 75 written questions were designed to test the candidates' foundation knowledge in athletic training-related topics,

such as anatomy, physiology, pathology, biomechanics, and injury prevention (Grace, 1999). The remaining 75 written questions were focused on theory and the application of principles within the field of athletic training. This included content on injury identification, orthopedic assessment, injury management, rehabilitation, nutrition, ethics, and several other areas within athletic training (Grace, 1999). The oral-practical section of the examination involved the demonstration of common techniques used by professional athletic trainers in injury prevention, injury identification, and injury management (Grace, 1999). This part of the examination commonly required the candidate to demonstrate prophylactic taping, therapeutic modality treatments, first aid, and injury assessment techniques on a standardized model under the review of several trained evaluators (Grace, 1999).

With the recognition of the NCHCA in 1982, the NATA created the Board of Certification and this committee assembled a panel of professionals to study the current roles and responsibilities of the entry-level athletic trainer (Grace, 1999). This was a significant advancement in the development of the certification examination when compared to the original NATA member questionnaire of that was used to help develop the earliest examination. The results of the study conducted by the BOC culminated in the development of the *Role Delineation Study for the Entry-Level Athletic Trainer Certification Examination*, and this role delineation study, also considered an analysis of professional practice, was repeated six times between 1982 and 2015. At the time of the first role delineation study, the panel identified the following performance domains for the profession: (1) prevention of athletic injuries; (2) recognition and evaluation of athletic injuries; (3) management, treatment, and disposition of athletic injuries; (4)

rehabilitation of athletic injuries; and (5) organization and administration in athletic training (Grace, 1999, p. 289). As of 2020, the most recent edition, *Practice Analysis,* 7th Edition (Henderson, 2015), was published in 2015 by the Board of Certification and continued to provide a review of the roles, responsibilities, and expectations of the entry-level athletic trainer (Henderson, 2015). While there were significant changes to the content identified within each domain, and the overall number of domains has occasionally changed, the original domains described in 1982 remained similar to those documented in 2015. A comparison of these domains is illustrated in Table 4.

**Table 4**

*Domains in Athletic Training*

| Domain | *Role Delineation Study for the Entry-Level Athletic Trainer Certification* (1982) | *Practice Analysis, 7th Edition* (2015) |
|---|---|---|
| **1** | Prevention of Athletic Injuries | Injury Prevention and Wellness Promotion |
| **2** | Recognition and Evaluation of Athletic Injuries | Examination, Assessment, and Diagnosis |
| **3** | Management, Treatment, and Disposition of Athletic Injuries | Immediate and Emergency Care |
| **4** | Rehabilitation of Athletic Injuries | Therapeutic Interventions |
| **5** | Organization and Administration | Healthcare Administration and Professional Responsibility |

As the profession continued to become more recognized and the domains continued to expand in content areas, the certification exam continued to be critically reviewed on an ongoing basis. For example, in addition to the 150 multiple-choice question portion of the examination and the oral-practical section, the NATABOC added a third section to better assess decision-making capabilities (Henderson, 1997). This section was commonly referred to as the written simulation, and it was implemented after

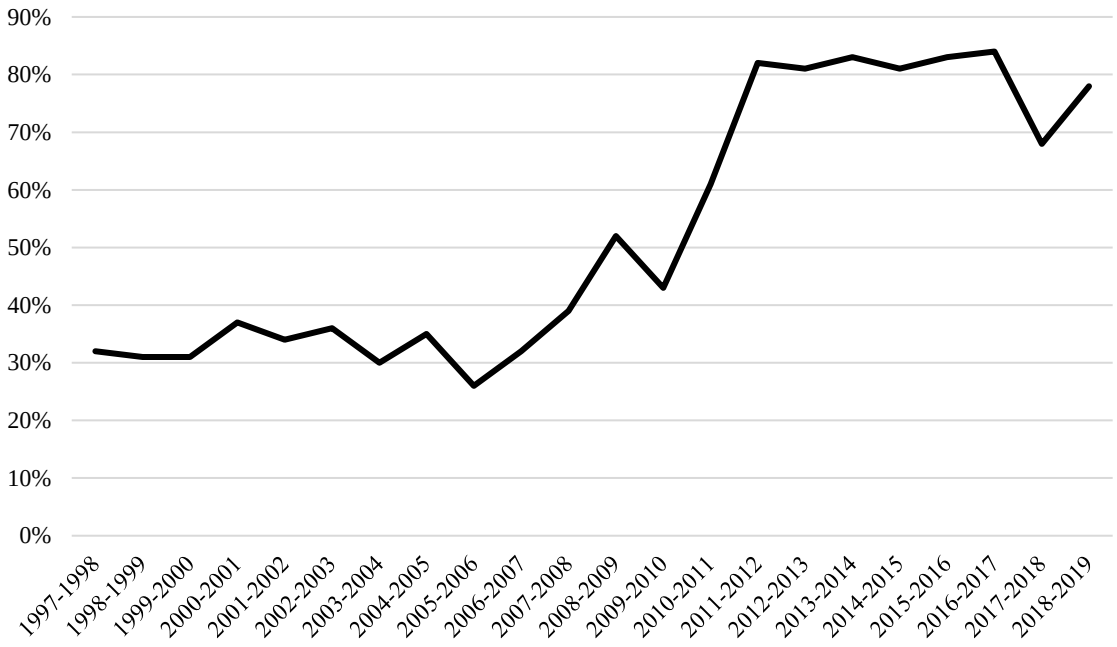
the NATABOC completed the Simulation Validation Study in 1996 (Henderson, 1997, p. 2). The written simulation portion of the examination presented eight unique scenarios based on the role delineation study (Henderson, 1997). Students received immediate written feedback as they answered questions about the scenario, and this feedback was intended to continue guiding the student through the scenario (Henderson, 1997). The certification examination continued with these three core components until the 2007-2008 test period, when the BOC introduced a computerized version of the examination that attempted to combine the previously used written simulation and practical components into scenario-based hybrid questions (Castle Worldwide Inc., 2008). Thus, the BOC eliminated the oral-practical component and transitioned all aspects of the test to a fully computerized version. While there was considerable debate over the removal of the practical portion of the examination, it was the position of the CAATE that the evaluation of the clinical skills and overall clinical development of the athletic training student was at the discretion of the individual program (CAATE, 2012).

Prior to implementing the new examination during the May/June 2007 testing period, students taking the three-part examination achieved a first-time pass rate of 26.2% in the 2005-2006 test period and 31.5% in the 2006-2007 test period (Castle Worldwide Inc., 2008, p. 4). The new examination contained 125 multiple-choice questions and a hybrid section containing two scenarios that included a subset of 12 to 17 items or questions. The computerized version of the examination was continually evaluated throughout the next decade, and as of 2019, the version included 175 multiple-choice questions. Fifty of these questions were under evaluation and were not evaluated as part of the student's performance. Of the 125 evaluated questions, there was a combination of

stand-alone multiple-choice questions, drag-and-drop labeling questions, text-based simulation questions, and focused testlets (scenario-based questions with multiple follow-up questions). The most recent data provided by the BOC identified the first-time pass rate for athletic training students in 2018-2019 as 77.8% (BOC, 2019), and Figure 1 represents first-time pass rates on the BOC examination from the 1997-1998 test period to the 2018-2019 test period.

**Figure 1**

*BOC Examination First-Time Pass Rates*




*Note*. The line in Figure 1 represents the national first-time pass rates on the BOC examination from the 1997-1998 testing year to the 2018-2019 testing year.

Many professionals in the field raised concern due to the sudden and significant increase in first-time pass rates following the elimination of the written simulation and practical components in 2007 (Moore, 2014). Additionally, many professionals believed new graduates did not have the same experience and professional preparation as previous

graduates (Moore, 2014). However, while the largest improvements in first-time pass rates did occur soon after the transition of the testing format, the improved student outcomes were found to be less associated with the test design and more likely an outcome of program accreditation requirements and the matriculation of higher quality students into the limited slots available within each program.

**Clinical Education Reform in Athletic Training**

One of the most impactful areas of change within the field of athletic training education involved the reform of clinical education. Clinical education in health care has been the foundation for professional preparation, and it involves the complex integration and application of knowledge in both lab-based and authentic clinical experiences with real patients (Edler et al., 2017). Clinical experience has been paramount to the educational process and professional development of athletic training students, as well as students seeking a degree in any health care field. Athletic training students have reported more than half of their learning and professional development occurred through clinical education, and for this reason, athletic training educators and program administrators have been particularly concerned with the quality of clinical experiences provided to students (Heinerichs et al., 2014). High-quality clinical experiences allowed students to develop critical thinking skills and incorporate information learned in the classroom into authentic situations with real patients (Armstrong & Jarriel, 2015). The importance of quality in clinical education in athletic training programs cannot be underestimated, and the CAATE, along with its predecessors, made significant changes and recommendations to accredited athletic training programs to ensure students received diverse experiences that contributed to their overall professional development. However, research within

athletic training education revealed considerable variability in clinical education, and many programs encountered difficulty with certain aspects pertaining to education reform (Brett et al., 2009). Some commonly reported issues and concerns involved the quality of clinical experiences, the variety of clinical experiences, the volume of clinical experiences, the quality of supervision provided, and the overall autonomy provided to students to think and act within their clinical rotations. These obstacles created concern among practicing athletic trainers, athletic training educators, and employers of athletic trainers and it was commonly being reported that "not all graduates [were] equipped with personal and practical skills necessary for high performance in the working world" (Brett et al., 2009, p. 73).

Some of the earliest and most significant changes within clinical education involved the removal of the internship route to certification in 2004 and changes to athletic training student supervision policies during clinical experiences. From the early 1980's until 2004, athletic training students could complete one of two types of education programs as a route to certification (Delforge & Behnke, 1999). This included the completion of an internship route through a non-accredited athletic training program or the completion of an accredited athletic training education program. During this time, athletic training students from both types of programs frequently participated in unsupervised periods of clinical education as reported (Weidner & Pipkin, 2002). In 2002, Weidner and Pipkin reported that freshman in athletic training programs spent 5% of their time unsupervised, sophomores were unsupervised 7.3% of the time, juniors were unsupervised 13.7% of their time, and seniors were unsupervised 21.6% of their time in clinical education (p. 244). Students enrolled in an internship program commonly

attended practices and events without supervision, and these students often traveled with athletic teams, providing athletic training services that included preventative care and injury assessment (Aronson et al., 2015). The internship program was drastically different from the accredited program, and the removal of this route to certification was expected to improve the overall consistency in the education of students in athletic training programs and address some of the issues with unsupervised clinical experiences (Weidner & Pipkin, 2002). The internship route also lacked formal curriculum standards, and the overall student experience was much more similar to an apprenticeship. Accreditation served to provide structure, guidance, and consistency among programs which would result in better student outcomes and professional practice upon the completion of the academic program (Weidner & Pipkin, 2002). Furthermore, Weidner and Pipken (2002) reported, "the internship route [had] been viewed as the weak link in professional preparation in athletic training and impeded licensure efforts needed to protect the profession and the public those athletic trainers serve" (p. 246).

Changes to the supervision policy for athletic training students in accredited programs were later implemented to reduce the potential for athletic training students replacing full-time professional staff, ensure state practice acts were not violated, and most importantly, protect the well-being of patients. However, these changes did not occur until 2011, and prior to this time, many programs accredited continued to allow students to function in a more autonomous role as a first responder. Thus, when a preceptor was not present or immediately available to supervise a student in a clinical environment, students were permitted to perform skills within their scope of practice according to their state practice act (Mazerolle & Bowman, 2017). These opportunities

allowed students to perform skills independently, and that may have had a positive impact on their professional development, especially with regard to confidence and communication (Mazerolle & Bowman, 2017). While many considered this an opportunity for autonomous learning and essential professional development, others believed this to be a misuse of athletic training students and a method for coaches, administrators, and athletic trainers to add inexpensive support to their program (Scriber & Trowbridge, 2009). Weidner and Pipkin (2002) provided further evidence that athletic training students were commonly providing medical care and services well beyond that which described a first responder, and students often felt pressure to perform athletic training duties since they were an athletic training student. More importantly, the use of unsupervised athletic training students in these roles created significant concerns regarding patient care, especially within the medical community and general public.

While the CAATE did not advocate this practice, the CAATE did provide the following information in an accreditation update:

- Unsupervised clinical experiences were to be conducted outside of the accredited program.
- Unsupervised clinical experiences did not count as approved clinical hours under the CAATE.
- Unsupervised clinical experiences could not be mandated.
- Students were to receive a clear job description pertaining to the experience and their role as a first responder.
- Programs were to provide evidence clearly showing the students were protected through liability insurance.

- Programs were to document that student participation at events as a first responder did not violate any state practice act (CAATE, 2008).

The CAATE readdressed this issue in 2011 by requiring all students to be under direct supervision, which was defined as having a clinical instructor on-site with the ability to intervene on behalf of the student at any time. This decision was made to protect the athletic training student, as well as the patient, but it did come with opposition. The loss of autonomy in clinical education was viewed by some as an inadvertent setback as students experienced limited opportunities to make clinical decisions and learn from these decisions. Scriber and Trowbridge (2009) had previously reported that students failed to effectively synthesize their experiences because a supervisor was always present to step in if needed, and Mazerolle and Bowman (2017) concluded the updated supervision requirements limited independent thinking. However, Knight (2008) had argued that autonomy alone did not work, and when students made decisions in isolation, there was a lack of guided reflection and reinforcement. Mazerolle and Bowman (2017) based their conclusions on student outcomes following the change in supervision requirements and suggested "the pendulum may have swung too far in requiring direct supervision" (p. 107). This complex balance between learning and independence was described by Scriber and Trowbridge (2009) as a situation of irony, as many athletic training students, faculty, and professionals stated they learned best when gaining experience alongside a clinical supervisor and when they were allowed to practice autonomously. The CAATE recognized the need for students to develop their psychomotor and clinical reasoning skills in authentic situations, and it was the CAATE's position that graded autonomy allowed for the following: an opportunity for the preceptor

to establish safe boundaries for student practice; an environment for continued learning and discovery; and opportunities for student engagement with actual patients (Bowman & Dodge, 2013). When authentic opportunities were limited, the CAATE recommended the use of simulations, standardized patient encounters, and other assessment techniques to facilitate learning and evaluation. These techniques were not new to athletic training, but athletic training programs began implementing these practices more regularly. Additionally, programs continued to explore other methods that promoted critical thinking and encouraged professional maturation while providing students with opportunities to learn and demonstrate competency (Aronson et al., 2015).

**Clinical Competency in Athletic Training Education**

Athletic training programs have implemented a wide variety of methods to evaluate clinical competency, and a majority of these methods can be classified as either behavioral or holistic (Thompson et al., 2014). Thompson et al. (2014) described the behavioral approach as an effective performance assessment when evaluating a student's psychomotor skills in one specific context. Under this approach, programs historically used basic rubrics or dichotomous grading scales (i.e., yes or no) that evaluated an individual's ability to perform a specific skill upon receiving an instructional prompt. This method of evaluation was commonly used in athletic training programs, and it was consistent with the oral-practical examination previously utilized by the Board of Certification. Conversely, the holistic performance assessment allowed for a clinical educator to assess a student's ability to demonstrate knowledge, critical thinking, psychomotor skills, and clinical decision-making in the environment presented at that moment (Thompson et al., 2014). Epstein and Hundert (2002) believed that all health

care personnel and stakeholders should view competency more comprehensively and not simply by the ability of a student to demonstrate a skill in one context. Epstein and Hundert (2002) proposed the following definition of professional competence:

> Professional competence is the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individual and community being served. Competence builds on a foundation of basic clinical skills, scientific knowledge, and moral development. It includes a cognitive function (acquiring and using knowledge to solve real-life problems); an integrative function (using biomedical and psychosocial data in clinical reasoning); a relational function (communicating effectively with patients and colleagues); and an affective/moral function (the willingness, patience, and emotional awareness to use these skills judiciously and humanely). Competence depends on habits of mind, including attentiveness, critical curiosity, self-awareness, and presence. Professional competence is developmental, impermanent, and context-dependent. (pp. 226–227)

Based on Epstein and Hundert's (2002) definition, holistic performance measures should be the preferred method for assessing student competency, as these assessments are not done in an isolated, controlled environment, but rather, they are situational and context-dependent. Examples of holistic performance assessment would include practical examinations, simulations, problem-based learning scenarios, and standardized patient evaluations. The CAATE recommended programs use a combination of these performance assessments to evaluate student competency, due to the situational aspect of clinical experiences and the inability for programs to provide all students with equal

authentic opportunities related to each of the competencies within athletic training education.

**Principles of Clinical Education**

Clinical education is paramount to the professional development of athletic training students, as it provides opportunities for students to apply their clinical skills and knowledge in a safe, controlled environment with real patients (Benes et al., 2014). Clinical education in athletic training originated as an apprenticeship model, but following several decades of education reform, programs were required to follow a competency-based model that sought to integrate the didactic and clinical aspects of the program. While this transition was deemed necessary for improving patient care and ensuring student outcomes, it is a complex model that encountered many problems previously experienced in other medical fields (Weidner & Henning, 2002). One key area of complexity involved the balance and uniformity among program administrators, teaching faculty (didactic and clinical), and clinical preceptors (Weidner & Henning, 2002). Successful health care programs developed a strong curriculum by having a dedicated faculty that engaged with students and encouraged productive discourse, and these same faculty qualities were also seen in the students' clinical settings (Heale et al., 2009).

The clinical education program should be designed to improve student knowledge, promote the integration of didactic knowledge, facilitate critical thinking and problem solving skills, improve written and verbal communication, and advance administrative knowledge and skills (Mazerolle et al., 2015). To accomplish these objectives, health care programs, such as athletic training, have relied heavily on the

ability of their clinical preceptors to effectively close the loop for students, with regard to the transition of didactic knowledge and the application of clinical skills (Rich, 2009). Rich (2009) acknowledged the role of the clinical preceptor, or supervisor, as one of the most critical aspects in the professional development of athletic training students. Mazerolle and Bowman (2016) offered further support and concluded that mentorship was a key role of the clinical preceptor and effective mentoring had the potential to improve the student's overall socialization to the field of athletic training. Additionally, Mazerolle and Bowman (2016) concluded that students relied on clinical preceptors to serve as mentors by guiding their clinical development and improving their knowledge base, skill level, and clinical decision-making through deliberate dialogue initiated by the preceptor. The importance of effective mentorship by the preceptor cannot be underestimated, and due to the lack of independent learning opportunities available to students, the ability of a preceptor to provide guided autonomy has been key to the students' professional development. In an effort to prepare preceptors to become effective clinical educators, Rich (2009) recommended that individuals supervising students in a clinical experience should be cognizant of the students' foundation knowledge and what information they are currently being exposed to in the didactic setting. Rich (2009) believed this information was critical for clinical preceptors to identify teachable moments that can effectively be used to build upon the students' theoretical knowledge.

To better understand what athletic training students believed benefitted them most in their clinical education, Aronson et al. (2015) asked senior-level athletic training students to complete a survey regarding their clinical experiences. From this study, Aronson et al. (2015) concluded that students appreciated preceptors who modeled

professional behaviors, provided supervised autonomy, and encouraged students to integrate what they have learned. Supervised autonomy, or guided autonomy, allowed students to perform skills in authentic situations and participate in clinical decision-making in a supervised environment that fostered collaboration, feedback, and discourse. Depending on the student's grade level, knowledge, competence, and confidence, effective preceptors adjusted the amount of autonomy on an individual student basis (Mazerolle & Bowman, 2016). In addition to supervised autonomy, research also showed that observation-only clinical experiences were also an effective teaching mechanism, but these experiences must be supported with individual and preceptor-guided reflection (Mazerolle et al, 2015).

Another key aspect of clinical education was the evaluation of student performance, and adequate student supervision was essential to accurately complete this essential function. The lack of supervision that previously existed in athletic training programs posed an obvious problem with evaluations of the student's clinical performance and level of competency. Armstrong et al. (2009) reported that "real-time clinical evaluation [was] valued as a hallmark process for professional growth, because these evaluations [were] performed in unpredictable environments while students [were] actively engaged in clinical experiences" (p. 636). However, the potential for authentic clinical experiences to cover the breadth of the competencies in athletic training education was not likely to occur for each student. Thus, faculty and clinical preceptors were required to identify alternative methods that provided students with ample opportunities to demonstrate competency. These methods commonly included simulations and standardized patient encounters which were generally conducted by the

faculty (Armstrong & Jarriel, 2015). Clinical preceptors were also encouraged to use simulated scenarios and focused questioning that ranged from lower-level questions to higher-level questions. The lower-level questions commonly assessed only factual knowledge, but higher-level questions required critical thinking, application, and reflection.

In addition to the need for experienced, engaged, and highly-qualified clinical preceptors, student outcomes were also associated with individual clinical environments. Within athletic training education programs, the CAATE required each student to be exposed to a variety of clinical settings, which provided students with the opportunity to see authentic patients with varying demographics (CAATE, 2012). This typically included clinical rotations at high schools, colleges and universities, health clinics, and physician offices. Research suggested that student outcomes improved when students were placed in clinical environments that provided opportunities for authentic clinical experiences, performance evaluations, and guided reflection (Armstrong et al., 2009). Studies suggested that clinical preceptors and program administrators both believed clinical rotations at the high school and collegiate level provided the most opportunities for authentic, real-time clinical experiences and student performance evaluations (Walker et al., 2008).

The ability for a program to provide consistent clinical education and performance assessments was largely dependent on the quality of the clinical preceptors and the clinical sites. Despite education reform in athletic training and improvements made in regard to the standards and competencies for athletic training programs across the nation, clinical education continued to be a concern for many stakeholders, including

professional athletic trainers, employers of athletic trainers, and most importantly, the patients of athletic trainers (Carr & Volberding, 2011). This remained a significant concern, as graduates of athletic training programs perceived that more than half of their professional preparedness was directly related to their clinical education (Heinerichs et al., 2014). Therefore, it was essential for programs to recognize and implement high-impact practices within all aspects of clinical education, and it was also important for programs to recognize universal and program-specific barriers for delivering high-quality clinical experiences. These barriers have commonly included a lack of authentic opportunities for clinical development, a lack of student engagement, high levels of student frustration, and inadequate preceptor preparation and performance (Heale et al., 2009).

**Barriers to Effective Clinical Education**

There was extensive research available on the barriers to clinical education in multiple health care fields, including athletic training, physical therapy, and nursing, Within athletic training, students, clinical preceptors, and academic faculty identified a lack of real-time clinical experience as one of the most significant barriers to professional development and the evaluation of student performance (Armstrong et al., 2009). Authentic clinical experiences in athletic training were often times situational, and regardless of a student's clinical preceptor or clinical site, not all athletic training graduates were afforded the same opportunities during their clinical education. Armstrong et al. (2009) reported that students and clinical preceptors experienced the greatest amount of difficulty with identifying sufficient opportunities in specific content areas, such as nutrition, pharmacology, and psychosocial interventions. For this reason,

many programs added additional opportunities for simulation and incorporated the use of standardized patient encounters to provide realistic experiences to replace and emphasize some aspects of the student's clinical experience (Armstrong & Jarriel, 2016). Both of these methods have been well-researched in a variety of health care programs and have consistently been shown to be valuable resources from an educational and assessment perspective (Armstrong & Jarriel, 2016).

Another barrier within clinical education involved student engagement, and previous work done by Heale et al. (2009) demonstrated the importance of active student participation, as it was determined to be a critical component to professional development. Previous research also revealed that high attrition rates within athletic training programs were commonly associated with low levels of student integration and engagement in the academic and clinical aspects of the program (Bowman & Dodge, 2013). According to Bowman and Dodge (2013), many students felt unengaged in class and in their clinical rotations, and while this was associated with attrition, it was also associated with deficient academic, clinical, and professional development of students. While there was an obvious connection between student engagement, performance, and attrition, additional research was necessary to identify and better understand the various factors that may have resulted in decreased student engagement.

In one investigative study by Bowman and Dodge (2013), a group of students were interviewed to generate a theory regarding student frustration in a single undergraduate athletic training program. The results of the study identified several themes leading to student frustration, including student life strain and monotonous clinical experiences (Bowman & Dodge, 2013). With regard to life strain, students

reported feelings of anxiety and being overwhelmed with the demands of the academic program, in addition to the time requirements of the clinical program (Bowman & Dodge, 2013). Furthermore, several students in the study discussed the negative impact the program can have on one's social life, as some students reported it was difficult to have a genuine college experience (Bowman & Dodge, 2013). Students reported that clinical hours in the afternoons, evenings, and weekends prevented them from being involved in other campus activities and this commonly led to additional sacrifices regarding time spent with family and friends (Bowman & Dodge, 2013). The theme regarding monotonous clinical experiences was further investigated, leading to the discovery that students commonly felt unmotivated in their clinical rotations due to extended periods of time without much to observe (Bowman & Dodge, 2013). Based on the researchers' findings, students reported that only about 40% of their time during clinical education involved active engagement (Bowman & Dodge, 2013, p. 84). While this percentage of engagement is quite low, one must also understand the traditional athletic training environment and how an athletic training clinical education program is quite different from other health care fields. For instance, while many health care programs utilize clinical rotations that involve an established schedule of patient encounters, athletic training students are often times participating in a clinical rotation that may or may not yield many authentic opportunities for clinical practice.

In a similar study by Heinrichs et al. (2014), researchers developed and used the Athletic Training Student Frustration Instrument (ATSFI) and a more significant sample size of 14 accredited programs was used to further explore the issue of student frustration. The survey was developed and based on similar studies that had been

performed in the field of nursing and physical therapy (Heinerichs et al., 2014). While athletic training was still considered a newer profession in the allied health care field, there was an abundance of research available in similar fields, such as nursing, that has helped provide the foundation for many studies involving athletic training education, and specifically, the clinical component of athletic training education. The results from the ATSFI were consistent with previous findings, but it also revealed several additional student concerns that were not discovered in Bowman and Dodge's (2013) previous work. First, students reported a lack of respect as one of the highest sources of frustration in their clinical rotations (Heinerichs et al., 2014). Specifically, students perceived there was a lack of respect from coaches, student-athletes, and clinical preceptors, and this lack of respect led to a negative experience (Heinerichs et al., 2014). Students also experienced frustration when their clinical supervisors did not provide them with appropriate levels of autonomy to apply what they had learned (Heinerichs et al., 2014). The concept of graded autonomy was supported in clinical education after guidelines were changed that mandated direct supervision, however; many preceptors have not been adequately trained in providing opportunities and educating students in this manner (Bowman & Dodge, 2013). Furthermore, research has shown that nearly 50% of clinical preceptors experience significant levels of role strain, as they struggle to balance their responsibilities as a health care provider and a clinical educator (Henning & Weidner, 2008, p. 278).

An additional student frustration in Heinrich's study (2014) involved the lack of opportunities to develop professional behaviors and administrative duties of a certified athletic trainer. These additional skills include time management, record keeping and

other administrative duties, as well as appropriate ways to communicate with fellow health care professionals, patients, parents, coaches, administrative members, and several others (Heinerichs et al., 2014). These areas have been linked to additional stress, as students often feel unprepared to manage these aspects of the professional position (Heinerichs et al., 2014). These frustrations appeared to be well-grounded, as surveys of recent graduates and employers of recent graduates have also identified thematic deficiencies in the areas of interpersonal communication and administration (Carr & Volberding, 2011).

Heinerichs et al. (2014) proposed that program directors, faculty, and clinical preceptors must recognize and appreciate these student concerns and develop initiatives to prevent these factors from becoming significant sources of frustration. Additionally, it was believed that student frustrations could be avoided or mitigated with improved socialization of the athletic training student to the requirements of the program and more formal training programs for preceptors (Heinerichs et al., 2014). However, there was substantial evidence from many health care professions, including athletic training, that while training may improve preceptor performance, preceptors faced numerous barriers that continued to limit their overall effectiveness as an educator and mentor (Benes et al., 2014; Mazerolle et al., 2014; Mazerolle & Bowman, 2016).

**Barriers to Preceptor Effectiveness**

The role of the clinical preceptor in athletic training is to provide direct supervision of athletic training students while providing a safe environment for students to develop their psychomotor skills, improve their critical thinking, and gain experience in authentic situations with real patients. To best achieve the desired results, the preceptor

must fully understand the importance of the preceptor triad, which is based on equal relationships between the preceptor, the program faculty, and the student (Paton, 2010). However, a large number of preceptors were young professionals or recent graduates who were still developing and did not have the skills necessary to balance the role of an educator and practitioner (Mazerolle et al., 2014). Clinical education is an integral component for student development; however, clinical preceptors often lacked the educational background to serve in this capacity (Mazerolle et al., 2014). More specifically, it was reported that preceptors specifically lacked experience as a teacher and a mentor (Heale et al., 2009). Additionally, it was found that preceptors were commonly added to and removed from programs, and this inconsistency was associated with frustration levels in health care students (Heale et al., 2009). Ultimately, the lack of highly qualified preceptors was a significant barrier to clinical education, and ineffective preceptor performance has been linked to inadequate socialization to the role of a preceptor, as well as professional role strain experienced by the preceptor (Heale et al., 2009).

In a study by Weidner and Henning (2002), it was concluded that most athletic training programs selected preceptors based on location, availability, willingness to serve as a preceptor, and expertise as clinicians and not because of their expertise or background as educators. In addition, these preceptors were not typically compensated or adequately recognized for their role in the program, and it was difficult for programs to develop long term relationships with preceptors. While training was required for preceptors, the lack of structured preceptor training and socialization to the role was shown to negatively impact a preceptor's ability to balance their role as an educator,

facilitator, and clinical practitioner (Mazerolle et al., 2014). This lack of socialization, training, and support commonly resulted in poor preceptor performance and high preceptor turnover, resulting in a large percentage of preceptors not remaining in their role long enough to develop and benefit from their own personal experiences.

Mazerolle et al. (2014) investigated preceptor preparation and socialization methods through a qualitative study designed to better understand current trends and practices used by athletic training programs to train, prepare, and educate athletic training professionals to become clinical preceptors. The selected preceptors were employed equally at the collegiate and high school setting, and these individuals had an average of 9 years of clinical experience, ± 6 years, and an average of 5 years of preceptor experience, ± 3 years (Mazerolle et al., 2014, p. 76). At the conclusion of the study, two major themes, formal processes and informal processes, emerged to provide future guidance for the socialization of an athletic trainer into the preceptor role (Mazerolle et al., 2014). Within formal processes, the interviewed preceptors believed the following areas were integral to preceptor socialization: (1) preceptor training/workshops, (2) professional development sessions, and (3) teacher certification (Mazerolle et al., 2014). Within the informal processes, preceptors revealed the following areas as being key for professional development: (1) observations, (2) previous experiences/interactions, and (3) self-reflections and student evaluations (Mazerolle et al., 2014). The role of the clinical preceptor in the overall development of the athletic training student is critical, and programs must take the necessary time to ensure preceptors fully understand the program, the content being taught in the courses, the expectations of the students, and their role in educating and evaluating the student.

Unfortunately, conventional models used for teaching and student learning vastly underestimated the unpredictable nature and complexity of real-time patient situations in health care programs and dismissed the contributions that experienced preceptors have in the overall development of young health care professionals and students (Paton, 2010). These models originally proposed that the application of didactic experiences and knowledge into clinical-based situations occurred seamlessly (Paton, 2010). Paton (2010) argued this point and concluded, "The process of translating knowledge from the classroom and laboratory context to the clinical environment is challenging and fraught with the assumptions that overlook the contributions of precepting" (p. 144). Students in health care programs experience a wide variety of emotions and feelings, including anxiety, fear, and incompetence; and preceptors must be trained through quality programs to provide an encouraging, safe environment (Paton, 2010). Preceptors must not only be skilled clinicians, but they must also take the time to develop a relationship with the clinical students; show a legitimate concern for the student's clinical development and overall education, as well as their feelings; and demonstrate skilled methods of communication in a variety of situations (Paton, 2010).

While health care programs diligently worked to improve their selection, training, education, and overall socialization of clinical preceptors, preceptor role strain emerged as an unintended consequence for many preceptors assuming the role. Role strain on the part of the preceptor commonly produced a stressful learning environment for students, and it limited opportunities for clinical application, patient interaction, and personal development (Heale et al., 2009). In a survey of clinical preceptors serving in a variety of health care professions, such as physical therapy, occupational therapy, nursing, and

audiology, participants were asked to provide feedback regarding the barriers and challenges they faced as a clinical educator, as well as methods that proved to be beneficial in providing them support (Heale et al., 2009). Some of the major barriers identified by clinical educators included a lack of time, lack of resources, inadequate orientation, limited contact with the academic program, and the inability to manage multiple roles (Heale et al., 2009). Many of these factors have been previously discussed as weaknesses in the socialization process of preceptors, but education programs had limited control over several of these factors, such as a lack of time, lack of resources, and role strain. For instance, according to Rich (2009), clinical instructors reported that other responsibilities, such as administrative tasks, was their greatest barrier to "initiating a teaching moment" (p. 298). The second most commonly reported barrier by clinical instructors involved their role as a health care provider (Rich, 2009). Many clinical instructors believed the care being provided to their patients took priority, and since they were ultimately responsible for the care of these patients, they did not extend certain opportunities to the student (Rich, 2009). This was more commonly observed in younger preceptors, as they often limited student opportunities in an effort to gain more clinical experience of their own.

Balancing the roles of a health care provider and a clinical educator continued to be a significant source of role strain, and this was well-researched throughout health care education programs. In a study specific to clinical preceptors in athletic training education programs, it was determined that nearly 50% of clinical preceptors experienced moderate to high levels of role strain, and clinical preceptors with inadequate socialization suffered higher levels of role strain (Henning & Weidner, 2008).

Interestingly, while it was assumed that an education background could improve preceptor performance and better prepare individuals to limit and manage role strain, a formal background in teaching did not appear to have any effect on total role strain (Henning & Weidner, 2008). Thrasher et al. (2015) reported similar findings on role strain and stated clinical preceptors largely cited time constraints as a major barrier to providing effective mentorship. Clinical preceptors also reported that a significant source of their role strain involved their perceptions of being "overworked, underpaid, and understaffed" (Thrasher et al., 2015, p. 330). These specific barriers have been linked to high levels of burnout in health care professionals, and while serving as a clinical preceptor can result in an elevated level of personal satisfaction in one's position, burnout usually resulted in decreased preceptor performance (Henning & Weidner, 2008).

Preceptors also reported that students could be a barrier to effective precepting, as a lack of student initiative resulted in limited opportunities (Rich, 2009). Ironically, this point was echoed by students, as students reported a lack of initiative on their part was the most common barrier for initiating a teaching moment between the preceptor and the student (Rich, 2009). Based on these findings, unmotivated or hesitant students were not likely to gain the same experience as those who were more motivated, confident, and willing to attempt clinical skills in authentic situations with real patients.

While athletic training programs have been provided with the autonomy to determine the most effective methods for training their associated preceptors, considerable research must be continued to assist in determining best practice (Volberding & Richardson, 2015). Programs must be committed to recruiting quality preceptors, and consideration must be made to the time and personal commitment these

preceptors will be making to assist the program's respective students. Offering incentives such as college credit, continuing education, and other opportunities can help increase preceptor satisfaction and function in this role (Volberding & Richardson, 2015). Preceptors must be continually trained and communication is imperative to ensure consistency within the department, as well as developing a sense of preceptor belonging within the athletic training program (Volberding & Richardson, 2015). Preceptors must understand the importance of guided autonomy and be dedicated to providing opportunities involving simulated and real-time situations for evaluating clinical proficiencies and performance while constantly promoting critical reflection and strategic questioning (Mazerolle & Bowman, 2016). Unfortunately, athletic training students have revealed that a lack of respect from their respective preceptor and a lack of autonomy within each of their clinical rotations was one of the most frustrating aspects of their clinical education (Heinerichs et al., 2014). This was an important point for program administrators, as student frustration was shown to impede academic and clinical performance and lead to attrition within the educational program (Bowman & Dodge, 2013). Preceptors in clinical education must be dedicated to providing opportunities for students to apply what they have learned, and students must be engaged in the clinical decision-making process (Heinerichs et al., 2014). By allowing students to actively participate in clinical decision-making, students can become more empowered and develop an increased sense of confidence for making clinical decisions in the future (Heinerichs et al., 2014).

**Clinical Education Models in Athletic Training**

Clinical experience has been a critical component of student development in all health care fields. However, the manner in which these clinical experiences have been delivered evolved over time and remained quite different within each profession. The earliest curricula in athletic training involved an apprenticeship model that focused largely on the quantity of clinical experience and included a mandatory clinical hour requirement. Over time, the hour requirements were eliminated as accredited programs were required to follow a competency-based education model as well as the published standards for athletic training education. The CAATE provided programs with institutional autonomy to determine the most effective way to meet these standards, but the CAATE did require all professional programs to provide clinical experiences in a logical progression that spanned a minimum of two academic years and incorporated various patient populations and occupational settings (CAATE, 2012). Since the implementation of the CAATE's standards, athletic training programs have based their clinical experiences on an integrated model or an immersive model (Edler et al., 2017). The clinical immersion model allowed for full-time placement in a clinical rotation with minimal or no didactic involvement, and the clinical integration model allowed for students to complete their didactic and clinical education simultaneously (Edler et al., 2017). Historically, the clinical integration model has been most commonly used in athletic training programs, and this is mostly due to the inflexible aspect of the traditional semester schedule which did not align well with an immersive experience (Edler et al., 2017). However, the 2020 standards provided by the CAATE (n.d.-b) required all professional athletic training programs to utilize clinical immersion to some degree. At a

minimum, the CAATE (n.d.-b) required all programs to provide at least one four-week immersive experience for athletic training students enrolled in a professional program. The incorporation of immersive experiences into the athletic training curriculum made the curriculum more similar to other health care programs, as many other health care programs already utilized an immersive model, and it was common for other accrediting bodies to require this type of experience (Accreditation Council for Occupational Therapy Education [ACOTE], n.d.; CAPTE, 2018). For example, the Accreditation Council for Occupational Therapy Education (ACOTE) utilized multiple stages of clinical experience, beginning with clinical observation and progressing to a minimum of 24 weeks of full immersion (ACOTE, n.d.). Full immersion consisted of the student being placed in a clinical setting on a full-time basis, similar to the schedules of the professionals at the site with minimal didactic coursework requirements (Edler et al., 2017). The Commission on Accreditation in Physical Therapy Education (CAPTE) also required students to participate in a full-immersion clinical experience, however, the CAPTE (2018) did not specify a minimum time requirement for this experience. Despite no CAPTE-mandated time requirement for clinical immersion, it was determined that physical therapy students needed to dedicate nearly 50% of their time to clinical education experiences (Recker-Hughes et al., 2014). Physician assistant programs also did not have a mandated clinical time requirement (Accreditation Review Commission on Education for the Physician Assistant [ARC-PA], 2013). Within a physician assistant program, the requirements were more closely related to the student gaining experience in a variety of clinical settings that were associated with specific patient populations and conditions they will likely encounter in real clinical practice (ARC-PA, 2013). Lastly,

nursing programs allowed for institutional autonomy for establishing clinical experience requirements, as long as these requirements were consistent with contemporary practice (Edler et al., 2017).

Many changes made by the CAATE, especially those that involved clinical education, were made to improve the athletic training student's transition to practice. When compared to many other health care programs, athletic training remained a newer profession and had opportunities to learn from best practices identified in other fields. However, research regarding key components of a successful clinical education program remained inconsistent (Recker-Hughes et al., 2014), and there was no available research identifying the best clinical model for improving student outcomes related to professional practice, patient care, and clinical-decision-making (Edler et al., 2017). Furthermore, while a variety of experiences were used within either clinical model, such as lab-based learning, simulations, standardized patient encounters, and real-time experiences with authentic patients, there was considerable variety in the length of time and type of exposures provided to students (Edler et al., 2017).

**Experiential Learning Theory**

Previous research has shown that athletic training students believe more than half of their learning and professional development occurred through clinical education (Heinerichs et al., 2014), and similar to other health care programs, athletic training education programs have placed a large focus on experiential learning. Experiential learning can be defined "as a particular form of learning from life experience, often contrasted with lecture and classroom learning" (Kolb & Kolb, 2017, pp. 13–14). While Kolb and Kolb (2017) focused primarily on experiential learning theory, they did

acknowledge the benefit of other learning-style frameworks as a tool for helping individuals become more cognizant of different learning strategies they can use. The concept of experiential learning was not new, and historically, educators at all levels have come to understand a multitude of learning style frameworks. One of the most common was Fleming's VARK model, which represented the following learning styles: visual, auditory, reading/writing, and kinesthetic (Childs-Kean et al., 2020). The VARK model provided a way to better understand how individuals obtain information, whereas Kolb's theory of experiential learning focused more on how individuals perceive experiences (Childs-Kean et al., 2020). Kolb and Kolb (2017) recognized that "learning . . . is not a fixed psychological trait but a dynamic state resulting from synergistic transactions between the person and the environment" (p. 22). However, many academic programs utilizing experiential learning to improve student outcomes failed to focus on the synergistic aspect. Most notably, there was a lack of guided reflection and analysis of the students' experiences (Kolb & Kolb, 2017).

The presence of a trained clinical preceptor in health care programs helped to provide synergy and bridge the gap between academic courses and experiential activities. Preceptors had the potential to effectively function in each of the four common roles described by Kolb and Kolb (2017) in the Kolb Educator Role Profile. These roles included facilitator, subject expert, evaluator, and coach (Kolb & Kolb, 2017). Through these roles, this single individual had the ability to guide students through the four modes of Kolb's learning cycle: feeling, reflecting, thinking, and acting (Kolb & Kolb, 2017). Kolb and Kolb (2017) recognized the learning environment must be stimulating and challenging, but they also understood that students participating in an experiential

learning activity must feel safe and supported. This was a consistent point within the research on athletic trainings students, as Heinerichs et al. (2014) found high levels of student frustration in students who reported a lack of emotional support from the preceptor.

Within Kolb and Kolb's (2017) work on experiential learning, they also addressed the need for repetition to achieve proficiency. Achieving proficiency with psychomotor skills, clinical decision-making, and other areas of clinical practice is an essential component within athletic training education. Past studies have shown that successful athletic training students actively sought engaging learning opportunities with their clinical preceptors and preferred concrete experiences that provided opportunities to apply what they have learned (Mazerolle et al., 2015). These concrete learning experiences have been shown to facilitate student competence, but these concrete learning experiences were not limited to traditional experiences in real-time with authentic patients. Clinical educators and preceptors have commonly collaborated to provide simulations, standardized patient examinations, and other critical thinking exercises to supplement the student's experience, and all of these have been shown to be effective elements for improving student engagement (Armstrong & Jarriel, 2016). More importantly, athletic training educators have created and validated methods for assessing student performance and competence on these supplemental learning activities (Lafave & Katz, 2014). Additionally, observational learning has also been shown to be effective in clinical education if supplemented with adequate guidance, discussion, and reflection. However, these experiences should be limited, as they were sometimes viewed as disengaging by the students (Mazerolle et al., 2015). Mazerolle et al. (2015) believed that

"reflective observation can improve athletic training students' knowledge and clinical skill development, particularly when followed closely by active experimentation through direct patient care or simulations" (p. 37).

**Factors Affecting BOC Examination Performance in Athletic Training**

There have been few studies conducted in recent years to identify predictor variables that are correlated to first-time pass rates on the Board of Certification in athletic training. Early studies focused on different measurements of academic and clinical performance, and a statistically significant positive correlation was found between grade point average and BOC success (Middlemas et al., 2001). Additionally, it was determined that students completing an accredited curriculum program, as compared to an internship program, had a much higher first-time pass rate on the BOC examination (Middlemas et al., 2001). This finding supported the decision by the CAATE to eliminate the internship route to certification. Middlemas et al. (2001) sought to better understand the relationship between clinical performance and BOC outcomes, but their research only focused on the quantity of clinical experiences (i.e., hours) completed by students during their athletic training education. Within this research, Middlemas et al. (2001) determined no significant relationship between the time spent in clinical experiences and BOC performance. Middlemas et al. (2001) did acknowledge the clinical component of the research was limited to a unidimensional exploration of the quantity of time spent in clinical experiences, and the quality of clinical experiences varied widely across all programs. Thus, additional research was needed to better understand the possible correlation between BOC performance and the quality of education, instruction, and opportunities within clinical experiences. In a more recent study, Bruce et al. (2019)

examined multiple variables and their ability to predict first-time BOC examination performance. Based on this study, Bruce et al. (2019) concluded that comprehensive grade point average was the strongest single predictor of first-time BOC examination success.

Additional research on standardized test performance also focused on psychological factors, such as test anxiety, but there was little available research specific to athletic training. In one exploratory study, Breitbach et al. (2013) sought to investigate the possible relationship between several psychological factors and first-attempt pass rates on the BOC examination. This research was based on a survey of 145 recent athletic training graduates, and an analysis was conducted to determine the relative impact of locus of control, coping methods, and anxiety (Breitbach et al., 2013). Breitbach et al. (2013) concluded that increased test anxiety and decreased problem-focused coping behaviors may negatively impact the performance of athletic training students on the BOC examination. While low levels of test anxiety was not found to be a predictor of success on the BOC examination, Breitbach et al. (2013) still concluded that psychological preparation for the BOC examination could have a positive impact on student outcomes.

A review of literature from other health care programs, such as physical therapy and nursing, provided much more insight into possible predictive factors for success on certification and licensure examinations. Several predictive factors that have been studied within these fields included student age at time of admission, ACT scores, GPA (e.g., core course GPA and pre-admission GPA), GRE scores, clinical performance, comprehensive examinations provided by the program, number of program faculty, and

faculty-to-student ratios (Meiners, 2015). In a retrospective study by Luedtke-Hoffman et al. (2012) on predictive variables for successful performance on the National Physical Therapy examination (NPTE), GPA in the professional phase of the program was determined to have the highest correlation with first-time success on the examination, and this finding was consistent with previous research. While GPA demonstrated the greatest relationship, Luedtke-Hoffman et al. (2012) also illustrated a positive correlation between clinical performance assessments and student performance on the NPTE. Clinical performance was evaluated using the Physical Therapist Manual for the Assessment of Clinical Skills, also known as the PT MACS (Luedtke-Hoffmann et al., 2012). Specifically, Luedtke-Hoffman et al. (2012) found a small, but statistically significant correlation on the "group of PT MACS skills assessing Evaluation and Diagnosis and the corresponding section of the NPTE, and the PT MACS skills assessing Outcomes and the Prognosis and Outcomes section of the NPTE" (Luedtke-Hoffmann et al., 2012, p. 46). A statistically significant correlation was not found between the overall scores on the PT MACS and the NPTE, and it was proposed that a fundamental difference in the assessment tools may be a significant part of the reason (Luedtke-Hoffmann et al., 2012). Standardized assessments like the NPTE and the BOC examination emphasized the cognitive learning domain, while clinical performance assessments were more strongly rooted in the psychomotor learning domain.

**Summary**

The athletic training profession and the professional preparation for athletic trainers underwent significant growth and change over the past 50 years. Some of the earliest and most significant changes included the development of NATA-approved

athletic training programs and the implementation of a national certification examination based on a role delineation study. These advancements occurred alongside the development and implementation of athletic training-specific competencies and program standards used to guide the approved athletic training programs. Additionally, one of the most notable achievements by the NATA during this era was gaining recognition by the AMA as an allied health care profession.

More recently, the educational preparation for professional athletic trainers continued to evolve. This included the elimination of internship-style programs, and the requirement for all athletic training education programs preparing students for the BOC examination to be accredited by the CAATE. The BOC examination was also modified from a three-part examination which included a multiple-choice segment, a written-simulation section, and a practical component, into a single modality. This involved the elimination of the written-simulation and practical components, resulting in a 150-question multiple-choice examination. Over time, first-time pass rates on the BOC examination rose nearly 50%, with first-time pass rates in the final year of the three-part examination at 31.5% (Castle Worldwide Inc., 2008, p. 4) and first-time pass rates from the 2018-2019 testing period at 77.8% (BOC, 2019, p. 3).

The CAATE also made significant changes within the clinical education requirements and guidelines within the clinical education component of accredited athletic training programs. One of these changes included the elimination of a clinical hour requirement, as the CAATE encouraged athletic training education program administrators to focus more on the overall quality of the clinical education experiences rather than the quantity of hours within a clinical experience. The CAATE also modified

the standards and definitions used with regard to clinical education supervision. These changes were implemented to reduce the potential for athletic training students replacing full-time professional staff, ensure state practice acts were not violated, and most importantly, protect the well-being of patients. Specifically, the CAATE made a deliberate attempt to curb unsupervised practice by athletic training students by requiring all students be under direct supervision during all clinical experiences. Based on the definition provided by the CAATE, direct supervision required having a clinical instructor on-site with the ability to intervene on behalf of the student at any time. Prior to this decision, it was common for athletic training programs to allow students to participate in clinical experiences with indirect supervision, or without supervision, if the student was only acting in the role of a first responder and within their scope of practice as defined by the state practice acts (Mazerolle & Bowman, 2017). Much like the elimination of the internship route to certification, this decision was highly contested by a significant number of athletic training educators, and more recent research has been conducted to determine if this change resulted in a negative impact on the overall development of autonomy and confidence in recent athletic training graduates (Mazerolle & Bowman, 2017).

To address these concerns, programs have sought to develop additional avenues for experiential learning and incorporated the use of new validated clinical performance assessments, such as simulations and standardized patient encounters, to replace the lack of authentic experience during clinical experiences. As with other health care programs, the overall success of the clinical education component is highly dependent on the quality of the preceptors supervising the students throughout their experiential learning

opportunities, and there have been numerous barriers identified that contribute to poor preceptor performance, student frustration, and deficient student outcomes. Some of these barriers have included a lack of preceptor socialization and training; preceptor role strain; and difficulty identifying and retaining highly-qualified, experienced preceptors.

Overall, with the guidance of multiple stakeholders, including the NATA, AMA, CAATE, and the BOC, the evolution of the professional preparation of athletic training students resulted in improved student outcomes on the certification examination. However, there were concerns with regard to the lack of autonomy, independence, and development of other professional characteristics within the clinical education component of athletic training programs. Additionally, due to the requirements of the CAATE for programs to maintain a 70% three-year aggregate first-time pass rate on the BOC examination, research has been conducted to determine the potential for any variables that can be used to help predict student performance on the BOC examination. The literature was limited with regard to athletic training and the modern version of the BOC examination, but GPA was previously identified as a strong indicator for success on the BOC examination, and it has continued to be recognized as a predictor for success on certification examinations in other health care programs. Furthermore, there was research within other allied health care programs, such as physical therapy, that indicated a possible correlation between certain clinical performance assessments and student performance on standardized written examinations.

# Chapter Three: Methodology

## Introduction

The purpose of this study was to explore the possible benefits associated with the implementation of a comprehensive skill-based clinical examination for athletic training students prior to graduation. There were three main goals of this study: (1) determine the relationship of student outcomes on a comprehensive clinical examination and student performance on the BOC examination; (2) explore the student-perceived benefits of a comprehensive clinical examination on BOC performance and professional preparedness; and (3) explore other possible predictors for BOC examination performance. To meet the objective, this study utilized a mixed-methods model to gather both quantitative and qualitative data to identify and better understand relationships within the data. The mixed-methods design can aid researchers in developing a deeper understanding of the data, and it has the potential to compensate for methodological concerns that may arise (Almalki, 2016). Quantitative data collected for the study consisted of examination results from the clinical examination and the BOC examination, grade point averages, ACT scores, and student surveys. Qualitative data were collected through a questionnaire to explore student perceptions and attitudes regarding the comprehensive clinical examination and BOC examination, methods for preparing for each examination, and the impact these examinations may have had on the students' perceptions of their own professional preparedness. The outcomes of the study could support the implementation of comprehensive clinical examinations and provide further support for the use of performance assessments as a method for improving cognitive performance on written examinations. Additionally, the identification of predictor variables for BOC examination

success would be useful for athletic training programs to appropriately identify, select, and retain students with the greatest likelihood of success. Furthermore, these variables can also be used to identify students who may need additional support throughout the program.

**Null Hypotheses**

*Null Hypothesis 1:* Students who pass the comprehensive clinical examination on their first attempt will have no increase in likelihood of passing the BOC examination on their first attempt when compared to students who do not pass the comprehensive clinical examination on their first attempt.

*Null Hypothesis 2:* There will be no significant correlation between first-attempt student scores on the comprehensive clinical examination and first-time pass rates on the BOC examination.

*Null Hypothesis 3:* There will be no significant correlation between student passing scores on the comprehensive clinical examination and first-time pass rates on the BOC examination.

*Null Hypothesis 4:* There will be no significant correlation between student grade point average (core classes only) and first-time pass rates on the comprehensive clinical examination.

*Null Hypothesis 5:* There will be no significant correlation between student grade point average (core classes only) and first-time pass rates on the BOC examination.

**Research Questions**

*Research Question 1:* What is the student preparation process for the comprehensive practical examination?

*Research Question 2:* What is the student preparation process for the Board of Certification examination?

*Research Question 3:* How do students perceive the value of the comprehensive clinical examination as a preparation tool for the BOC examination?

*Research Question 4*: How do students perceive the value of the comprehensive clinical examination as a tool for improving professional preparedness?

**Relationship to Participants**

The researcher for this study was a full-time faculty member in an athletic training program at a private midwestern university. Participation in the study was limited to the researcher's institution, as the utilization of a comprehensive and holistic clinical examination was a novel concept, and this examination was not being implemented at other institutions.

**Study Population**

Secondary data were collected for all athletic training graduates who attempted the BOC examination from the 2016-2017, 2017-2018, 2018-2019, and 2019-2020 academic years. Collectively, these four cohorts provided a sample of 53 participants. An analysis of the study population is provided in Table 5.

**Table 5**

*Descriptive Statistics of Study Population*

| Descriptor | | n | % | M | SD |
|---|---|---|---|---|---|
| Biological Sex | | | | | |
| | Male | 14 | 26.4 | | |
| | Female | 39 | 73.6 | | |
| Age at Time of Graduation | | | | 22.8 | 1.67 |
| | 21-22 | 32 | 60.4 | | |
| | 23-24 | 13 | 24.5 | | |
| | >25 | 8 | 15.1 | | |
| Admission Type | | | | | |
| | Traditional | 42 | 79.2 | | |
| | Transfer | 11 | 20.8 | | |
| Race/Ethnicity | | | | | |
| | White, not Hispanic/Latino | 43 | 81.1 | | |
| | Hispanic/Latino | 5 | 9.4 | | |
| | Black or African-American | 3 | 5.7 | | |
| | Asian, Pacific-Islander | 2 | 3.8 | | |

Participation on the survey and questionnaire was also requested for the 53 individuals who met the initial participation criteria. Thirty-three of the potential 53 participants (62.2%) completed the survey. Table 6 provides an analysis of the survey and questionnaire participant demographics.

**Table 6**

*Descriptive Statistics of Survey Respondents*

| Descriptors | | n | % | M | SD |
|---|---|---|---|---|---|
| Biological Sex | | | | | |
| | Male | 7 | 21.2 | | |
| | Female | 26 | 78.8 | | |
| Age at Time of Graduation | | | | 22.6 | 1.98 |
| | 21-22 | 22 | 66.7 | | |
| | 23-24 | 7 | 21.2 | | |
| | >25 | 4 | 12.1 | | |
| Admission Type | | | | | |
| | Traditional | 28 | 84.8 | | |
| | Transfer | 5 | 15.2 | | |

*Note*. The demographics in Table 6 describe the portion of the sample that completed the survey. Information on race/ethnicity was not collected in the survey.

The participants in the study represented undergraduate students at one private university, and participant demographics were compared to other programs across the country. The CAATE collected demographic information on athletic training students enrolled in all accredited programs, including 252 undergraduate programs and 111 graduate programs, and a published report was reviewed for comparison. According to the CAATE, the most recent analytics reported the typical professional program consisted of 62.5% females and 37.5% males (CAATE, 2018a, p. 5). The CAATE also reported the average student enrollment as being 83.3% white and 16.7% non-white (CAATE, 2018a, p. 5). As compared to the student composition of other accredited athletic training programs, the participants in this study represented a slightly larger proportion of females-to-males, but a consistent representation based on race.

**Research Instrumentation**

This mixed-methods study consisted of both retrospective and prospective aspects. Retrospectively, the study consisted of archived academic and demographic data from the studied university. Academic data consisted of performance records from a comprehensive clinical examination, grade point average, ACT scores, and BOC examination performance records. Specific metrics regarding the BOC examination was limited to pass/fail and scores (percentages) within each domain, as the BOC denied formal requests for the students' overall scores. Demographic data consisted of participant age at time of graduation, matriculation type (i.e., first-time freshman or transfer), biological sex, and race/ethnicity. Prospectively, a survey was developed and utilized to provide quantitative and qualitative data to explore perceptions pertaining to

the comprehensive clinical examination, the BOC examination, and professional preparedness.

**Comprehensive Clinical Examination**

The comprehensive clinical examination (CCE) used in the study was originally designed by the researcher in 2008 following the removal of the oral practical component on the BOC examination. From 2008 to 2016, the CCE was continually reviewed, evaluated, and updated with input from multiple athletic training professionals, each with several years of experience in athletic training education and clinical practice. Similar to the practical component of the previously used BOC examination, the earliest forms of the examination consisted of several sections specifically designed to test the psychomotor skills associated with athletic training education. Over time, the examination evolved to better evaluate clinical competency using both behavioral and holistic assessments.

The data used in this study comes from the most current versions of the examination, which were utilized from 2016 to 2020. During this time, there were a total of seven different versions used. While specific scenarios varied, each form contained the same content areas, evaluation rubrics, and weighted scale for determining an overall score. Table 7 provides an outline of the test design. A more detailed description of the test with grading rubrics, evaluator instructions, and student instructions can be found in Appendix A.

## Table 7

*Comprehensive Clinical Evaluation Test Design*

| Content Area | Description | Weight |
|---|---|---|
| Palpations | Student was provided with fifteen anatomical landmarks and asked to locate each landmark on a model. Student was asked to place an adhesive sticker on each landmark for confirmation. | 10% |
| Taping | Student was provided with a model, three different pathologies, and a treatment goal (e.g., prevent further injury) for each. Student was asked to demonstrate an appropriate taping technique to achieve the goal. | 10% |
| Manual Muscle Tests | Student was provided with a model and asked to demonstrate the proper manual muscle test for three different skeletal muscles. Student was also asked to provide the appropriate score based on the model's demonstration (0-5). | 5% |
| Goniometry | Student was provided with a model and asked to demonstrate two different joint measurements using a goniometer. Student was also asked to state the expected finding (i.e., normal range of motion) and their finding on the model. | 5% |
| Joint Mobilizations | Student was provided with a model and two goals involving range of motion. Student was asked to demonstrate the appropriate joint mobilization technique to achieve each goal. | 5% |
| Neurological Tests | Student was provided with a model and two different neurological pathologies (e.g., nerve root compression). Student was asked to perform specific tests for the condition (e.g., myotome/dermatome/ reflex). | 5% |
| Acute Care | Student was provided with a model and a scenario involving an acute musculoskeletal injury at a specific setting. Student was asked to demonstrate an appropriate method for immobilizing the injured area and safely moving the model from the setting. | 5% |
| Orthopedic Tests | Student was provided with a model and three different orthopedic pathologies. Student was asked to perform an appropriate orthopedic test for each condition. Student was also asked to state the positive finding(s) for each test. | 10% |
| Therapeutic Interventions | Student was provided with a model presenting with an acute, chronic, or post-surgical orthopedic condition. Student was asked to demonstrate an effective treatment/rehabilitation session based on their current status and physician-directed goals. | 15% |
| Emergency Management | Student was provided with a model presenting with a medical emergency. Student was asked to evaluate the patient and provide the appropriate immediate care. | 10% |
| Orthopedic Evaluation | Student was provided with a model presenting with a musculoskeletal pathology. Student was asked to perform a thorough physical examination and provide an accurate diagnosis of the condition. | 20% |

Each section of the CCE required demonstrations of knowledge and skills directly related to the *Practice Analysis,* 7th Edition (Henderson, 2015), which included specific task statements for each domain. For each task statement, the BOC also provided additional information that elaborated on the knowledge and skills that best aligned with the task statement. For example, Domain 2 was based on the examination, assessment, and diagnosis of patient conditions. The second task statement within Domain 2 was: "Perform a physical examination that includes diagnostic testing to formulate a differential diagnosis" (Henderson, 2015, p. 26). As previously stated, the BOC provided a list of the associated knowledge and skills that would be necessary for a student to complete this task. For the second task statement in Domain 2, students were expected to have knowledge of normal and abnormal human anatomy, human biomechanics, mechanisms of injury, and pathological conditions. Students were also expected to have skill in analyzing biomechanics, palpating anatomical structures, assessing strength, evaluating range of motion, performing special tests, and interpreting test results. Thus, all sections of the CCE, such as palpations, goniometry, manual muscle tests, and special tests can be directly cross-referenced with the *Practice Analysis*, 7th Edition (Henderson, 2015).

In the four years included in the study, the CCE was administered to multiple students simultaneously using a station-based model. Based on the number of sections and trained personnel available to deliver the examination, a total of five or six stations were used, and the total examination time for each student was approximately two hours. As stated earlier, multiple variations of the examination were utilized to reduce the risk of information sharing between students. While this could have impacted the reliability

between the various versions of the examination, each examination was reviewed for content validity by all test administrators, including the proctors and models. All test administrators were professional athletic trainers with several years of professional experience, in addition to experience in athletic training education. Test administrators were provided with copies of each examination and asked to complete a content validity form. The content validity form required test administrators to review the test content while considering what skills would be expected of an entry-level athletic trainer. Based on feedback, further discussions ensued with the program director until a consensus was met. If there was a consensus that a specific skill, demonstration, or rubric component would not be expected of an entry-level athletic trainer, it was modified, replaced, or removed.

The test administrators were selected by the program director and responsible for the delivery and evaluation of student performance on their respective sections. This selection process was based on contemporary expertise (e.g., teaching history, clinical experience), previous roles within the program, and experience with evaluating student performance. Individuals responsible for proctoring the examination were provided with specific reading instructions for each section to ensure consistency with test delivery.

Additional training for standardized models was also provided, and this training was dependent on their assigned sections. For example, taping and palpations were combined into one section, and while the model for this section provided feedback to assist in the grading process, there were no active demonstrations needed on their part. Other parts of the examination (e.g., emergency management, acute care, orthopedic evaluation) did require more training to ensure a consistent and accurate demonstration

for each. All models were also trained on the scoring and evaluation rubrics, and their feedback was an essential part of the grading process. Grading for each section was based on a consensus being met between the test administrator and the standardized model. All test proctors and models were previously trained to serve as clinical preceptors within the athletic training program, and they had prior experience using similar grading rubrics to evaluate student performance during the students' clinical rotations. Successful completion of the CCE was indicated by an overall score of 75% or higher.

**Validity of the Comprehensive Clinical Examination**

At the time of this study, there were no established and validated methods for conducting a CCE for athletic training students, and establishing validity in standardized performance assessments had been part of an ongoing challenge in athletic training education. Historically, validity in research has been defined as a test, or other construct, that measured what it was proposed to measure. However, this definition evolved over time, and can now be defined as "the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of a test" (American Educational Research Association et al., 1999, p. 9). It was the purpose of this study to establish the necessary evidence to support the continued use and score interpretation of the CCE.

The comprehensive clinical examination in this study utilized both behavioral and holistic performance assessments. The behavioral performance assessments consisted of basic psychomotor skills with dichotomous grading scales, and this included the following: palpations, taping, manual muscle tests, joint range of motion measurements, joint mobilizations, neurological tests, and orthopedic tests. The holistic performance assessments included scenarios for acute care (e.g., splinting), emergency management

(e.g., emergency cardiac care), therapeutic interventions, and orthopedic evaluation. Each scenario required a trained, standardized model. Grading for the holistic performance assessments was completed on standardized grading rubrics; however, these rubrics were less specific and allowed for differences in student demonstrations (See Appendix A for an example of the comprehensive clinical examination).

The use of behavioral assessments and dichotomous grading rubrics provided greater consistency in test design, and this model worked well for testing basic psychomotor skills. Standardized behavioral performance assessments also decreased the possibility of subjectivity on the part of the evaluator, resulting in a lower possibility of grading bias. However, the required generalizability of this model resulted in a lack of authenticity and its application was limited, as standardized performance assessments and their associated grading criteria did not allow for alternative methods for demonstrating competence. Thompson et al. (2014) provided that "educators want to use quality assessments but perhaps are unsure how to provide evidence to support the use of more holistic, open-ended forms of performance assessments" (p. 136). Thompson et al. (2014) went further and provided the following argument in support of holistic practical examinations despite the lack of consistent evidence on their validity.

> Competence is a complex concept that is difficult to define clearly because even among experts in a particular profession there are a variety of approaches to handling situations that arise in professional practice. This, in turn, makes assessments of competent performance difficult as well because it is challenging to clearly define how an examinee should respond to a given situation during an

> assessment. However, most professionals have a very good idea of what competence and, even more so, incompetence look like. (p. 136)

Thus, while there were understandable concerns regarding evaluator bias in a holistic performance assessment, subjectivity can be warranted at times, and standardizing certain aspects of an assessment could have been more threatening to the overall validity. As Thompson et al. (2014) stated, "Including some aspects of subjective assessment may speak to the art of health care that extends beyond what can be captured on a standardized scale" (p. 137).

**Reliability of the Comprehensive Clinical Examination**

A key aspect of this study focused on performance data from seven different versions of a comprehensive clinical examination implemented over a four-year period for senior athletic training students in an undergraduate program. Each version of the examination evaluated the same content areas, but there were minor differences in the specific tasks or scenarios within each section. For example, within the palpation section, students were asked to place a marker on 15 different anatomical landmarks on a model. The specific palpations required for each version of the examination were randomly selected from a list of anatomical landmarks used to generate each examination. To improve reliability between test versions, all test items within each content area were evaluated by multiple faculty members, and all approved items were considered equivalent with regard to their level of importance and difficulty for an entry-level athletic trainer. While the test development and reviewing process was established to ensure the test assessed the knowledge and skills of an entry-level athletic trainer,

traditional methods for establishing parallel forms reliability were not completed prior to this study.

The researcher had considered multiple methods for evaluating reliability of the various forms, but many of these methods did not align with how the examination was utilized within the program. Under optimal conditions, each examination could have been evaluated for internal consistency, test-retest reliability, or parallel forms reliability. These methodologies were not employed, due to the manner in which the examination content needed to be controlled and protected by the program.

**Board of Certification Examination**

The BOC examination was another primary research instrument involved in the study. As stated by the BOC, "The purpose of the BOC exam [was] to assess [student] knowledge in the five domains of athletic training as defined by the current BOC *Practice Analysis*" (Board of Certification, Inc., 2018). The BOC is accredited by the National Commission for Certifying Agencies (NCCA), and all test forms were examined for reliability and the standard error of measurement as part of the reporting requirements for NCCA accreditation. There were multiple forms of the BOC examination utilized within the testing years of the data collected for this study, but there was evidence to support reliability of each form (BOC, 2017, 2019, 2020; Johnson, 2013). Furthermore, equivalence across all forms ranged from acceptable to strong each year (BOC, 2017, 2019, 2020; Johnson, 2013).

During all testing years used in this study, the format of the computerized BOC examination remained consistent, with 175 scored and unscored questions. The unscored questions were experimental and under review for potential future use. The layout of the

examination consisted largely of multiple choice and multiple correct questions, in addition to several focused testlets that consisted of scenario with multiple follow up questions pertaining to the scenario. The examinations administered in the 2016-2017 testing period were based on the 6th edition of the *Practice Analysis*, and the examinations administered in subsequent test years were based on the 7th edition of the *Practice Analysis* (Henderson, 2015). Due to variations in test forms, and the potential for different levels of difficulty, raw scores were not utilized. Rather, the outcomes for each examination form were based on a scaled score, with scores ranging from 200-800, and a score of 500 was needed to pass the examination. “Scaled scores are particularly useful at providing the basis for meaningful long-term comparisons of results across different administrations of an exam” (BOC, 2019, p. 1).

The researcher was employed as the athletic training program director and had direct access to student performance records on the BOC, but this was limited to indicators of pass or fail. Due to test score confidentiality, specific overall scores could not be obtained by the BOC despite multiple requests following IRB approval. However, the researcher did have access to student scores provided as percentages for each domain.

**Surveys**

Upon receiving approval from the Institutional Review Board of the study university, a survey was provided to each graduate in the sample (see Appendix B). The survey was developed by the researcher for the sole purpose of this study. The questions were reviewed by two professionals within the field for understandability, and following the review process, no changes were made to the survey. The survey utilized a six-point Likert scale for the student to rate each item (1 = Completely Disagree, 2 = Mostly

Disagree, 3 = Slightly Disagree, 4 = Slightly Agree, 5 = Mostly Agree, 6 = Completely Agree). A 6-point scale was selected over the traditional 5-point scale to eliminate the neutral response option. This decision was supported by studies that have indicated the inclusion of a neutral option produced a significant number of neutral responses despite the participant actually having an opinion on the topic (Edwards & Smith, 2011). Reasons for participants to gravitate to the neutral response have previously included the following: (1) it allowed for reduced cognitive effort on the part of the participant; (2) it allowed participants to avoid conflicting internal feelings; and (3) it allowed participants a more socially desirable option despite having a negative opinion or attitude toward the question (Edwards & Smith, 2011).

All individuals meeting the study's inclusion criteria were asked to participate in the survey, and each individual received multiple e-mails requesting participation (see Appendix C for an example of the e-mail requesting participation). Prospective participants were initially contacted via e-mail, containing a statement of informed consent, and the option to be redirected to the electronic survey. All survey responses were collected anonymously through *Qualtrics*. Additional requests for participation were sent out at two weeks and four weeks from the initial request. Due to the anonymous nature of the data collection, all prospective participants received each request.

Participants were also asked to provide responses to several open-ended questions regarding their methods for preparing for the CCE and BOC examination and how they believed the CCE impacted their preparedness and performance on the BOC examination.

Lastly, participants were asked to provide information to complete a demographic profile which would be used in the analysis of the surveys and questionnaires. This included biological sex, age at time of graduation, entry status at the studied institution (i.e., traditional versus transfer), highest composite ACT score, cumulative GPA at graduation, number of attempts on the CCE, number of attempts on the BOC examination, and whether they had successfully completed the BOC examination.

**Demographics and Other Predicting Variables**

The study also included secondary data from the university to develop a demographic profile of the sample. This included: (1) cumulative GPA; (2) GPA in courses with an athletic training prefix (i.e., AT); (3) ACT scores; (4) age at time of graduation; (5) initial enrollment type (i.e., first-time freshman or transfer); (6) biological sex, and (7) race or ethnicity. These independent variables allowed for a complete demographic profile of the sample and were specifically selected due to their potential relationship with student outcomes on the CCE and the BOC examination (Bruce et al., 2019).

**Data Collection and Analysis Procedures**

Data were collected for each subject represented in the study and compiled into a single Excel spreadsheet. After completing the data collection, all subject names were replaced with a unique identification number. The contents from the Excel spreadsheet were then exported into a data file within SPSS 27.0 (Statistical Package for the Social Sciences).

A chi-square test of independence was initially used to evaluate the relationship between student performance on the comprehensive clinical examination and the BOC

examination. An analysis of the chi-square test provided the probability of success or failure on the BOC examination based on the outcome of the comprehensive clinical examination. Additionally, sensitivity, specificity, and odds ratio were also determined to further examine the relationship between student outcomes on the two examinations. The relationship between the comprehensive clinical examination and the BOC examination was also investigated by using the overall scores on the CCE. The overall scores on the BOC examination were not available, and the researcher was limited to using binary data (i.e., pass or fail) regarding the BOC examination. For this reason, a point-biserial correlation coefficient was calculated. The point-biserial correlation coefficient is a special case of the Pearson product moment correlation, and this test is used to measure the direction and magnitude of the association between one dichotomous variable and one continuous variable, which must be measured on a ratio or interval scale (Sheskin, 2011). In addition to the point-biserial correlation test, an independent samples *t*-test was also conducted on CCE scores with groups determined by BOC examination outcomes. While the overall scores on the BOC examination were not available, the researcher did have access to student scores in each of the separate domains within the BOC examination. Pearson product moment correlations were then calculated using the overall score from the CCE and the five domains on the BOC examination.

The study also investigated the correlation between multiple independent variables and student performance on the two examinations. These independent variables included biological sex, age at time of graduation, entrance status at the university (i.e., first-time freshman or transfer), ACT score, and college grade point average. Descriptive statistics, including mean and standard deviation, correlation tests, and independent

samples *t*-tests were performed to examine the association between these factors and student performance on the CCE and BOC examination.

Independent variables measured on a continuous scale with a significant correlation to the BOC examination were further evaluated using a receiver-operating characteristic (ROC) curve analysis. The purpose of the ROC curve analysis was to identify optimal cut-scores for predicting student performance on the BOC examination. Independent variables demonstrating significant correlations with BOC examination outcomes and the variables produced following the ROC curve analysis were further examined using 2x2 contingency tables and independent samples *t*-tests. The contingency tables provided the sensitivity, specificity, likelihood ratio, and odds ratio for each variable. Additionally, 2x2 cross tabulation tables were utilized with unique combinations of the variables to determine possible interactions. Bruce et al. (2019) published a study during the completion of this project using similar methods for developing a prediction model for BOC examination success.

The questions on the survey with an associated Likert-scale were also analyzed using SPSS 27.0. The analysis of the survey produced descriptive statistics to better understand the students' perceptions of the comprehensive clinical examination. The survey also included open-ended questions, and the qualitative information collected by these questions were subjected to thematic analysis. To complete the thematic analysis, student responses were first reviewed for similar elements, and codes were established. After coding the responses, common themes were established and further analyzed.

**Summary**

This was a mixed-methods study designed to investigate the potential benefits and utility of a comprehensive clinical examination in an accredited athletic training program. The study primarily relied on secondary data from the program, including first-attempt scores on the CCE and first-attempt BOC examination outcomes. Initially, a statistical analysis was performed to evaluate the overall relationship between student performance on the two examinations. Additional secondary data relative to the sample population were also utilized in the study to investigate possible predictor variables for first-time BOC examination success. This included variables, such as age at graduation, matriculation type, cumulative GPA, core GPA, and ACT scores. The study hypothesized there would be a significant positive correlation between first-attempt test scores on the CCE and the BOC examination. It was also hypothesized that the relationship between core grade point average and first-time BOC examination success would be statistically significant.

Students represented in the four cohorts in the study were also asked to participate in a survey that included Likert-scale questions and a questionnaire. The purpose of the survey was to explore the student's perceptions of the comprehensive clinical examination and learn more about their preparation process for the comprehensive clinical examination and the BOC examination.

Accredited athletic training programs are required to maintain a three-year aggregate first-time pass rate of 70% or higher on the BOC examination, and there was a need for programs to better understand what tools could be used to improve and predict student performance on the BOC examination. Programs also needed to better understand

the possible association between predictor variables and student performance on the BOC examination. This information could be useful in determining program admission and retention criteria, and it could help identify students most likely to benefit from additional assistance and early intervention strategies.

# Chapter Four: Results

## Introduction

The following section presents the findings and a detailed analysis of the impact, benefits, and utilization of a comprehensive clinical examination in an accredited athletic training program. This section also provides an analysis of several variables for predicting first-time student performance on the BOC examination. The study primarily focused on an analysis of secondary data, including student performance on the BOC examination, student scores on the comprehensive clinical examination, student grade point average, ACT scores, and other student demographic information. All secondary data were initially organized in a Microsoft Excel spreadsheet with participant names. After completing the data collection, the participant names were removed and replaced with random numbers to protect participant anonymity. The data were then entered into SPSS 27.0 for review and analysis. An alpha level of .05 was utilized for all statistical tests.

The study also included a survey which included Likert scale responses and open-ended questions to explore student perceptions of the comprehensive clinical examination and BOC examination. All surveys were completed anonymously through *Qualtrics*. Likert scale responses were initially analyzed within *Qualtrics*, and these data were imported into SPSS 27.0 for further analysis. Data collected from the open-ended questions were exported into a Microsoft Excel spreadsheet for coding and thematic analysis.

**Null Hypothesis 1**

*Null Hypothesis 1:* Students who pass the comprehensive clinical examination on their first attempt will have no increase in likelihood of passing the BOC examination on their first attempt when compared to students who do not pass the comprehensive clinical examination on their first attempt.

A chi-square test for independence was initially utilized to determine if student performance on the BOC examination was independent of the student's first-time performance on the CCE (see Table 8). The assumption for the chi-square test for independence is that the expected value in each cell is greater than five. Since the value in one of the cells was below five, Fisher's Exact Test was utilized to complete the analysis. The results of the test indicated a significant association between first-time pass rates on the two examinations, $p = .042$.

**Table 8**

*Contingency Table for First-Time Student Performance on the CCE and BOC Examination*

| | | BOC Examination (Pass or Fail) | | |
|---|---|---|---|---|
| | | Pass | Fail | Total |
| Comprehensive Clinical Examination (Pass or Fail) | Pass | 31 | 2 | 33 |
| | Fail | 14 | 6 | 20 |
| | Total | 45 | 8 | 53 |

CCE = comprehensive clinical examination. BOC = Board of Certification.

According to the data, 93.9% (31 of 33) of students who passed the CCE on their first attempt also passed the BOC examination on their first attempt. The BOC success rate for students who failed their first attempt on the CCE was 70.0% (14 of 20), indicating a 23.9% decrease in the likelihood, or probability, of the student being successful in their first attempt on the BOC examination. The odds ratio was determined

to be 6.643, indicating the odds of a student passing the BOC examination on their first attempt was 6.643 times greater for those who passed the CCE when compared to those who failed the CCE on their first attempt. The results illustrated an increased likelihood in passing the BOC examination for students who successfully completed the CCE on their first attempt, and the null hypothesis was rejected.

**Null Hypothesis 2**

*Null Hypothesis 2:* There will be no significant correlation between first-attempt student scores on the comprehensive clinical examination and first-time pass rates on the BOC examination.

To evaluate the statistical significance, a point-biserial correlation was first utilized to determine the strength of the relationship between first-attempt student scores on the comprehensive clinical examination and first-time pass rates on the BOC examination. Outcome data for the BOC examination were limited to pass or fail, and the point-biserial correlation provided a method of evaluating the association for a continuous variable (e.g., comprehensive clinical examination score) and a dichotomous variable (e.g., BOC examination outcome). The point-biserial correlation coefficient revealed a moderate positive correlation of statistical significance, $r_{pb}(51) = .494$, $p < .001$. The null hypothesis was rejected, and it was concluded that a significant positive correlation existed between first-attempt scores on the CCE and first-attempt pass rates on the BOC examination.

An independent samples *t*-test also revealed a significant difference in first-attempt scores on the clinical examination for students who passed the BOC examination on their first attempt (M = 75.89, SD = 6.76) and students who failed the BOC

examination on their first attempt (M = 65.13, SD = 7.86); $t(51) = 4.053$, $p < .001$, $d = 1.56$.

Student scores for each of the five domains on the BOC examination were available to the researcher, and these scores were also correlated to first-time student scores on the clinical examination. Table 9 outlines the Pearson product moment correlation coefficients and significance levels for student test scores on the CCE and scores for each of the five domains on the BOC examination.

**Table 9**

*Correlation Analysis of CCE First-Attempt Scores and Scores in BOC Examination Domains*

| | | BOC Domains | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| 1st Attempt Scores on | Pearson Correlation | .322* | .528* | .278* | .395* | .297* |
| Comprehensive Clinical | Sig. (2-tailed) | .019 | .000 | .044 | .003 | .031 |
| Examination | N | 53 | 53 | 53 | 53 | 53 |

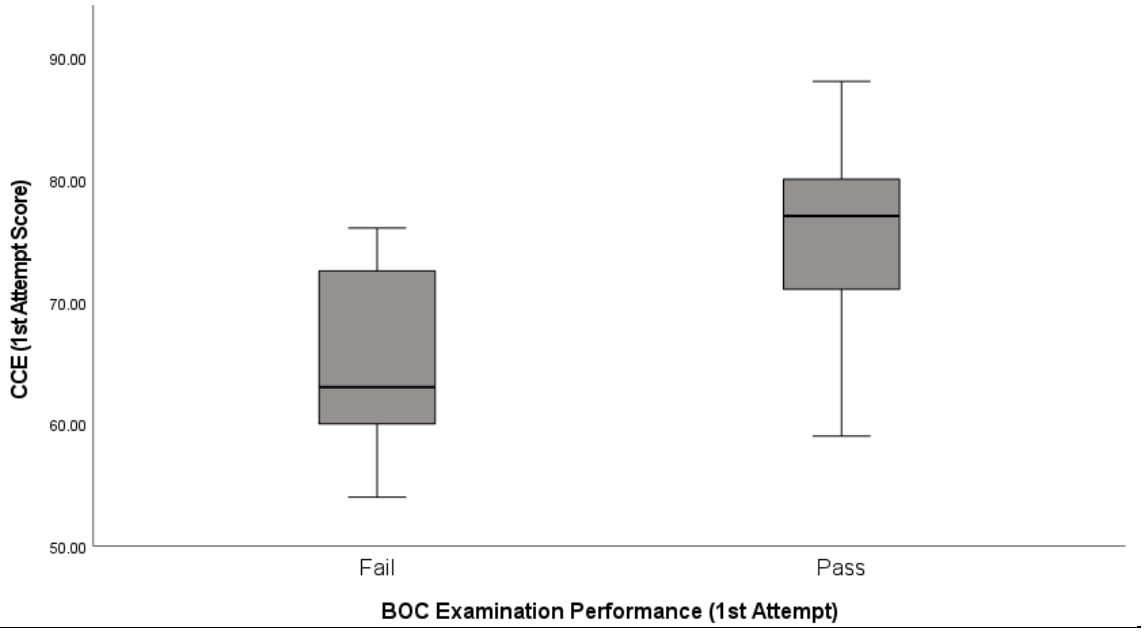
CCE = comprehensive clinical examination. BOC = Board of Certification.

*Denotes significance at the .05 level.

The boxplot in Figure 2 provides an illustration of first-time scores on the CCE when grouped by first-time BOC examination outcomes. The top and bottom lines for each boxplot represent the highest and lowest scores, respectively. The bottom line of each rectangle represents the 25th percentile, and the top line of each rectangle represents the 75th percentile. The horizontal black line through each rectangle represents the median score, or 50th percentile.

**Figure 2**

*Boxplot on First-Attempt CCE and BOC Examination Outcomes*




CCE = comprehensive clinical examination. BOC = Board of Certification.

As shown in Figure 2, there was minimal overlap between the two boxplots. The first-time CCE score associated with the 75th percentile (73.75%) in students who failed the BOC examination was nearly equivalent to the 25th percentile score (70.5%) for students who passed the BOC examination. Furthermore, the CCE score associated with the 50th percentile for students who passed the BOC examination on their first attempt was 14 points higher than those who failed the BOC examination (see Table 10).

**Table 10**

*First-Attempt CCE Percentiles and Scores Grouped by BOC Examination Outcomes*

| | Comprehensive Clinical Examination (CCE) Scores | | |
|---|---|---|---|
| | 25th Percentile | 50th Percentile (Median) | 75th Percentile |
| Failed BOC Examination | 59.00 | 63.00 | 73.75 |
| Passed BOC Examination | 70.50 | 77.00 | 80.50 |

CCE = comprehensive clinical examination. BOC = Board of Certification.

An ANOVA was also performed to investigate between group differences in student scores on each section of the BOC examination when groups were determined by first-attempt scores on the CCE (i.e., < 75% and ≥ 75%). The results of the ANOVA are shown in Table 11 and further support the association between first-attempt scores on the CCE and first-attempt BOC examination outcomes, particularly with outcomes related to Domains 2 and 4.

**Table 11**

*Analysis of Variance Between Student Scores on BOC Examination Domains when Grouped by First-Attempt CCE Outcomes*

| Variable | *df* | *F* | Sig. (2-tailed) |
|---|---|---|---|
| Domain 1 | 1 | 1.00 | .322 |
| Domain 2 | 1 | 9.344 | .004* |
| Domain 3 | 1 | 2.259 | .139 |
| Domain 4 | 1 | 3.846 | .050* |
| Domain 5 | 1 | 1.164 | .286 |

CCE = comprehensive clinical examination. BOC = Board of Certification.

*Denotes significance at the .05 level.

**Null Hypothesis 3**

*Null Hypothesis 3:* There will be no significant correlation between student passing scores on the comprehensive clinical examination and first-time pass rates on the BOC examination.

There was no limit to the number of attempts for students to successfully complete the CCE, and student attempts ranged from one to eight. Table 12 provides a frequency table, identifying the number of students and associated attempts required to successfully complete the CCE.

**Table 12**

*Frequency Analysis for Attempts Required to Pass the CCE*

| Number of Attempts | Frequency | Percentage |
|---|---|---|
| 1 | 33 | 62.3 |
| 2 | 12 | 22.6 |
| 3 | 2 | 3.8 |
| 4 | 4 | 7.5 |
| 5 | 0 | 0 |
| 6 | 1 | 1.9 |
| 7 | 0 | 0 |
| 8 | 1 | 1.9 |

*Note*. Frequency indicates the number of students who successfully completed the comprehensive clinical examination given the specific number of attempts stated in the first column. Percentage indicates the percentage of students who successfully completed the comprehensive clinical examination given the specific number of attempts stated in the first column (N = 53). CCE = comprehensive clinical examination.

The correlation between student passing scores on the CCE and first-time pass rates on the BOC examination was tested by determining the point-biserial correlation coefficient; $r_{pb}(51) = .067$, $p = .635$. An independent samples *t*-test also revealed no significant difference in the CCE passing scores for students who passed the BOC examination on their first attempt (M = 79.067, SD = 3.664) and students who failed the BOC examination on their first attempt (M = 78.375, SD = 4.373); $t(51) = .478$, $p = .635$, $d = .183$.

As previously reported, examination of student overall performance on the BOC examination was limited to dichotomous measures of pass or fail, however, secondary data on student performance within each domain (i.e., score percentages) on the BOC examination was available. Table 13 provides data on the correlation between the students' passing scores, regardless of the number of attempts, on the CCE and test scores associated with each specific domain on the BOC examination.

**Table 13**

*Correlation Analysis of CCE Passing Scores and Scores in BOC Examination Domains*

| | | BOC Domains | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| Passing Scores on | Pearson Correlation | -.075 | .239 | -.091 | .169 | -.005 |
| Comprehensive Clinical | Sig. (2-tailed) | .596 | .085 | .515 | .228 | .973 |
| Examination | N | 53 | 53 | 53 | 53 | 53 |

CCE = comprehensive clinical examination.

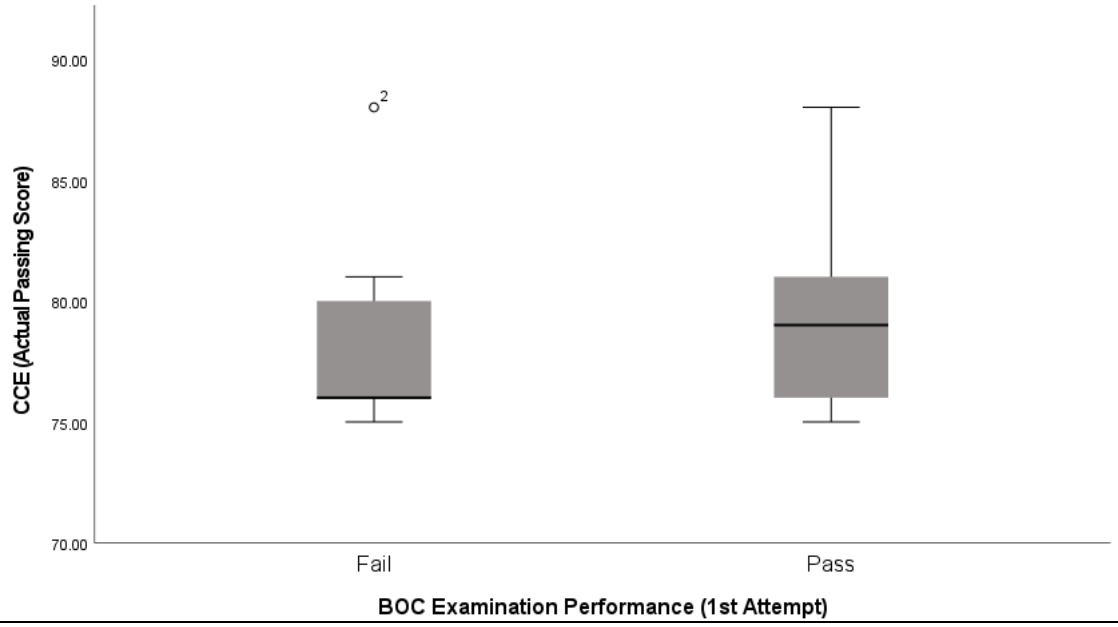
*Denotes significance at the .05 level.

The data provided in Table 13 demonstrates the lack of a significant correlation between passing scores on the CCE and first-time performance in each of the BOC examination domains.

The boxplot in Figure 3 provides an illustration of students' passing scores on the CCE, regardless of the number of attempts, when differentiated by BOC examination outcomes.

**Figure 3**

*Boxplot on CCE Passing Scores and BOC Examination Outcomes*




CCE = comprehensive clinical examination. BOC = Board of Certification.

The scores associated with each percentile for both groups were nearly equivalent (see Table 14). These data strongly suggest a lack in the ability of the comprehensive practical examination to predict BOC examination performance when multiple attempts were permitted on the CCE.

**Table 14**

*CCE Passing Score Percentiles and Scores Grouped by BOC Examination Outcomes*

| | Comprehensive Clinical Examination (CCE) Scores | | |
|---|---|---|---|
| | 25th Percentile | 50th Percentile (Median) | 75th Percentile |
| Passed BOC Examination | 76.00 | 79.00 | 81.50 |
| Failed BOC Examination | 76.00 | 76.00 | 80.50 |

CCE = comprehensive clinical examination. BOC = Board of Certification.

In conclusion, the null hypothesis was not rejected. There was no clear evidence to support a significant association between passing scores on the CCE and first-time success on the BOC examination.

**Null Hypothesis 4**

*Null Hypothesis 4:* There will be no significant correlation between student grade point average (core classes only) and first-time pass rates on the comprehensive clinical examination.

The point-biserial correlation coefficient was utilized to evaluate the potential relationship between student grade point average (GPA) in core classes and overall performance on the CCE. The results indicated a positive moderate correlation of statistical significance; $r_{pb}(51) = .434$, $p = .001$. The point-biserial correlation for cumulative GPA was nearly equivalent; $r_{pb}(51) = .427$, p = .001. When analyzing the relationship between core GPA and actual first-time test scores on the comprehensive clinical examination, there was an increase in the strength of the correlation; $r(51) = .573$, $p < .001$. Cumulative GPA was also found to have a similar correlation to first-attempt test scores on the CCE; $r(51) = .564$, $p < .001$. Based on the evidence provided, the null hypothesis was rejected.

An independent samples *t*-test was also conducted to compare core GPA and student outcomes on the CCE. The results indicated a significant difference in the core GPA for students who passed the clinical examination on their first attempt (M = 3.50, SD = .290) and students who failed the clinical examination on their first attempt (M = 3.22, SD = .274); $t(51) = 3.442$, $p = .001$, $d = .975$. Cumulative GPA and CCE outcomes were also evaluated with an independent samples *t*-test, which also revealed significance.

Students who passed the clinical examination on their first attempt had a higher cumulative GPA (M = 3.54, SD = .279) compared to students who failed the clinical examination on their first attempt (M = 3.27, SD = .272); $t(51) = 3.370$, $p = .001$, $d = .955$.

**Null Hypothesis 5**

*Null Hypothesis 5:* There will be no significant correlation between student grade point average (core classes only) and first-time pass rates on the BOC examination.

The point-biserial correlation coefficient was calculated to evaluate the relationship between student grade point average (GPA) in core classes and performance on the BOC examination. The results showed a significant, moderate, positive correlation; $r_{pb}(51) = .443$, $p = .001$. The point-biserial correlation coefficient was also determined for cumulative GPA and first-attempt pass rates on the BOC examination, and these variables demonstrated a slightly higher correlation with statistical significance; $r(51) = .507$, $p < .001$.

To further investigate the relationship between core GPA and first-time pass rates on the BOC examination, an independent samples *t*-test was performed. Students who passed the BOC examination on their first attempt (M = 3.45, SD = .29) compared to students who failed the BOC examination on their first attempt (M = 3.07, SD = .26) achieved a significantly higher core GPA; $t(51) = 3.528$, $p = .001$, $d = 1.33$. Based on these findings, the null hypothesis was rejected.

An independent samples *t*-test was also performed for cumulative GPA, and the results indicated students who passed the BOC examination on their first attempt (M = 3.50, SD = .264) compared to students who failed the BOC examination on their first

attempt (M = 3.08, SD = .259) also had a significantly higher cumulative GPA; $t(51) = 4.197$, $p < .001$, $d = 1.610$.

**Research Question 1**

*Research Question 1:* What is the student preparation process for the comprehensive practical examination?

Fifty-three students were invited to participate in completing a survey regarding their experience with the CCE and the BOC examination. A total of 33 students responded, resulting in an overall response rate of 62.3%. After coding student responses and developing themes based on similarity, 26 of the 33 students identified group work, specifically with hands-on practice, as a key method for preparing for the CCE. The students also reported they developed scenarios and simulations to test each other when working in pairs or groups. When working independently, students most frequently stated they read previous textbooks and reviewed previous coursework. Five students also reported the use of flashcards for learning and assessing their knowledge of specific psychomotor skills.

In addition to questions on study methods, the questionnaire also included open-ended questions to better understand the amount of time students dedicated to preparing for the CCE. A total of 31 students provided information about time spent preparing for the CCE, including 22 students who passed the CCE on their first attempt and nine students who failed the CCE on their first attempt. Collectively, these 31 students reportedly spent an average of 9.6 hours each week (SD = 5.20) for an average period of 8.6 weeks (SD = 5.25) studying and preparing for the clinical examination. An independent samples *t*-test did not reveal a significant difference in time spent studying

for those who passed the CCE on their first attempt (M = 8.18, SD = 3.75) and those who failed the CCE on their first attempt (M = 9.44, SD = 8.08); $t(29) = .60$, $p = .553$.

**Research Question 2**

*Research Question 2:* What is the student preparation process for the Board of Certification examination?

Students were asked on the questionnaire to describe their method for preparing for the BOC examination. Of the 33 respondents, 19 students stated they focused on reading textbooks, and six specifically stated they outlined the key topics of the textbook used in their foundations of athletic training course. Twelve students stated they utilized standardized practice exams that were modeled after the BOC examination. Several students also reported using a study calendar that outlined key topics and allowed them to organize their studying around the five domains, as well as their areas of strength and weakness. Students frequently reported the use of several NATA resources, including the NATA position statements; the fifth edition of the *Athletic Training Education Competencies*; and the crosswalk analysis that linked the *Practice Analysis,* 7th Edition (Henderson, 2015) and the *Athletic Training Education Competencies*.

Twenty-eight of the 33 students responded to a question requesting information on their time spent studying for the BOC examination. On average, students spent 7.6 weeks (SD = 4.20) preparing for the BOC examination and an average of 9.6 hours each week (SD = 4.99). An independent samples *t*-test revealed the number of weeks spent preparing for the BOC for students who passed the examination on their first attempt (M = 7.92, SD = 4.23) was greater than those who failed their first attempt on the BOC

examination (M = 4.00, SD = 0.00), but it lacked statistical significance; $t(26) = 1.29$, $p = .209$.

**Research Question 3**

*Research Question 3:* How do students perceive the value of the comprehensive clinical examination as a preparation tool for the BOC examination?

Table 15 outlines the data collected from the Likert scale survey items. Based on these data, students mostly agreed or completely agreed that their preparation for the CCE improved their knowledge, skills, and abilities (M = 5.52, SD = .83); and their preparation process for the CCE had a positive impact on their BOC examination performance (M = 5.36, SD = .90).

**Table 15**

*Summary of Data from Student Survey (n = 33)*

| Survey Items | M | SD |
|---|---|---|
| 1. The CCE is an important component of the athletic training program. | 5.61 | .66 |
| 2. Preparation process for the CCE improved skills and abilities. | 5.52 | .83 |
| 3. Preparation process for the CCE improved knowledge. | 5.46 | 1.09 |
| 4. Preparation process for the CCE positively influenced performance on BOC exam. | 5.36 | .90 |
| 5. Passing the CCE improved my confidence for the BOC exam. | 5.18 | 1.16 |
| 6. Passing the CCE improved my confidence to practice as an athletic trainer. | 5.15 | 1.12 |
| 7. Reading information is an effective way for me to learn. | 5.03 | 1.02 |
| 8. Hearing information is an effective way for me to learn. | 5.15 | .83 |
| 9. Kinesthetic learning is an effective way for me to learn. | 5.85 | .36 |

*Note.* The 6-point Likert scale used the following scoring system: (1) Completely Disagree; (2) Mostly Disagree; (3) Slightly Disagree; (4) Slightly Agree; (5) Mostly Agree; (6) Completely Agree.

CCE = comprehensive clinical examination. BOC = Board of Certification

While there was the potential for bias in student responses based on individual outcomes on the CCE, an independent samples *t*-test revealed no significant differences in student responses pertaining to the clinical examination between groups of students

who passed the CCE on their first attempt and those who required multiple attempts (see Table 16). Students requiring more attempts on the CCE did provide significantly lower responses (M = 4.67, SD = 1.00, $p$ = .039) on their ability to learn through hearing information when compared to students who passed the CCE on their first attempt (M = 5.33, SD = .70). Learning styles was not a significant part of the study, but data on student-perceived learning style preferences were collected to support the concept of kinesthetic learning through student preparation for the CCE. Based on the survey responses outlined in Table 16, students strongly agreed that kinesthetic learning was an effective way of them to learn, regardless of their initial performance on the CCE.

**Table 16**

*Independent Samples t-Test of Survey Data (n = 33)*

| | Passed Clinical Examination on First Attempt (n = 24) | | Failed Clinical Examination on First Attempt (n = 9) | | |
|---|---|---|---|---|---|
| Survey Items | M | SD | M | SD | Sig. (2-tailed) |
| 1. The CCE is an important component of the athletic training program. | 5.67 | .64 | 5.44 | .73 | .397 |
| 2. Preparation process for the CCE improved skills and abilities. | 5.58 | .88 | 5.33 | .71 | .452 |
| 3. Preparation process for the CCE improved knowledge. | 5.46 | 1.18 | 5.44 | .88 | .975 |
| 4. Preparation process for the CCE positively influenced performance on BOC exam. | 5.38 | .92 | 5.33 | .87 | .907 |
| 5. Passing the CCE improved my confidence for the BOC exam. | 5.21 | 1.18 | 5.11 | 1.17 | .834 |
| 6. Passing the CCE improved my confidence to practice as an athletic trainer. | 5.25 | 1.15 | 4.89 | 1.05 | .419 |
| 7. Reading information is an effective way for me to learn. | 5.21 | 1.02 | 4.56 | .88 | .101 |
| 8. Hearing information is an effective way for me to learn. | 5.33 | .70 | 4.67 | 1.00 | .039 |
| 9. Kinesthetic learning is an effective way for me to learn. | 5.88 | .34 | 5.78 | .44 | .503 |

*Note.* The 6-point Likert scale used the following scoring system: (1) Completely Disagree; (2) Mostly Disagree; (3) Slightly Disagree; (4) Slightly Agree; (5) Mostly Agree; (6) Completely Agree.

CCE = comprehensive clinical examination. BOC = Board of Certification.

Students were also asked to reflect on their preparation process for the CCE and comment on how their preparation may have impacted their readiness for the BOC examination. Following a thematic analysis of the student responses, it was determined the majority of students believed the CCE positively impacted their BOC readiness and performance. One student stated, 'The clinical examination preparation was much more challenging than the BOC preparation. Upon completion of the clinical examination, I felt very prepared to take the BOC examination.' Additional support for the clinical examination as a tool for BOC preparedness came from another student who stated, 'Most of the information I learned came from preparing for the practical test.' Another student wrote, 'The preparation involved to be successful on the clinical examination greatly impacted my preparedness for the BOC examination. The clinical examination required me to begin preparing much earlier than I would have.' Another student commented, 'It helped me realize what I know and what I don't know, and it gave me the motivation to study the things I don't know.'

Ten of the 33 respondents reported the CCE benefitted them by providing a source of motivation to study and review key topics. Without this motivation, they may have postponed their preparation for the BOC examination to a time much closer to their expected test date. Several students also reported an increase in confidence for taking the BOC examination after successfully completing the clinical examination. For example, one student wrote, 'My confidence and readiness came from my preparation for the practical test.' In addition to improving confidence for the BOC examination, students also reported reduced anxiety in their preparation for the BOC examination. One student replied, 'Studying for the practical exam increased my confidence and reduced anxiety

when it came to taking the BOC. I learned to maintain a calm mind during testing to reduce mistakes.'

Finally, many students reported the manner in which they studied for the CCE is what benefitted them most with regard to the BOC examination. For instance, one student stated, 'My classmates and I also created scenarios and talked through how we would handle them. I felt like I was incredibly prepared for the BOC because of years of practicing hands-on skills and acting out scenarios.' While this was the only comment that specifically addressed the perceived benefits of hands-on learning and its connection to improving performance on written examinations, students did identify kinesthetic learning as their most effective way to learn (M = 5.85, SD .36) when compared to learning by reading (M = 5.03, SD = 1.02) and hearing (M = 5.15, SD = .83).

**Research Question 4**

*Research Question 4*: How do students perceive the value of the comprehensive clinical examination as a tool for improving professional preparedness?

According to the student survey responses (n = 33), students strongly agreed that their preparation process for the CCE improved their skills and abilities (M = 5.52, SD = .83); their overall knowledge (M = 5.46, SD = 1.09); and their confidence for professional practice (M = 5.15, SD = 1.02). In addition to the data collected in the Likert scale survey items, 30 students responded to an open-ended question asking them to describe how the comprehensive clinical examination impacted their confidence level for professional practice. After coding the individual responses, 21 of the students reported the CCE improved their confidence for entry-level practice as an athletic trainer. Several students reported their improved confidence was in response to their performance on the

examination, while others believed it was due to the preparation that was required for them to be successful on the clinical examination. For example, one student replied, ‘I felt like if I could pass the senior oral practical [comprehensive clinical examination] in that high stakes, high nerves environment, then I could be ready for anything in professional practice.’ Another student stated, ‘I feel the senior oral practical [comprehensive clinical examination] was the best way to prepare for professional practice as it required me to be confident in my decision making and ensure I could make the correct decisions in various situations.’ A fellow student commented on the benefits of their preparation for the clinical examination and stated, ‘I believe that having a set schedule and studying as a group is what helped me prepare the most. After I had passed the senior oral practical [comprehensive clinical examination], I definitely had more confidence and felt I had a better understanding.’

While the overwhelming majority of students provided positive remarks about the CCE and its impact on their professional confidence, one student did provide an alternative opinion. The student stated, ‘I think failing it did more to harm my confidence than anything. There’s a lot of pressure put on this test, and if you don’t pass, you feel like you’re never going to be a good athletic trainer.’

**Predictor Variables**

The data collected and analyzed in the study provided an additional opportunity to evaluate student performance measures and investigate possible predictor variables for outcomes on the BOC examination. Table 17 provides an overview of the descriptive statistics associated with possible predictor variables for the study participants.

**Table 17**

*Descriptive Statistics for Possible Predictor Variables of First-Time Success on the BOC Examination*

| Predictor Variables | Range | Mean ± SD | Median |
|---|---|---|---|
| Age at Graduation | 21 – 28 | 22.8 ± 1.67 | 22 |
| ACT Score | 18 – 31 | 23.4 ± 3.17 | 23 |
| Cumulative GPA | 2.69 – 4.00 | 3.44 ± .30 | 3.41 |
| Core GPA | 2.65 – 4.00 | 3.39 ± .31 | 3.42 |
| Comprehensive Clinical Examination | | | |
| Number of Attempts | 1 – 8 | 1.75 ± 1.39 | 1 |
| 1st Attempt Score (%) | 54.00 – 88.00 | 74.26 ± 7.88 | 76.00 |
| Passing Score (%) | 75.00 – 88.00 | 78.96 ± 3.74 | 78.00 |

BOC = Board of Certification

Table 18 illustrates the correlations for all identified predictor variables and first-time BOC examination performance, and Table 19 illustrates a secondary statistical analysis of the predictor variables through a comparison of the means between the two defined BOC outcome groups (i.e., pass or fail).

**Table 18**

*Correlations for Predictor Variables and First-Time Success on the BOC Examination*

| Predictor Variables | Correlation Coefficient | Sig. (2-tailed) |
|---|---|---|
| Age at Graduation | .129 | .362 |
| ACT Score | .121 | .471 |
| Cumulative GPA | .507 | < .001* |
| Core GPA | .443 | .001* |
| Comprehensive Practical Examination | | |
| 1st Attempt Score | .494 | < .001* |
| Number of Attempts | -.498 | < .001* |
| Passing Score | .067 | .635 |
| 1st Attempt Outcome (pass/fail) | .324 | .018* |

*Denotes significance at the .05 level.

**Table 19**

*Independent Samples t-Tests for Predictor Variables and First-Time Success on BOC Examination*

| Predictor Variables | ***t*** | df | Sig. (2-tailed) | *d* |
|---|---|---|---|---|
| Age at Graduation | .921 | 51 | .362 | .354 |
| ACT Score | .729 | 36 | .471 | .350 |
| Cumulative GPA | 4.197 | 51 | < .001* | 1.610 |
| Core GPA | 3.528 | 51 | .001* | 1.354 |
| Comprehensive Practical Examination | | | | |
| 1st Attempt Score | 4.053 | 51 | < .001* | 1.556 |
| Number of Attempts | -4.099 | 51 | < .001* | -1.573 |
| Passing Score | .478 | 51 | .635 | .183 |
| 1st Attempt Outcome (pass/fail) | 2.447 | 51 | .018* | .939 |

*Note.* Sample groups were determined by first-time performance on the BOC examination (i.e., pass or fail).

*Denotes significance at the .05 level.

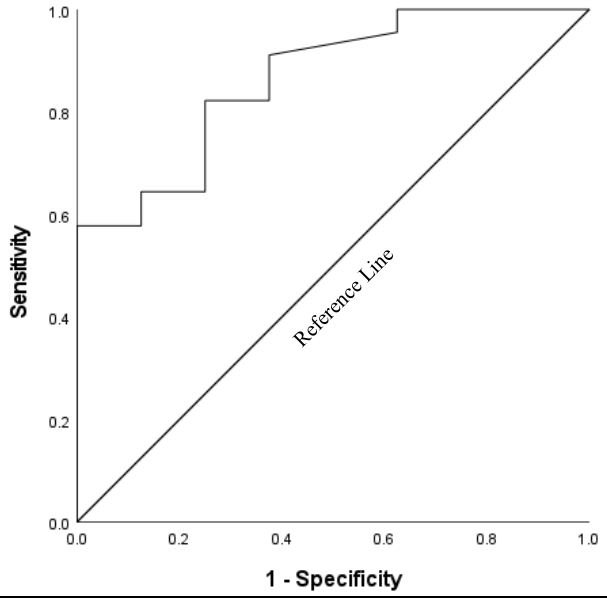
As shown in Tables 18 and 19, cumulative GPA, when compared to core GPA, was shown to have a greater effect size on BOC examination performance. The other predictor variables shown to have the most significant effect size were first-time scores on the CCE and number of attempts required to successfully complete the CCE with a 75% or higher. The number of attempts required to pass the CCE was inversely related to BOC performance, resulting in negative *t* scores and Cohen's *d* values.

The overall value and utility for using the top three predictor variables was further assessed after determining optimal cut-points through Receiver Operating Characteristic (ROC) curve analysis. Establishing specific cut-points, or cut-scores, for each of these variables provided a method for establishing a dichotomous scoring system that could be utilized in contingency tables to calculate and compare sensitivity, specificity, and odds ratios. Additionally, this provided an opportunity to evaluate the current cut-points used by the program to determine success on the CCE, as well as GPA retention criteria currently used to determine good academic standing within the program. The first ROC

curve analysis was conducted for cumulative grade point average, and the ROC curve is shown in Figure 4.

**Figure 4**

*ROC Curve Analysis for Cumulative Grade Point Average*




*Note*. Diagonal segments are produced by ties.

The optimal cut-point is indicated on a ROC curve as the point that represents the highest sensitivity value and lowest 1-specificity value. Sensitivity values are associated with the true positive rate, and 1-specificity is equivalent to the false positive rate. The chart can be used to estimate the cut-point, which is typically identified as the point closest to the top left corner of the chart. The Youden index method identifies another method for determining the cut-point, which utilizes the coordinates of the curve to identify the maximal Youden function. The Youden function is the difference between the true positive rate (sensitivity) and the false positive rate (1-specificity; Unal, 2017). Data sets from SPSS 27.0 provided the coordinates of the curve, as shown in Table 20, and in this case, the Youden index method was used to determine the optimal cut-point.

**Table 20**

*ROC Curve Analysis for Cumulative Grade Point Average: Coordinates of the Curve*

| Cumulative GPA (positive if ≥ the value) | Sensitivity | 1 – Specificity |
|---|---|---|
| 1.69 | 1.000 | 1.000 |
| 2.74 | 1.000 | .875 |
| 2.88 | 1.000 | .750 |
| 3.00 | 1.000 | .625 |
| 3.03 | .978 | .625 |
| 3.04 | .956 | .625 |
| 3.08 | .933 | .500 |
| 3.12 | .911 | .375 |
| 3.15 | .889 | .375 |
| 3.19 | .867 | .375 |
| 3.22 | .844 | .375 |
| 3.24 | .822 | .375 |
| 3.27 | .822 | .250 |
| 3.30 | .800 | .250 |
| 3.31 | .778 | .250 |
| 3.33 | .756 | .250 |
| 3.34 | .733 | .250 |
| 3.36 | .689 | .250 |
| 3.37 | .644 | .250 |
| 3.38 | .644 | .125 |
| 3.39 | .622 | .125 |
| 3.40 | .600 | .125 |
| 3.41 | .578 | .125 |
| 3.42 | .578 | .000 |
| 3.45 | .556 | .000 |
| Cumulative GPA (positive if ≥ the value) | Sensitivity | 1 – Specificity |
| 3.51 | .467 | .000 |
| 3.54 | .444 | .000 |
| 3.58 | .422 | .000 |
| 3.60 | .400 | .000 |
| 3.61 | .378 | .000 |
| 3.62 | .356 | .000 |
| 3.65 | .311 | .000 |
| 3.69 | .289 | .000 |
| 3.72 | .244 | .000 |
| 3.73 | .222 | .000 |
| 3.75 | .200 | .000 |
| 3.76 | .178 | .000 |
| 3.79 | .156 | .000 |
| 3.83 | .111 | .000 |
| 3.86 | .089 | .000 |
| 3.92 | .067 | .000 |
| 3.98 | .044 | .000 |
| 5.00 | .000 | .000 |

The greatest Youden function was identified as .578, and a cumulative GPA of 3.42 was identified as the optimal cut-point for predicting success on the BOC examination. This GPA was associated with a true positive rate of .578 and false positive rate of .000. The area under the curve was determined to be .864. “An area under the curve (AUC) of 0.5 suggests no discrimination, 0.7 to 0.8 is considered acceptable, 0.8 to 0.9 is considered excellent, and more than 0.9 is considered outstanding” (Mandrekar, 2010, p. 1316). The cumulative GPA cut-point of 3.42 was then used to produce a contingency table with BOC pass rates to further assess its utility as a predictor variable (see Table 21).

**Table 21**

*Contingency Table for Cumulative GPA: Cut-Point = 3.42*

| | | BOC Examination (Pass or Fail) | | |
|---|---|---|---|---|
| | | Pass | Fail | Total |
| Cumulative GPA | 3.42 and above | 26 | 0 | 26 |
| | 3.41 and below | 19 | 8 | 27 |
| | Total | 45 | 8 | 53 |

Fisher’s Exact test of independence indicated cumulative GPA with a cut-point of 3.42 was significantly associated with first-time BOC examination outcomes, $p = .004$. Furthermore, based on the data provided in Table 21, the probability of an individual with a cumulative GPA of 3.42 or above passing the BOC examination on their first attempt was 100%. The probability of first-time success on the BOC examination for students with a cumulative GPA of 3.41 or below was 70.4%.

A second contingency table (see Table 22) was also created to examine a cut-point of 3.27, as this grade point average resulted in a Youden function of .572. This

Youden function was nearly equivalent to the function determined for a grade point average of 3.42, and a 3.27 cut-score was also found to be significantly associated to first-time BOC examination performance, $p = .003$.

**Table 22**

*Contingency Table for Alternative Cumulative GPA: Cut-Point = 3.27*

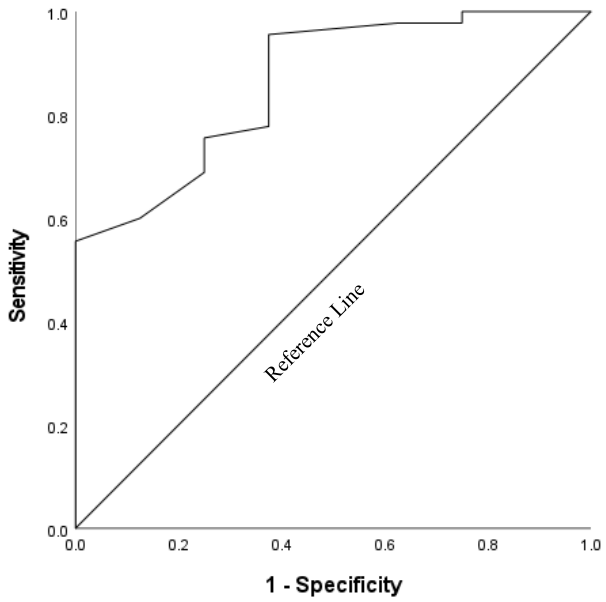
| | | BOC Examination (Pass or Fail) | | |
|---|---|---|---|---|
| | | Pass | Fail | Total |
| Cumulative GPA | 3.27 and above | 37 | 2 | 39 |
| | 3.26 and below | 8 | 6 | 14 |
| | Total | 45 | 8 | 53 |

The alternative GPA of 3.27 was associated with a 25% decrease in specificity, which resulted in specificity of 75%. Thus, a cut-point of 3.27 resulted in a 25% increase in false positives. In other words, 25% of the students who failed the BOC examination on their first attempt met this lower benchmark and would be considered false positives. However, the alternative GPA also resulted in a 24.4% increase in sensitivity, increasing the sensitivity from 57.8% to 82.2%. This resulted in 24.4% less false negatives.

Similar analytical methods involving ROC curves and contingency tables were then used to evaluate the other proposed predictor variables. These variables included the student's first-attempt score on the CCE and the number of attempts required to successfully complete the CCE with a 75% or higher. Figure 5 provides the ROC curve analysis for first-attempt scores on the comprehensive clinical examination.

**Figure 5**

*ROC Curve Analysis for First-Attempt Scores on the CCE*




*Note*. Diagonal segments are produced by ties.

CCE = comprehensive clinical examination.

The area under the curve was determined to be .862, and again, this would be considered excellent. The coordinates of the curve are provided in Table 23.

**Table 23**

*ROC Curve Analysis for First-Attempt Scores on the CCE: Coordinates of the Curve*

| Examination Score (positive if ≥ the value) | Sensitivity | 1 – Specificity |
|---|---|---|
| 53.00 | 1.000 | 1.000 |
| 56.00 | 1.000 | .875 |
| 58.50 | 1.000 | .750 |
| 60.50 | .978 | .750 |
| 62.50 | .978 | .625 |
| 64.00 | .956 | .375 |
| 65.50 | .933 | .375 |
| 66.50 | .889 | .375 |
| 67.50 | .867 | .375 |
| 68.50 | .800 | .375 |
| 69.50 | .778 | .375 |
| 70.50 | .756 | .250 |
| 71.50 | .711 | .250 |
| 73.50 | .689 | .250 |
| 75.50 | .600 | .125 |
| 76.50 | .556 | .000 |
| 77.50 | .489 | .000 |
| 78.50 | .422 | .000 |
| 79.50 | .311 | .000 |
| 80.50 | .244 | .000 |
| 81.50 | .200 | .000 |
| 82.50 | .133 | .000 |
| 83.50 | .111 | .000 |
| 84.50 | .089 | .000 |
| 85.50 | .067 | .000 |
| 87.00 | .022 | .000 |
| 89.00 | .000 | .000 |

CCE = comprehensive clinical examination.

Based on the coordinates of the curve provided in the ROC analysis, a cut-score of 64% on the CCE was associated with a sensitivity of .956 and 1-specificity of .375. The Youden function was determined to be greatest at this level, with a value of .581. Table 24 provides a contingency table for this specific cut-point.

**Table 24**

*Contingency Table for CCE: Cut-Score 64%*

| | | BOC Examination (Pass or Fail) | | |
|---|---|---|---|---|
| | | Pass | Fail | Total |
| 1st Attempt Score on Clinical Examination | 64% or Above | 43 | 3 | 46 |
| | Below 64% | 2 | 5 | 7 |
| | Total | 45 | 8 | 53 |

CCE = comprehensive clinical examination.

Fisher's Exact test revealed a significant relationship between first-time scores on the CCE with a cut-score of 64% and student outcomes on the BOC examination, $p < .001$. The odds of an individual who scored a 64% or higher on the CCE and passing the BOC examination on their first attempt was 14.33. The probability of first-time success on the BOC examination for students scoring a 64% or above on the CCE was 93.48%. The odds of an individual scoring less than 64% on the CCE and passing the BOC examination on their first attempt was .40. The probability of first-time success on the BOC examination for students scoring less than 64% on the CCE was 28.6%. The odds ratio was 35.83.

For comparison, Table 25 is based on the 75% cut-score used in the study.

**Table 25**

*Contingency Table for CCE: Cut-Score 75%*

| | | BOC Examination (Pass or Fail) | | |
|---|---|---|---|---|
| | | Pass | Fail | Total |
| 1st Attempt Score on Clinical Examination | 75% or Above | 31 | 2 | 33 |
| | Below 75% | 14 | 6 | 20 |
| | Total | 45 | 8 | 53 |

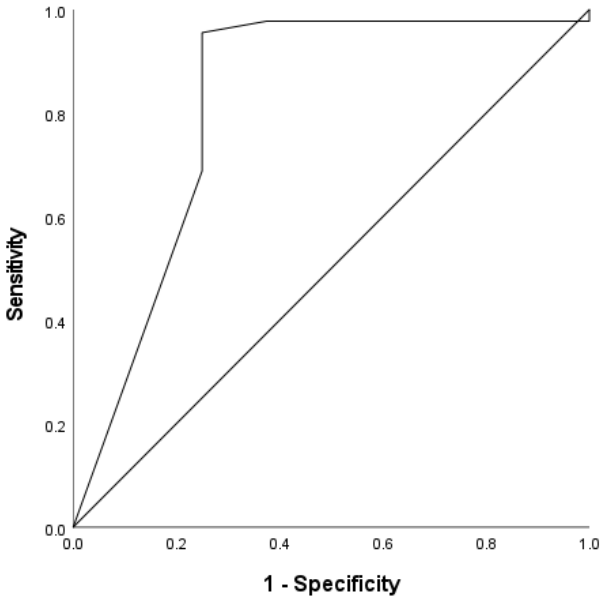
CCE = comprehensive clinical examination.

Using the 75% cut-score from the study, Fisher's Exact test indicated a statistically significant relationship between first-time test scores on the CCE and performance on the BOC examination, $p = .042$. The odds of first-time success on the BOC examination for individuals who scored a 75% or higher on the CCE was 15.5. The probability of first-time success on the BOC examination for students scoring 75% or higher on their first attempt on the CCE was 93.94%. The odds of first-time success on the BOC examination for individuals who scored less than 75% on the CCE was 2.33, and their probability of first-time success on the BOC examination was 70%. When compared to the 64% cut-score, the odds ratio with the 75% cut-score was significantly reduced, OR = 6.64.

The final predictor variable analyzed with a ROC curve (see Figure 6) was the number of attempts required for students to successfully complete the comprehensive clinical examination with a 75% of higher. The area under the curve in Figure 6 was determined to be .818, and the coordinates of the curve are provided in Table 26.

**Figure 6**

*ROC Curve Analysis for CCE Attempts Required with a 75% Cut-Score*




*Note*. Diagonal segments are produced by ties.

CCE = comprehensive clinical examination.

**Table 26**

*ROC Curve Analysis for CCE Attempts Required with a 75% Cut-Score: Coordinates of the Curve*

| Number of Attempts (positive if ≤ the value) | Sensitivity | 1 – Specificity |
|---|---|---|
| 0 | .000 | .000 |
| 1 | .689 | .250 |
| 2 | .956 | .250 |
| 3 | .978 | .375 |
| 5 | .978 | .875 |
| 7 | .978 | 1.000 |
| 9 | 1.000 | 1.000 |

CCE = comprehensive clinical examination.

Using the coordinates of the curve, the Youden index method was again used to determine the optimal cut-point. The cut-point was determined to be two attempts, and Table 27 provides a contingency table for this specific cut-point.

**Table 27**

*Contingency Table for CCE Attempts with a 75% Cut-Score*

| | | BOC Examination (Pass or Fail) | | |
|---|---|---|---|---|
| | | Pass | Fail | Total |
| Number of Attempts | 2 Attempts or Less | 43 | 2 | 45 |
| | More than 2 Attempts | 2 | 6 | 8 |
| | Total | 45 | 8 | 53 |

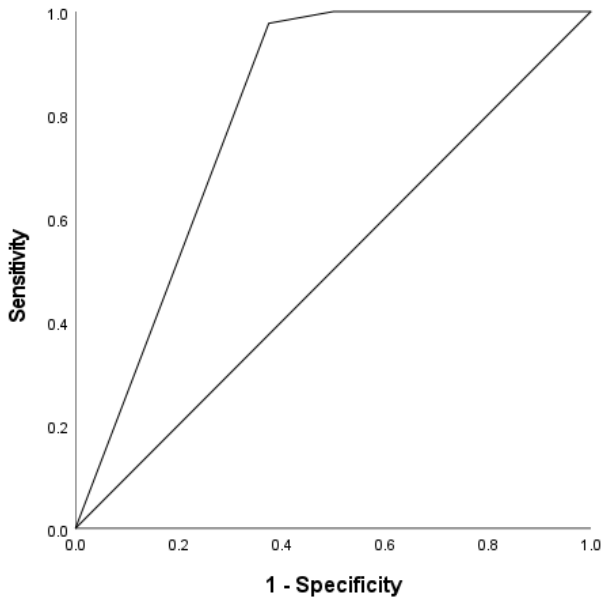
CCE = comprehensive clinical examination.

Based on the data in the contingency table, Fisher's Exact test indicated the number of attempts needed for students to achieve a 75% was not randomly associated to student outcomes on the BOC examination, $p < .001$. The odds of an individual who successfully completed the CCE with two attempts or less and passing the BOC examination was 65.15 times greater than the odds of an individual passing the BOC examination after requiring three or more attempts on the CCE. The probability of first-time success on the BOC examination for students requiring less than two attempts on the CCE was 95.6%. The probability of first-time success on the BOC examination for students requiring more than two attempts on the CCE was 25%.

A ROC curve analysis was also developed to determine the optimal cut-point for number of attempts on the CCE if the cut-score was adjusted to 64% (see Figure 7). The ROC curve analysis yielded an area under the curve (AUC) of .807, and Table 28 provides the coordinates of the curve.

**Figure 7**

*ROC Curve Analysis for CCE Attempts Required with a 64% Cut-Score*




*Note*. Diagonal segments are produced by ties.

CCE = comprehensive clinical examination.

**Table 28**

*ROC Curve Analysis for CCE Attempts Required with a 64% Cut-Score: Coordinates of the Curve*

| Number of Attempts (positive if ≤ the value) | Sensitivity | 1 – Specificity |
|---|---|---|
| 0 | .000 | .000 |
| 1 | .977 | .375 |
| 2 | 1.000 | .500 |
| 4 | 1.000 | 1.000 |

CCE = comprehensive clinical examination.

Based on the coordinates of the curve, the optimal cut-point for number of attempts permitted on the comprehensive clinical examination would be 1, as indicated by the maximized Youden function of .602. An additional contingency table and description of the results was not provided here, as this information would be identical to

Table 24, which provided an analysis of first-time pass rates on the clinical examination with a cut-score of 64% and first-time BOC examination success. However, the second highest Youden function of .500 was associated with a cut-point of two attempts on the examination. Table 29 provides a contingency table for this cut-point with the alternative cut-score of 64%, and this provides a comparison for Table 27, which used a cut-point of two attempts and a cut-score of 75%.

**Table 29**

*Contingency Table for CCE Attempts with a 64% Cut-Score*

| | | BOC Examination (Pass or Fail) | | |
|---|---|---|---|---|
| | | Pass | Fail | Total |
| Number of Attempts | 2 Attempts or Less | 44 | 4 | 48 |
| | More than 2 Attempts | 1 | 4 | 5 |
| | Total | 45 | 8 | 53 |

CCE = comprehensive clinical examination.

As shown in Table 29, when grouped by number of attempts required to score a 64% of higher on the CCE, Fisher's Exact test revealed a significant association with first-time BOC pass rates, $p = .001$. The odds of an individual who scored a 64% of higher within two attempts on the CCE and passing the BOC examination on their first attempt was 44 times greater than the odds of an individual passing the BOC examination after scoring less than 64% on their first two attempts on the CCE. The probability of first-time success on the BOC examination for students requiring less than two attempts on the CCE was 91.67%. The probability of first-time success on the BOC examination for students requiring more than two attempts to earn a 64% on the CCE was 20%.

Table 30 summarizes the key findings from correlation tests and 2x2 contingency tables for the proposed predictor variables and associated cut-points. As seen in the table,

the variables with the greatest significance included a cumulative GPA of 3.27 or higher; a first-attempt score of 64% or higher on the CCE; and the total number of attempts required to pass the CCE with a 75% or higher.

**Table 30**

*Univariable Analysis of Predictor Variables for First-Time BOC Examination Success*

| Predictor Variable | $r_{pb}$ | Sig. (2-tailed) | Fisher's Exact Test (2-sided) | Sn | Sp | +LR | -LR | OR |
|---|---|---|---|---|---|---|---|---|
| [a]GPA | .465 | < .001* | .003* | .822 | .750 | 3.288 | .237 | 13.875 |
| [b]GPA | .414 | .002* | .004* | .578 | 1.00 | 10.286** | .449** | 23.034** |
| [a]$CCE_{FA}$ | .614 | < .001* | < .001* | .956 | .625 | 2.549 | .070 | 35.833 |
| [b]$CCE_{FA}$ | .324 | .018* | .042* | .689 | .750 | 2.756 | .415 | 6.643 |
| [a]$CCE_{TA}$ | .585 | < .001* | < .001* | .978 | .500 | 1.956 | .044 | 44.000 |
| [b]$CCE_{TA}$ | .706 | < .001* | < .000* | .956 | .750 | 3.824 | .059 | 64.500 |

[a]GPA = cumulative GPA $\geq$ 3.27; [b]GPA = cumulative GPA $\geq$ 3.42; [a]$CCE_{FA}$ = first attempt score on comprehensive clinical examination was $\geq$ 64%; [b]$CCE_{FA}$ = first attempt score on comprehensive clinical examination was $\geq$ 75%; [a]$CCE_{TA}$ = total attempts on comprehensive clinical examination was $\leq$ 2 with 64% passing score; [b]$CCE_{TA}$ = total attempts on comprehensive clinical examination was $\leq$ 2 with 75% passing score; $r_{pb}$ = point-biserial correlation; Sn = Sensitivity, Sp = Specificity; +LR = positive likelihood ratio; -LR = negative likelihood ratio; OR = odds ratio.

CCE = comprehensive clinical examination; BOC = Board of Certification

*Denotes significance at .05.

**Indicates adjustments were made with Haldane-Anscombe correction.

The next step in the process was to determine the potential interaction between the predictor variables for first-time BOC examination success. Table 31 outlines the interactions between grade point average cut-points and variables associated with a cut-

score of 64% on the CCE, and Table 32 provides a multivariable analysis of grade point average and predictor variables associated with a cut-score of 75% on the CCE.

**Table 31**

*Multivariable Analysis of Predictor Variables for First-Time BOC Examination Success with 64% Cut-Score on the CCE*

| Predictor Variables | $r_{pb}$ | Sig. (2-tailed) | Fisher's Exact Test (2-sided) | Sn | Sp | +LR | -LR | OR |
|---|---|---|---|---|---|---|---|---|
| [a]GPA & [a]$CCE_{FA}$ | .501 | < .001 | .001 | .778 | .875 | 6.224 | .143 | 24.476 |
| [a]GPA & [a]$CCE_{TA}$ | .526 | < .001 | < .001 | .800 | .875 | 6.400 | .229 | 27.972 |
| [b]GPA & [a]$CCE_{FA}$ | .414 | .002 | .004 | .578 | 1.00 | 10.286** | .449** | 23.034** |
| [b]GPA & [a]$CCE_{TA}$ | .414 | .002 | .004 | .578 | 1.00 | 10.286** | .449** | 23.034** |

[a]GPA = cumulative GPA $\geq$ 3.27; [b]GPA = cumulative GPA $\geq$ 3.42; [a]$CCE_{FA}$ = first attempt score on comprehensive clinical examination was $\geq$ 64%; [a]$CCE_{TA}$ = total attempts on comprehensive clinical examination was $\leq$ 2 with 64% passing score.

CCE = comprehensive clinical examination; BOC = Board of Certification

*Denotes significance at .05.

**Indicates adjustments were made with Haldane-Anscombe correction.

**Table 32**

*Multivariable Analysis of Predictor Variables for First-Time BOC Examination Success with 75% Cut-Score on the CCE*

| Predictor Variables | $r_{pb}$ | Sig. (2-tailed) | Fisher's Exact Test (2-sided) | Sn | Sp | +LR | -LR | OR |
|---|---|---|---|---|---|---|---|---|
| [a]GPA & [b]$CCE_{FA}$ | .414 | .002 | .004 | .578 | 1.000 | 10.286** | .449** | 23.034** |
| [a]GPA & [b]$CCE_{TA}$ | .588 | < .001 | < .001 | .778 | 1.000 | 13.786** | .242** | 57.305** |
| [b]GPA & [b]$CCE_{FA}$ | .355 | .009 | .015 | .489 | 1.000 | 8.732** | .541** | 16.220** |
| [b]GPA & [b]$CCE_{TA}$ | .414 | .002 | .004 | .578 | 1.00 | 10.286** | .449** | 23.034** |

[a]GPA = cumulative GPA $\geq$ 3.27; [b]GPA = cumulative GPA $\geq$ 3.42; [b]$CCE_{FA}$ = first attempt score on comprehensive clinical examination was $\geq$ 75%; [b]$CCE_{TA}$ = total attempts on comprehensive clinical examination was $\leq$ 2 with 75% passing score.

*Denotes significance at .05.

**Indicates adjustments were made with Haldane-Anscombe correction.

According to the data in Table 32, each combination of variables provided a specificity of 1.00. This indicates that each individual who failed the BOC examination on their first attempt also failed to meet the criteria indicated by the paired predictor variables. The combination of predictor variables with the highest sensitivity and odds ratio included a cumulative GPA of 3.27 or above and successful completion of the CCE with two or less attempts when the passing score was set at 75%. The odds of a student passing the BOC examination who met both of these criteria was 57.31 times greater than the odds of student passing the BOC examination who did not have a minimum cumulative GPA of 3.27 and score 75% or higher on their first two attempts on the CCE.

**Summary**

The results of the study indicated a positive correlation between student performance on the CCE and the BOC examination, and students who passed the CCE on

their first attempt had a significantly increased likelihood of passing the BOC examination when compared to students who required multiple attempts on the CCE. The study also showed that the strength of association between student outcomes on the CCE and the BOC examination decreased significantly when multiple attempts were required on the clinical examination, regardless of the student's final passing score. Ultimately, students requiring more than two attempts on the CCE had a significantly lower likelihood of first-time success on the BOC examination. Grade point average was determined to be highly correlated to first-time success on the BOC examination, and cumulative GPA was shown to be a better predictor variable when compared to core GPA.

A ROC curve analysis indicated an optimal cut-point for cumulative GPA and predicting first-time BOC success cumulative was 3.27. The optimal cut-score for the CCE was identified as 64% or higher, with an odds ratio of 35.83. The single variable providing the greatest odds ratio (OR = 64.50) involved a cut-score of 75% on the CCE and successful completion of the examination in two or less attempts. A multivariable analysis revealed the students with a cumulative GPA of 3.27 or greater and a passing score of 75% or higher on the CCE in two or less attempts possessed the greatest odds (OR = 57.30) for successfully completing the BOC examination on their first attempt.

The qualitative analysis indicated students' perceived value in their preparation process for the CCE, and a majority of students believed their preparation for the CCE positively impacted their performance on the BOC examination. Students commonly reported the CCE provided them with motivation to study and confidence for the BOC

examination and professional practice, and students strongly agreed that the CCE was an important component of the overall program for ensuring student preparedness.

# Chapter Five: Discussion and Reflection

## Introduction

This study was initially designed to determine the potential benefits of a comprehensive clinical examination in an athletic training program and to understand the relationship between student outcomes on the clinical examination and the BOC examination. The CCE was designed and implemented for several reasons. First, it was designed to evaluate the student's skills, clinical decision-making, and overall preparation for employment as an entry-level athletic trainer. Second, the CCE was designed to be a formative assessment for the students in their preparation for the BOC examination. Third, it was implemented to assist the athletic training program with ensuring student preparedness for the BOC examination and identifying students who would benefit from additional preparation and strategic interventions relative to areas of deficiency. By comparing and analyzing student performance on the two examinations, the study aimed to validate the CCE and provide evidence to support its continued use.

The study also aimed to evaluate other possible variables for predicting first-attempt outcomes on the BOC examination, including ACT scores, student age at time of graduation, biological sex, initial enrollment classification, cumulative GPA, and core GPA. Potential predictor variables were initially analyzed with BOC examination outcomes to determine the point-biserial correlation coefficient, and variables demonstrating the highest level of significance were further evaluated using contingency tables to determine accuracy in predicting first-attempt BOC examination performance. A ROC curve analysis was also completed for certain predictor variables to determine optimal cut-points. By determining optimal cut-points, the study hoped to identify

specific criteria that could be used in the athletic training program as admission and retention criteria. Furthermore, this information could assist the athletic training program with identifying students at risk of not performing well on the BOC examination and allow opportunities for early interventions to improve student preparedness. As mandated by the CAATE, athletic training programs are required to maintain a three-year aggregate first-time pass rate of 70% or higher to remain in good standing with accreditation. At the time of this study, 25% of athletic training programs had a three-year aggregate first-time pass rate below 70%, and findings from this study could benefit programs with regard to this criterion (CAATE, 2019).

Lastly, the study incorporated a survey for students who completed the CCE and the BOC examination. The survey included nine Likert-scale survey items to examine student perceptions of the CCE and the BOC examination. The survey also included several open-ended questions to better understand the following: (1) the student's preparation process for each examination; (2) the student's perception of the CCE as an overall assessment of knowledge and abilities; (3) the students' perception of the role the CCE played in their preparation and readiness for the BOC examination, and (4) the students' perception on the impact of the CCE on their confidence for entry-level professional practice.

**Discussion**

**Null Hypothesis 1**: Students who pass the comprehensive clinical examination on their first attempt will have no increase in likelihood of passing the BOC examination on their first attempt when compared to students who do not pass the comprehensive clinical examination on their first attempt.

The results of the study indicated that students who passed the CCE on their first attempt, as compared to those who failed their first attempt, were 23.9% more likely to pass the BOC examination on their first attempt. Based on these results, the CCE appeared to be a useful tool for predicting the likelihood of success on the BOC examination.

The passing score for the CCE in the study was 75%, and this benchmark was consistent with previous clinical examinations experienced by the students. However, following a ROC curve analysis to identify the optimal cut-score, the results indicated a passing score of 64% provided the greatest combination of test sensitivity and specificity. A cut-score of 75% resulted in accurate predictions in 69.8% of the sample and an odds ratio of 6.64. Adjusting the cut-score to 64% resulted in an overall prediction accuracy of 90.6% and an odds ratio of 35.83. When evaluating the contingency tables for both cut-scores, the greatest difference was noted in the decreased number of false-negatives when using the 64% cut-score. False-negatives were identified as individuals who failed the CCE on their first attempt but passed the BOC examination on their first attempt. However, the 64% cut-score also resulted in a 12.5% increase in the number of false-positives, resulting in an overall specificity of 62.5%. False-positives were identified as individuals who passed the CCE on their first attempt but failed the BOC examination on their first attempt. Therefore, while the overall predictive accuracy improved with the lower cut-score, programs may benefit more from using the higher cut-score. The higher cut-score resulted in a much lower sensitivity (SN = .689), but it also produced a higher specificity (SP = .750), indicating less false-positives. Additionally, students who met the 64% benchmark on their first attempt were required to retake the examination until a

score of 75% or higher was achieved. It is possible that the additional time and preparation taken by the student to meet this requirement further improved the student's preparation for the BOC examination, and this may serve as an explanation for the decreased sensitivity of the CCE with a cut-score of 75% when compared to a cut-score of 64%. Hence, if students had attempted the BOC examination after passing the CCE with a score above 64% but below 75%, the first-time pass rate on the BOC examination may have decreased, resulting in greater sensitivity and less false-negatives.

Ultimately, when used as a tool to assess BOC preparedness, it would be most beneficial to use the benchmark with the lowest false-positive rate, despite the higher false-negative rate. Thus, the CCE with a cut-score of 75% was more effective in identifying students who would not be successful on the BOC examination when compared to the 64% cut-score. The ability to accurately identify students at risk of not being successful in their first-attempt on the BOC examination is extremely valuable for all athletic training programs, as the CAATE requires accredited programs to maintain a three-year aggregate first-time pass rate of 70% to avoid disciplinary action.

The content for both examinations was based on the standard competencies in athletic training education, however the two examinations evaluated student knowledge through different mechanisms, and this may have contributed to the false-negative rate. For instance, students with a history of anxiety and poor performance on written and standardized tests may perform better on verbal exams and practical demonstrations; and students who experience increased anxiety when completing simulations and practical examinations may perform better on written examinations. Either way, the differences in

the style and delivery of each examination may have contributed to inconsistencies in student performance between the two examinations.

Within the survey, many students commented on the stress associated with the comprehensive clinical examination, and due to the stakes of the examination and the manner in which it was designed and implemented, students frequently reported it as being much more stressful than the BOC examination. From a program perspective, the test was designed to be rigorous, and it certainly does require students to demonstrate sound clinical decision-making, perform skills quickly and effectively, and maintain composure and the ability to communicate. These abilities were most important in the stations of the examination that involved case-based scenarios, rather than simple psychomotor demonstrations. The amount of stress experienced by the students may have impacted their ability to learn information during their preparation process, and it may have impacted their performance on the CCE. The surveys also revealed that a majority of students developed an increased sense of confidence for the BOC examination following their preparation and successful completion of the clinical examination. In light of these findings, additional studies within athletic training programs on the impact of simulations and comprehensive clinical examinations on stress, anxiety, and confidence are recommended.

**Null Hypothesis 2**: There will be no significant correlation between first-attempt student scores on the comprehensive clinical examination and first-time pass rates on the BOC examination.

A key objective of this study was to validate the comprehensive clinical examination by analyzing student performance on the clinical examination and the BOC

examination. To test the validity of the clinical examination, the study investigated the relationship between first-time scores on the clinical examination and first-time pass rates on the BOC examination.

The study revealed a statistically significant moderate positive correlation existed between first-attempt scores on the comprehensive clinical examination and first-time pass rates on the BOC examination. On average, students who passed the BOC examination on their first attempt scored 11.76% higher on their first comprehensive clinical examination attempt, resulting in a very large effect size ($d$ = 1.56) for the CCE. However, it was not possible to determine if a significant difference existed on the overall scores on the BOC examination between groups, because the researcher was limited to dichotomous outcomes for the BOC examination.

The study was able to determine the correlation of first-attempt scores on the comprehensive clinical examination and the specific domains on the BOC examination, and correlations of statistical significance were determined for each domain. The largest and most significant correlations were found with Domain 2 (Examination, Assessment, and Diagnosis) and Domain 4 (Therapeutic Interventions). This was anticipated as the tasks and skills required for the comprehensive clinical examination aligned best with the content in these domains. This alignment was intentional, as these two domains represented more than 50% of the questions on the examination. Domain 5 was associated with the lowest correlation and level of significance, although it was still statistically significant. This domain involved content related to knowledge and skills in healthcare administration and professional responsibility, which was not specifically

evaluated on the clinical examination. Content from Domain 5 was only represented in 13% of the questions on the BOC examination.

As previously stated, the student's overall score on the BOC examination was not available, and while it would have been possible to use the student scores in each domain to produce an overall score, this score would not have been equivalent to the student's actual composite score on the BOC examination. The percentage of questions for each domain was known, as well as the student's score in each domain, but each question on the BOC examination was assigned a weight factor that remained unknown. Without this information, any attempt to produce a composite score would have been speculative.

Additionally, while there may be a significant relationship between first-attempt scores on the comprehensive clinical examination and BOC examination outcomes, it remains unclear how the comprehensive clinical examination may have directly impacted student knowledge and abilities. Students commonly reported in the survey that the comprehensive clinical examination motivated them to study and prepare earlier than if the clinical examination was not required. Students also frequently stated that their methods for preparing for the clinical examination improved their overall knowledge and positively impacted their BOC examination outcomes. These reported techniques frequently involved case-based learning and simulations that required hands-on clinical demonstrations followed by group discussion and reflection, and Kolb's previous findings support these methods for improving knowledge and depth of understanding (A. Kolb & Kolb, 2017). In the future, additional research is recommended to evaluate the potential impact of the comprehensive clinical examination on BOC outcomes by using a test group and control group. However, the high-stakes nature of the clinical examination

in the program may be a key motivating factor for students to adequately prepare. As reported in the survey, students in the study spent about 10 hours per week over eight weeks preparing for the comprehensive clinical examination, and without the clinical examination being connected to a grade or course, it can be speculated that the student preparation process would be much different than what was reflected in this study.

**Null Hypothesis 3***:* There will be no significant correlation between student passing scores on the comprehensive clinical examination and first-time pass rates on the BOC examination.

The comprehensive clinical examination and the BOC examination both evaluated student knowledge with regard to the athletic training education competencies; however, the assessments were structured very differently. While students may have previously demonstrated a higher aptitude on one style of testing over another, it was hypothesized that the methods used by students to prepare for the clinical examination would better prepare them for success on the BOC examination. Additionally, it was hypothesized that students requiring multiple attempts to complete the clinical examination would further benefit from their continued preparation for the clinical examination with regard to their first-time performance on the BOC examination. For students requiring additional attempts on the CCE, the amount of time between each clinical examination ranged from four to eight weeks, and this was primarily dependent on the academic calendar. It was expected that students would use the allotted time to further prepare for the clinical examination, and their continued preparation for the clinical examination would positively impact their BOC examination preparedness.

The study revealed a significant positive correlation with first-attempt pass rates and first-attempt scores on the comprehensive examination with BOC examination performance, but there was no statistical significance observed when multiple attempts were permitted. As seen with the first-attempt scores on the clinical examination, the student's passing scores were most highly correlated to Domain 2 and Domain 4, but both lacked statistical significance. Interestingly, the correlations between passing scores and student performance in Domains 1, 3, and 5 were all negative, but they also lacked statistical significance. Ultimately, the repeated student exposure to the clinical examination appeared to decrease the examination's overall ability to predict BOC performance. This could be due to several reasons, including learned behaviors and reduced test performance anxiety. Students may have also used the outcomes from their failed performances to determine areas of deficiency and focused their preparation specifically within that content, or domain. It was hypothesized that additional attempts on the comprehensive clinical examination would be associated with increased preparation leading to improved knowledge of concepts in all domains, but this was not supported by the findings. However, while the overall passing scores on the CCE were not indicative of success for the BOC examination, it is still possible that it may have led to improved BOC examination performance, despite scoring under the established threshold for passing the BOC examination.

The survey utilized in the study collected feedback from the students on their time commitment and methods for preparing for the CCE, but it did not differentiate student preparation for the comprehensive clinical examination based on the attempt. Retrospectively, it would have been advantageous to ask students requiring multiple

attempts if their study habits and methods changed, and if they found certain methods more beneficial for improving their performance. This information would also provide program faculty and staff with additional details and ideas that could be used to support student learning in the future.

As previously indicated, the results of the study did not identify a significant correlation between first-time pass rates on the BOC examination and final passing scores on the CCE when multiple attempts were allowed. The results, however, did identify value in using the total number of attempts on the CCE to help predict BOC examination success. Specifically, students who successfully completed the CCE with a 75% or greater on their first or second attempt had 95% probability of passing the BOC examination on their first attempt compared to the 25% probability of passing the BOC examination for those who required more than two attempts on the CCE.

**Null Hypothesis 4**: There will be no significant correlation between student grade point average (core classes only) and first-time pass rates on the comprehensive clinical examination.

A student's grade point average provides a specific numerical indicator of how well they have performed in academic courses. The core GPA for the sample in this study included all courses identified with the athletic training (AT) prefix, in addition to several required courses in biology, chemistry, health, nutrition, psychology, and math. Collectively, this included 101 credit hours. It was hypothesized that students with a higher core GPA would be more likely to be successful on their first-attempt on the comprehensive clinical examination, and this was supported by the study results. It was also speculated that core GPA would be more closely linked to success on the

comprehensive clinical examination when compared to the cumulative GPA, but this was not supported by the findings.

The results indicated the student's core and cumulative GPA both had a significant positive correlation with first-time pass rates on the clinical examination and first-time scores on the clinical examination. When separated into groups based on first-time performance on the CCE (pass or fail), significant differences in both core and cumulative GPA were observed. Students who passed the comprehensive clinical examination on their first attempt (n = 33) earned an average core GPA of 3.50 (SD = .29) and an average cumulative GPA of 3.54 (SD = .28). In comparison, students who failed their first attempt (n = 20) on the comprehensive clinical examination achieved an average core GPA of 3.22 (SD = .27) and an average cumulative GPA of 3.27 (SD = .27). The study also showed a statistically significant negative correlation between both core and cumulative grade point averages and the total number of attempts required by students to successfully complete the clinical examination. Thus, lower grade point averages were associated with more attempts required on the comprehensive clinical examination.

**Null Hypothesis 5**: There will be no significant correlation between student grade point average (core classes only) and first-time pass rates on the BOC examination.

It was expected that core GPA would be highly correlated to BOC performance, and the findings of the study support this hypothesis. This finding is consistent with previous research supporting grade point average as a strong predictor variable for first-time BOC examination performance (Bruce et al., 2019; Middlemas et al., 2001). It was also expected that core GPA would be more closely associated with BOC examination

outcomes due to the specific nature of the test design and its relationship to content only instructed and evaluated in the core courses. However, it was determined that cumulative GPA was a slightly better indicator of first-time BOC examination success when compared to core GPA. Based on this determination, cumulative GPA was identified as a better predictor variable and was studied further with a ROC curve analysis to determine an optimal cut-point for predicting first-time BOC examination success.

The ROC curve analysis identified two distinct cumulative GPA cut-points as strong predictors of first-time BOC examination success, and both have their advantages for assisting the program in making data-driven decisions. First, a cumulative GPA of 3.42 provided a perfect specificity of 1.00, but the sensitivity was only .578. Second, a cumulative GPA of 3.27 provided a much lower specificity of .250, but the sensitivity increased to .822. A cumulative GPA cut-point of 3.42 had the greatest ability to identify individuals who were most likely to pass the BOC examination on their first attempt, and a cut-point of 3.27 was more useful in identifying individuals who were likely to fail the BOC examination on their first attempt. When deciding to use GPA cut-points for program decisions regarding selection and retention criteria, it will be important for programs to understand these key differences. Programs seeking to improve enrollment may benefit from using a lower cut-point as their selection and retention criteria, but these programs should plan to closely monitor students below the higher cut-point and recommend intervention strategies throughout the curriculum to further support these students. Programs with larger enrollments and the ability to be more selective in their admission process would benefit more from utilizing the higher GPA cut-point.

The results from this study represent a single program and institution, and there may be significant differences in core and cumulative grade point averages observed in other programs. Thus, each program should conduct an internal investigation of core and cumulative grade point averages to determine which variable would be more useful in making decisions related to the program and individual students. Moving forward, the decision to use core or cumulative GPA will be less of a concern as the CAATE has mandated all programs must be taught at the graduate level. Following the fall of 2022, no undergraduate programs will be permitted to accept any additional undergraduate students into an undergraduate athletic training program. Additional research is recommended within programs to determine what type of GPA and what GPA value has the greatest ability to predict retention and success within the program. Programs can choose to use an overall college GPA or a GPA specific to only prerequisite courses to make program admission decisions. Either way, it is recommended that GPA cut-points are determined through an analysis of historical academic performance and student outcomes specific to the institution. This will not be possible in the first several years for new programs, and many new programs will utilize admission standards that are common across similar institutions, but there should be a consideration for adjustments as program data is collected over time.

**Research Questions**

*Research Question 1:* What is the student preparation process for the comprehensive practical examination?

According to the results of the student survey, students dedicated a significant amount of time preparing for the comprehensive clinical examination. On average,

students spent approximately 10 hours each week over an eight-week period preparing for the clinical examination. There were no differences in reported study time between students who passed the clinical examination on their first attempt and students who failed the clinical examination on their first attempt. Furthermore, there were no significant differences in dedicated study time when factored by age, enrollment type (i.e., first-time freshman or transfer), biological sex, or grade point average.

Survey respondents indicated a variety of methods to prepare for the comprehensive clinical examination, and the most common theme involved collaborating with other students. Students commonly reported practicing skills with fellow classmates, designing scenarios to test each other's knowledge, and discussing with each other how they would manage certain conditions and scenarios. A variety of other study techniques were also used by students when working on their own, including reading content from textbooks, reviewing previous clinical examinations, and examining the key aspects of the NATA position statements for managing specific conditions commonly seen in the field of athletic training.

*Research Question 2:* What is the student preparation process for the Board of Certification examination?

Of the survey respondents (n = 33) providing information about time spent studying and preparing for the BOC examination, 26 passed on their first attempt, and only two required additional attempts. On average, students who passed the BOC examination on their first attempt spent approximately eight hours per week over a period of eight weeks preparing for the examination. Students who failed the BOC examination

on their first attempt spent an average of four weeks preparing for the examination, but again, this only included data from two individuals who responded to the survey.

Students were most likely to prepare for the BOC examination by reading course textbooks and completing practice exams. Many students designed a study calendar, and while the calendar was reported as being beneficial, most students reported a lack of compliance with their plan. Despite their lack of reported compliance with the study calendar, the process of developing a study plan with a timeline may have helped students to appreciate the breadth of the competencies and the time required to adequately review the content identified in each of the athletic training domains.

The majority of students stated they began focusing on their BOC examination preparation after successfully completing the CCE. Thus, it is possible that the CCE could delay students from preparing for the BOC examination. However, students more commonly reported that the CCE was a motivating factor for them to begin reviewing content and material, and without the CCE, students would not have initiated their study plans until a much later date.

*Research Question 3:* How do students perceive the value of the comprehensive clinical examination as a preparation tool for the BOC examination?

The majority of students reported the CCE had a positive impact on their BOC preparedness and performance, and they provided numerous points to support their belief. First, many students commented on the methods they used to prepare for the CCE and how these methods improved their overall knowledge and depth of understanding. While there are distinct differences in the manner in which the CCE and BOC examination assess student knowledge, the content in each examination is grounded in the same

athletic training education competencies. In addition to improving knowledge, skills, and abilities, many students reported that the CCE improved their ability to manage stress, maintain composure, and think critically despite the added pressure. Students also reported an increase in confidence when taking the BOC examination after having successfully completed the CCE.

Lastly, students believed the CCE was a key motivating factor for them to remain focused during their last year in the program. Students commonly stated that without the CCE, they would have postponed their study plans for the BOC examination to a much later date. The CCE required the students to begin reviewing content and evaluating their depth of understanding with the content much sooner. Many students also stated their results and feedback from the CCE, as well as their methods for preparing for the CCE, helped them understand areas of weakness that required additional time and focused attention. Students frequently reported that after successfully completing the CCE, they felt more prepared and confident for the BOC examination, and they used the additional time before the BOC examination date to address areas of deficiency.

*Research Question 4*: How do students perceive the value of the comprehensive clinical examination as a tool for improving professional preparedness?

Students largely reported their successful completion of the comprehensive clinical examination increased their confidence for entry-level practice as a clinical athletic trainer. Passing the examination was noted by students as directly impacting their confidence, but students also commented that their preparation process for the CCE had a positive impact on their professional preparedness. Many students believe the examination improved their ability to manage their time, identify their professional

deficiencies, develop a plan for improving their performance, and manage stressful situations. Students also believed the CCE improved their confidence in making the clinical decisions and providing explanations to support these decisions.

Additional research is necessary to better understand the impact of the CCE on professional preparedness, and research should focus on the different athletic training practice domains. Preparation and successful completion of the CCE may be more likely to increase confidence and professional preparedness in certain content areas, such as diagnosis, emergency care, and rehabilitation. Other content areas, such as nutrition, psychosocial behaviors, and administration may be less impacted by implementation of the CCE.

**Practical Implications and Recommendations**

The outcomes of the study provide evidence to support the continued use of the CCE at the studied university, and implementation of the CCE in other programs could be beneficial for a variety of reasons. First of all, student performance on the CCE was shown to be highly associated with first-time student outcomes on the BOC examination.

The odds of an individual who successfully completed the CCE with a score of 75% or higher and two attempts or less and passing the BOC examination was 65 times greater than the odds of an individual passing the BOC examination after requiring three or more attempts on the CCE. The probability of first-time success on the BOC examination for students requiring less than two attempts on the CCE was 95.6%. The probability of first-time success on the BOC examination for students requiring more than two attempts on the CCE was 25%.

Secondly, students in the study frequently reported the CCE positively impacted their overall preparation and performance on the BOC examination. The CCE provided students a source of motivation to remain focused in their final year, and it promoted students to review a large amount of the principles learned throughout their enrollment in the program. The CCE also motivated students to review the material in a holistic manner and focus on the application of the principles in authentic situations. Additionally, many of the methods commonly used by students to prepare for the CCE have been consistently recognized as a high-impact practice within education, including simulations, case studies, and student-developed scenarios for role playing (Edler et al., 2017). Test preparation methods that promote a deeper understanding of the content may certainly lead to improved performance on the CCE and BOC examination, and these techniques have been correlated to reduced text anxiety (Cipra & Muller-Hilke, 2019). The reduction in test anxiety may also have an impact on examination outcomes, and additional studies are warranted to better examine this relationship.

As the number of undergraduate programs continues to decline and graduate degree programs develop for athletic training education, it will be important to reassess the student perceptions of the CCE. This student sample in this study were all from a single undergraduate program, and additional research on the utilization of a CCE should be conducted at the graduate level. Traditionally, the undergraduate programs were taught over a three-year period, and the graduate programs will typically be taught over a two-year period. Considering the difference in the amount of time in the program, the increased course rigor expectations of student performance, and the increase in the

anticipated age and maturity of students in graduate programs, student perceptions of the CCE may change.

In addition to the positive impact of the CCE on student development, athletic training programs can also benefit from the CCE as an assessment tool from both a formative and summative perspective. As a formative assessment, the CCE can provide programs an opportunity to evaluate student knowledge and abilities and use the results of the examination to provide individualized recommendations for each student. Formatively, the CCE can also function as an assessment tool within the program and provide program administrators and faculty with feedback on how well the didactic and clinical aspects of the program are preparing students to function as an entry-level athletic trainer. As a summative student assessment, the correlation between the CCE and the BOC examination supports the use of the CCE as a screening tool for predicting first-time performance on the BOC examination. Individual results from the CCE can be used by the program to make individualized remediation plans for students and support their continued overall development. The CAATE requires all accredited programs to demonstrate a 70% first-time pass rate average pass rate over each three-year period, and programs failing to maintain this pass rate are placed on probation by the CAATE. Thus, it is imperative for programs to identify methods for evaluating students in a comprehensive manner throughout the program, and the CCE provides an additional tool for assessing BOC preparedness as well as an opportunity to determine student deficiencies and offer remediation.

The program in this study required a cumulative GPA of 2.75 and a core GPA of 3.00 to remain in good standing. In retrospect, and based on the findings of the study, it is

recommended that programs use a higher GPA benchmark and provide structured remediation and intervention strategies for any student achieving a cumulative GPA below 3.27. This was an interesting finding, as many new and developing athletic training programs at the graduate level have identified a cumulative GPA of 3.25 and 3.30 as part of their program's eligibility criteria (University of Indianapolis, n.d.; University of Iowa, n.d.; Wayne State University, n.d.). As the undergraduate program in the study transitions to a graduate degree program, it is recommended to require a cumulative college GPA of 3.30 for admission.

The program in this study allowed an unlimited number of attempts to successfully complete the CCE with a 75% or higher. Despite the number of false negatives associated with this benchmark, a required score of 75% or higher had the greatest ability to identify students with the lowest probability of first-time success on the BOC examination. Therefore, it is recommended to continue the use of a cut-score of 75% on the CCE. Additionally, the number of attempts required by students to successfully complete the CCE was an important variable when predicting first-time BOC examination success. The findings of the study support formal remediation for any student requiring more than two attempts on the CCE.

Programs interested in using a CCE should dedicate substantial time into the development of the examination and training of all test administrators, including the proctors and models. Furthermore, program administrators should consider providing compensation for all test administrators, and this should be considered when planning and examining the program budget. Providing some form of compensation may prove beneficial for recruiting professionals with the necessary experience, expertise, and

availability. Additionally, participants should be expected to dedicate a considerable amount of time in attending training meetings, providing input on test items, reviewing grading rubrics, and rehearsing case demonstrations. It is also recommended for programs to identify and target professionals with specific expertise and assign their roles in the examination accordingly. Lastly, the studied program, as well as any program using a CCE should maintain accurate records of test outcomes for each test item and conduct an analysis of test reliability since multiple versions of the test will be required. Test items providing good internal consistency can be maintained in a comprehensive test bank and utilized to make countless variations of the examination with different combinations of test items without a significant concern for reliability between the alternate forms.

Programs can also consider using a CCE at multiple points throughout the program to evaluate student performance and provide formative feedback. As programs continue to transition to the graduate level, a CCE could be used at the end of the first year in a graduate program, as well as at the end of the final year. The initial CCE could be used as a low-stakes examination to provide feedback on strengths and weaknesses, or it could be used as part of the program's retention criteria for continuing within the program into the second year and determining the need for enrollment in formal remediation. The comprehensive nature of the examination, as well as the additional stress imposed by the examination, may facilitate improved learning. Students may have increased motivation to reflect on their knowledge and abilities, and it may improve their habits for preparing for future examinations. Additionally, repeated exposure to this type of test may decrease test anxiety, improve test-taking confidence, and lead to a positive

impact on their professional confidence and level of participation in their clinical experiences.

**Limitations**

While the results of this study may suggest certain benefits of the comprehensive clinical examination, the non-randomized convenience sample lacks generalizability. The convenience sample used in this study represented one accredited undergraduate athletic training program delivered at two campus locations. The sample was also limited to students who successfully completed the comprehensive clinical examination and attempted the BOC examination. During the time of this study, several students never achieved a passing score on the comprehensive clinical examination, and they never attempted the BOC examination. Despite it being hypothesized that these students would have not been successful in their first attempt on the BOC examination, this question remains unanswered for this student population. The sample used in this study also represented four different academic cohorts, each admitted into the athletic training program in a different academic year. During these four years, there were changes within the university, curriculum, and overall instruction of the material within the athletic training program being studied, and these factors may have impacted student performance on one or both of the examinations.

One of the primary objectives of the study was to determine the relationship and strength of association between student performance on a comprehensive clinical examination and the BOC examination. A high correlation between student scores on the two examinations would have helped establish predictive validity for the comprehensive clinical examination. However, the request for student overall scores on the BOC

examination from the BOC was denied. The CAATE does provide program directors with access to student outcomes (i.e., percentages) within each domain, but the student's overall BOC score is based on a scaled system that utilizes different weighting factors for each question. Thus, these percentages cannot be used to determine the overall score. A correlation between the two examinations was still determined, but this was limited to a point-biserial correlation, which is used to measure the correlation between one continuous variable and one dichotomous variable. In this correlation, the continuous variable was the student score on their first attempt on the comprehensive clinical examination, and the dichotomous variable was the student outcome on their first attempt on the BOC examination (i.e., pass or fail).

The comprehensive clinical examination was designed to evaluate the student's overall ability to perform the skills and demonstrate the knowledge of an entry-level athletic trainer. The examination incorporated specific scenarios and student demonstrations that aligned with the 7th edition of the *Practice Analysis* (Henderson, 2015), and each section was reviewed for content validity by a panel of experts. At the time of the study, no other research had been conducted on validity of the comprehensive clinical examination. Multiple variations of the examination were used throughout the study to prevent the sharing of test information between students, and despite steps to improve reliability across the different versions of the examination, questions can be raised regarding reliability. To improve reliability, content areas, grading rubrics, and test delivery remained the same for all four cohorts; but different test items and test scenarios were developed within each of the content areas. For each test item, content validity was consistently established by a panel of experts.

The comprehensive clinical examination was delivered to each cohort in a station-based model with different models and proctors at each station. All test administrators, models and proctors, received the finalized version of the examination a minimum of 72 hours before the examination date to ensure proper preparedness. Furthermore, all test administrators participated in a training session or meeting with the program director to review testing procedures, grading rubrics, and other aspects of the test to prevent evaluator bias and improve inter-rater reliability. Additional tests on inter-rater reliability were not completed as a part of this study.

Retrospectively, the researcher did investigate the reliability of the different versions of the test by comparing variance within each section across the versions. It was accepted by the researcher that the sample populations for each test version were not randomly selected, and there was no attempt to control multiple covariates that may have impacted performance within each group. These covariables included the student's primary campus, cumulative GPA, core GPA, clinical experiences, previous academic performance on practical examinations, and many others.

To assess reliability between the different versions of the exam, an analysis of variance (ANOVA) with Levene's test was initially performed. According to the concept of parallel forms reliability, different variations of a test produce scores that have the same mean and variance to be considered parallel, or equivalent. Levene's test concluded the assumption of homogeneity of variance was violated and significant differences in the variance of the means was present in nearly each section of the test when compared across the different versions (see Table 33).

**Table 33**

*Levene's Test for Homogeneity of Variance Between Alternate Versions of the Comprehensive Clinical Examination*

| Section of the Examination | Levene Statistic | df1 | df2 | Sig |
|---|---|---|---|---|
| Palpations | 1.335 | 6 | 46 | .261 |
| Taping | 7.194 | 6 | 46 | .280 |
| Orthopedic Testing | 4.903 | 6 | 46 | .001* |
| Neurological Testing | 2.921 | 6 | 46 | .017* |
| Joint Mobilizations | 6.470 | 6 | 46 | .000* |
| Manual Muscle Testing | 5.278 | 6 | 46 | .000* |
| Goniometry | 4.044 | 6 | 46 | .002* |
| Therapeutic Interventions | 2.821 | 6 | 46 | .003* |
| Acute Care | 2.313 | 6 | 46 | .049* |
| Emergency Evaluation and Management | 3.525 | 6 | 46 | .006* |
| Orthopedic Evaluation | 1.971 | 6 | 46 | .089 |

*Denotes significance at the .05 level.

Due to the violated assumption of equal variance across samples, the Games-Howell post-hoc test was completed to compare mean differences in outcomes on each section of the examination between all possible combinations of the test versions. Table 34 provides a list of the significant findings identified in the Games-Howell post-hoc test.

**Table 34**

*Games-Howell Test for all Versions of the Comprehensive Clinical Examination*

| Dependent Variable | (I) Version | (J) Version | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Neurological Testing | 2 | 6 | -.24185 | .06429 | .023 |
| | 3 | 6 | -.31723 | .04622 | .000 |
| Manual Muscle Testing | 2 | 3 | -.20615 | .06062 | .046 |
| | 2 | 6 | -.29585 | .05857 | .003 |
| | 2 | 7 | -.29785 | .06175 | .003 |
| | 4 | 6 | -.15450 | .02450 | .001 |
| | 4 | 7 | -.15650 | .03134 | .013 |
| Goniometry | 2 | 3 | -.22385 | .05819 | .021 |
| | 2 | 4 | -.21548 | .06360 | .042 |
| Therapeutic Interventions | 2 | 3 | -.24308 | .05708 | .006 |
| | 2 | 6 | -.32831 | .05867 | .001 |
| | 2 | 7 | -.33431 | .05559 | .000 |
| | 3 | 5 | -.14077 | .03590 | .016 |
| | 4 | 6 | -.17600 | .04343 | .027 |
| | 4 | 7 | -.18200 | .03917 | .009 |
| Acute Care | 3 | 5 | -.39231 | .08185 | .005 |
| | 3 | 7 | -.42231 | .07437 | .001 |

*Note*. Table only includes data that provided p-values < .05.

The Games-Howell post-hoc test revealed no statistical significance in variance of means across the different versions of the test for the following sections: taping; palpations; orthopedic tests; joint mobilizations; emergency evaluation and management; and orthopedic evaluation. Significant differences were noted between the following sections when compared across all versions: neurological tests; manual muscle tests; joint mobilizations; goniometry; therapeutic interventions; and acute care. Based on the results, 52.9% (9 of 17) of the cases involving significant variance were related to version 2. Version 2 was provided to the first cohort included in the study and included a sample of 13 students from one of the campuses represented in the study. Table 35 provides a summary of the sample associated with each version of the examination. As illustrated in Table 35, different versions of the examination were provided to different groups of students, but as stated previously, group allocation was not randomized.

**Table 35**

*Descriptive Analysis of Samples for Versions of Comprehensive Clinical Examination*

| Version | Cohort | Campus | n |
|---|---|---|---|
| 1 | 2016-2017 | 1 | 3 |
| 2 | 2016-2017 | 2 | 13 |
| 3 | 2017-2018 | 1 | 1 |
| | | 2 | 12 |
| 4 | 2018-2019 | 1 | 3 |
| | | 2 | 5 |
| 5 | 2018-2019 | 2 | 6 |
| 6 | 2019-2020 | 1 | 2 |
| | | 2 | 3 |
| 7 | 2019-2020 | 2 | 5 |

*Note*. Cohort described the student's expected graduation. Campus differentiated which campus the student attended, as the program was approved to offer the entire curriculum at multiple sites.

Based on the results of the Games-Howell post-hoc test, all significant differences involved a decrease in variance when compared to a version of the examination offered to subsequent cohorts. Due to this fact, it is important to recognize the changes in overall student performance during the four years represented in the study data. Average student scores on the clinical examination increased by 4.6% from the 2016-2017 cohort to the 2017-2018 cohort. Overall student performance increased by another 3.7% from the 2017-2018 cohort to the 2018-2019 cohort. Additionally, the standard deviations for overall test scores in the first three cohorts decreased respectively from .088, to .069, to .054. The curriculum utilized test outcomes to make data-driven decisions and implement focused interventions to improve common areas of deficiency. Additionally, students in the more recent cohorts had an increased knowledge of the examination design, performance expectations, and grading rubrics when compared to the earlier cohorts; and this may have also been associated with improved performance and decreased score variation on the examination for later cohorts.

**Recommendations for Future Research**

This study was based on the implementation of a comprehensive clinical examination in an undergraduate athletic training program at a single institution. Based on a decision by the CAATE, no undergraduate programs will be allowed to accept new undergraduate students into the program beyond the Fall 2022 Semester. Beyond this point in time, students interested in pursuing a degree in athletic training will be required to enroll in a graduate athletic training program that culminates with the awarding of a master's degree. Due to this significant change, additional research should be conducted in a graduate degree program. Additionally, it would be advantageous to recruit multiple programs into future studies and utilize the same clinical examinations for each cohort at different institutions.

Student surveys in the study provided evidence that a comprehensive clinical examination can motivate students and lead to improved knowledge, skills, and abilities through the students' various methods of preparation. However, the CCE was also reported to increase anxiety and create a significant amount of stress for the students. In the future, additional studies are recommended on the impact of simulations and comprehensive clinical examinations on stress and anxiety. Appropriate levels of stress have been shown to lead to improved learning and performance, but increasing levels of stress can also lead to negative effects on a student's cognitive performance, as well as their physical, emotional, and psychological well-being (Vogel & Schwabe, 2016). It would be beneficial to better understand the psychological impact of the CCE on students, how this stress effects their well-being, and how it may impact their performance on the CCE. Additional studies are also warranted in the areas of time

management, grit, and perseverance, and how these characteristics are associated with the student's preparation process for the CCE, as well as the examination itself. Previous research has shown that different approaches to learning are correlated to test anxiety (Cipra & Muller-Hilke, 2019), and while the CCE is intended to promote students to develop a deeper understanding of the content, programs must be adequately prepared and trained to provide effective coping strategies for surface learners and other at-risk students. Lastly, future studies on high-stakes simulations and comprehensive examinations can be designed to investigate the differences in student perceptions of stress and anxiety with the CCE and BOC examination.

The study also investigated common variables that have been previously researched as possible predictors for first-time success on the BOC examination. One of the more commonly studied predictor variables in athletic training, as well as other health care fields was grade point average (Luedtke-Hoffmann et al., 2012). The findings of this study support a cumulative GPA of 3.30 as a requirement for admission and retention in an athletic training program, however additional research will need to be conducted in a graduate level program. Specifically, research will need to determine if cumulative GPA remains a better predictor of success when entering a graduate degree athletic training program or if other GPA-based metrics are better predictors of retention and future success. As of 2020, the CAATE required all students entering an athletic training program to have completed prerequisite courses in biology, chemistry, physics, psychology, anatomy, and physiology at the university level. It is recommended for programs to collect internal data on cumulative GPA and prerequisite GPA to determine

the potential for these variables to predict retention within the program and successful completion of the BOC examination.

**Conclusions**

The findings of the study suggest the implementation of a comprehensive clinical examination in an undergraduate athletic training program can positively impact student performance on the BOC examination and confidence for professional practice. Students reported the CCE motivated them to continue learning while evaluating their depth of understanding, and the majority of students believed their study methods for preparing for the CCE improved their knowledge, skills, and abilities with regard to the athletic training education competencies. Student performance on the CCE and cumulative grade point average were both shown to be valuable predictors of student performance on the BOC examination. Athletic training programs can use these predictor variables to make programmatic decisions regarding retention criteria and individualized intervention strategies, or remediation. Additional research is necessary to examine different intervention strategies and how these strategies can improve student performance in an athletic training program and on the BOC examination. Ultimately, this may lead to improved first-time pass rate statistics associated with the BOC examination. Institutions of higher education are experiencing increased pressure to improve student outcomes, including graduation and employment rates, and athletic training programs are required by the CAATE to maintain a 70% three-year aggregate first-time pass rate on the BOC examination. The CCE can provide an opportunity for both institutions and athletic training programs to meet these expectations while simultaneously supporting the academic, clinical, and professional development of the student.

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# Appendices

## Appendix A: Comprehensive Clinical Examination - Sample

## Taping/Wrapping/Bracing

- Score = / 15
- 10% of Total Grade

**Verbal Instructions:** To properly evaluate your ability to provide prophylactic taping, padding, bracing, and wrapping techniques in the field of athletic training, you will be presented with three conditions. Please select and demonstrate the most appropriate method to protect the area and/or assist in rehabilitation. You will be graded on technique, application, effectiveness, and efficiency.

**TECHNIQUE**: Perform the prophylactic closed basket weave for a football player as he prepares for a game. **You will have three minutes.**

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Used correct patient and joint position | 1 | 0 | 0 | |
| Selected an appropriate technique | 1 | 0 | 0 | |
| Application was clean, effective and functional (identified by Standardized Patient, SP) | 2 | 1 | 0 | |
| Completed in allotted time | 1 | 0 | 0 | |

**TECHNIQUE:** Perform a taping technique to protect a 1st degree UCL sprain of the elbow in a football linebacker. Please make sure this technique is functional, yet significant enough to protect the area during a game. **You will have 5 minutes.**

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Used correct patient and joint position | 1 | 0 | 0 | |
| Selected an appropriate technique | 1 | 0 | 0 | |
| Application was clean, effective and functional (identified by Standardized Patient, SP) | 2 | 1 | 0 | |
| Completed in allotted time | 1 | 0 | 0 | |

**TECHNIQUE**: A soccer player presents with chronic pain throughout the longitudinal arch. Demonstrate what you would do to alleviate the athlete's symptoms and support the area for a game. **You will have three minutes.**

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Used correct patient and joint position | 1 | 0 | 0 | |
| Selected an appropriate technique | 1 | 0 | 0 | |
| Application was clean, effective and functional (identified by Standardized Patient, SP) | 2 | 1 | 0 | |
| Completed in allotted time | 1 | 0 | 0 | |

## Palpations

- Score = / 15
- 10% of Total Grade

**Verbal Instructions:** To properly evaluate your ability to identify, locate, and palpate key anatomical structures, fifteen landmarks will be selected for you to palpate. After being notified of each palpation, please place one of the adhesive labels on the landmark. Labels should be placed directly on the skin, and the center of the sticker should correspond with the center of the landmark, or structure.

| SKILL/OBJECTIVE | YES | NO |
|---|---|---|
| Anterior talofibular ligament | 1 | 0 |
| Peroneal tubercle | 1 | 0 |
| Insertion of the MCL | 1 | 0 |
| Triquetrum | 1 | 0 |
| Pes anserine | 1 | 0 |
| Bicipital groove | 1 | 0 |
| Dorsal pedal pulse | 1 | 0 |
| Erb's point (brachial plexus) | 1 | 0 |
| Insertion of the supraspinatus | 1 | 0 |
| Posterior tibiotalar ligament | 1 | 0 |
| Trapezium | 1 | 0 |
| Acromion | 1 | 0 |
| Origin of the plantar fascia | 1 | 0 |
| Cubital tunnel | 1 | 0 |
| Calcaneal bursa | 1 | 0 |

## MMT

- Score = / 15
- 5% of Total Grade

**Verbal Instructions:** To properly evaluate your ability to utilize manual muscle tests, you will be presented with three different muscles. You will be graded on your ability to demonstrate the appropriate manual muscle testing technique for each muscle as they would be used in the evaluation process. You will have five minutes to complete all tests.

**Model Notes:** Students will be required to score each MMT. Students should perform the test bilaterally in order to best assign a score. Models should adjust the strength demonstrated for each test in order to fully test the student's understanding of the grading scale. I have provided the score to be demonstrated for each muscle. We will be using the 5-point +/- scale.

**Muscle**: Biceps femoris (5)

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Uses the correct patient and joint position | 2 | 1 | 0 | |
| Effectively demonstrates the technique (as confirmed by the SP) | 2 | 1 | 0 | |
| Assigns the correct score | 1 | 0 | 0 | |

**Muscle**: Peroneal longus (4-)

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Uses the correct patient and joint position | 2 | 1 | 0 | |
| Effectively demonstrates the technique (as confirmed by the SP) | 2 | 1 | 0 | |
| Assigns the correct score | 1 | 0 | 0 | |

**Muscle**: Teres Minor (3)

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Uses the correct patient and joint position | 2 | 1 | 0 | |

| | | | | |
|---|---|---|---|---|
| Effectively demonstrates the technique (as confirmed by the SP) | 2 | 1 | 0 | |
| Assigns the correct score | 1 | 0 | 0 | |

## Orthopedic Tests

- Score = / 12
- 10% of Total Grade

**Verbal Instructions:** To properly evaluate your ability to perform orthopedic special tests and selective tissue tests, you will be provided with three separate conditions. For each condition, select and demonstrate the best test for you to assess this condition. Include a description of the positive findings for your selected tests. Please consider this an authentic situation, and understand the importance of performing the test properly, in a manner that would produce a positive test in a true patient. You will have five minutes to complete all demonstrations.

**Condition**: Tarsal tunnel syndrome
**Evaluator Note Only:** Student can perform Tinel's sign or the dorsiflexion/eversion test

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Accurately states the performed test for the condition | 1 | 0 | 0 | |
| Correctly performs test (as confirmed by SP) | 2 | 1 | 0 | |
| Correctly states the positive findings | 1 | 0 | 0 | |

**Condition**: SLAP lesion
**Evaluator Note Only:** Examples of tests that may be performed include, but are not limited to the following: biceps load test I and II, O'Brien's test, compression rotation test, dynamic labral shear test, anterior apprehension test, crank test, and anterior slide test

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Accurately states the performed test for the condition | 1 | 0 | 0 | |
| Correctly performs test (as confirmed by SP) | 2 | 1 | 0 | |
| Correctly states the positive findings | 1 | 0 | 0 | |

**Condition**: Ulnar collateral ligament sprain (elbow)

**Evaluator Note Only:** Examples of tests that may be performed include, but are not limited to the following: valgus stress test, moving valgus test, and milking maneuver

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Accurately states the performed test for the condition | 1 | 0 | 0 | |
| Correctly performs test (as confirmed by SP) | 2 | 1 | 0 | |
| Correctly states the positive findings | 1 | 0 | 0 | |

## Joint Mobilization

- Score = / 8
- 5% of Total Grade

**Verbal Instructions:** To properly evaluate your ability to assist in the rehabilitation of an injury, you will be presented with a goal for improving a specific range of motion of a joint. You will be graded on your ability to select and demonstrate the appropriate joint mobilization technique for achieving the desired goal. You will have two scenarios and five minutes to complete both demonstrations.

**Goal**: Improve knee extension
**Evaluator Note Only:** Student should demonstrate an anterior tibial glide or posterior femoral glide

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Uses the correct patient and joint position | 2 | 1 | 0 | |
| Demonstrates an effective technique (as confirmed by the SP) | 2 | 1 | 0 | |

**Goal**: Improve shoulder internal rotation
**Evaluator Note Only:** Student should demonstrate a posterior humeral glide

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Uses the correct patient and joint position | 2 | 1 | 0 | |
| Demonstrates an effective technique (as confirmed by the SP) | 2 | 1 | 0 | |

## Goniometry

- Score = / 16
- 5% of Total Grade

**Verbal Instructions:** To properly evaluate your ability to utilize a goniometer in the evaluation and rehabilitation of an injury, you will be asked to perform two range of motion measurements. After each measurement is performed, you will need to state your findings, as well as the normal/expected values, and show the goniometer to the evaluator. You will be graded on your technique and understanding of the normal range of motion. You will have six minutes to collect the two measurements.

**Motion**: Passive extension of the knee

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Uses the correct patient and joint position | 2 | 1 | 0 | |
| Effectively uses the goniometer (i.e., placement, alignment) | 2 | 1 | 0 | |
| Correctly reads the goniometer | 2 | 0 | 0 | |
| Correctly states the normal (anticipated) measurement | 2 | 0 | 0 | |

**Motion**: Active flexion of the shoulder

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Uses the correct patient and joint position | 2 | 1 | 0 | |
| Effectively uses the goniometer (i.e., placement, alignment) | 2 | 1 | 0 | |
| Correctly reads the goniometer | 2 | 0 | 0 | |
| Correctly states the normal (anticipated) measurement | 2 | 0 | 0 | |

## Acute Care

- Score = / Points vary by scenario
- 5% of Total Grade

**Verbal Instructions:** For the Acute Care portion of the exam, you will be presented with a scenario and a condition requiring immediate acute care. The purpose of this scenario is to assess your ability to provide effective management for an acute musculoskeletal injury. You are expected to treat the patient as if this was an authentic situation, but you will not complete a full injury evaluation. Rather, the condition (e.g., elbow dislocation) will be verbally presented to you early in the scenario by the evaluation team. Please be thorough but work quickly in the management of this situation. You will be graded on your ability to communicate with the athlete and your management of the patient condition. If there are no questions, we will now present the scenario and provide the necessary instructions.

**Primary instructions before entering the room:** "You are working a college volleyball game and see a player on the visiting team land awkwardly after attempting a block. As you enter the room, imagine you are coming off the bench to attend to the injured athlete. Understand that this scene is taking place on the court and you will be responsible for initial injury management and patient transportation."

**Secondary instructions (provided after reaching the patient and establishing contact):** The student should approach the athlete and establish communication. After establishing contact with the patient, you should state, "Upon evaluation of the lower leg on the court, it is determined the individual suffered a fracture of the tibia and fibula."

**Evaluator Notes:** Please make sure the student demonstrates/states how they would remove the individual from the court. This should include a demonstration of how the individual is picked up and transported to the athletic training room next to the court. You can identify a table on the other side of the room as the area you would like the individual to be moved to.

**Model Notes:** Present as an athlete in acute distress and significant pain. You should be holding the leg and unwilling to move. Position the knee in slight flexion. If asked, you are on the visiting team. Follow the student's instructions and answer the student's questions in a similar manner to how you would expect an athlete to respond/act. If the student states they would call 9-1-1 and wait for an ambulance to move you, please tell the student you want to get off the court. You can appear frustrated if they do not help you. If not yet discussed, after being removed from the court, ask the student for the immediate management plan (i.e., ER, ambulance, etc…). If asked, you can say there is an assistant coach who is able to leave the event to assist you.

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Establishes communication with patient | 2 | 1 | 0 | |
| Assesses patient status | Provided by Evaluator | | | |

| | | | | |
|---|---|---|---|---|
| Chooses appropriate resources (i.e., splints) | 2 | 1 | 0 | |
| Effectively manages condition (i.e., applies splint, checks pulse) | 2 | 1 | 0 | |
| Reassures patient throughout process | 2 | 1 | 0 | |
| Effectively moves/transports patient | 2 | 1 | 0 | |
| Identifies best course of action (i.e., EMS, home, ER, specialist) | 1 | 0 | 0 | |

## Neurological Tests

- Score = / Points vary by scenario
- 5% of Total Grade

**Verbal Instructions:** To properly evaluate your ability to conduct neurological tests as part of a routine examination, you will be presented with two different conditions and asked to complete various tests regarding the condition.

**Your first condition is a mild traumatic head injury, or mTBI.** You will be provided with three cranial nerves by number. Perform a test for each cranial nerve and state the name of the respective cranial nerve.

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| **Cranial Nerve VI** | | | | |
| **Name:** Abducens | 2 | 1 | 0 | |
| **Test:** Lateral eye movement | 2 | 1 | 0 | |
| **Cranial Nerve V** | | | | |
| **Name:** Trigeminal | 2 | 1 | 0 | |
| **Test:** Bite, facial sensory | 2 | 1 | 0 | |
| **Cranial Nerve III** | | | | |
| **Name:** Oculomotor | 2 | 1 | 0 | |
| **Test:** PEARL | 2 | 1 | 0 | |

**Your second condition is $C_5$ nerve root compression.** Perform a lower quarter screen for this nerve root, including a deep tendon reflex test, myotome test, and dermatome test. You will have 4 minutes to complete this task.

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| **Reflex:** | 2 | 1 | 0 | |

| | | | | |
|---|---|---|---|---|
| Tested correct reflex appropriately (biceps) | | | | |
| **Dermatome:** Tested correct dermatome appropriately (lateral upper arm) | 2 | 1 | 0 | |
| **Myotome:** Tested correct myotome appropriately (abduction or external rotation) | 2 | 1 | 0 | |

## Therapeutic Interventions

- Score = / Points vary by scenario
- 15% of Total Grade

**Verbal Instructions:** To evaluate your ability to assist in the rehabilitation of orthopedic injuries, you will be presented with a rehabilitation scenario. You will have 25 minutes to demonstrate your knowledge and ability to select and utilize modalities, manual therapy, and therapeutic exercise. You will be graded on your selection, demonstration, implementation, and communication. If additional information is needed regarding the patient's current status, please feel free to ask the patient all necessary questions.

**Student Notes:** A 16-yr old high school junior women's basketball player complains of left knee pain that has been present for approximately 1 month. The patient states that she felt her knee give way when she landed after a lay-up and states that it is happening more frequently. Upon evaluation it is noted she has patellar alta, VMO atrophy, tightness in lateral retinaculum, and Iliotibial band tightness. In addition, she has a (+) apprehension test, pain over medial patella border, and abnormal patellar tracking. Here are your goals or treating the patient's symptoms and patellar instability:

- Decrease patellofemoral pain
- Increase quadriceps activation and strength
- Improve patellar tracking
- Improve proprioception

**Model Notes:** You are a high school junior women's basketball player who complains of left knee pain that has been present for approximately 1 month. Demonstrate bilateral dynamic knee valgus during closed kinetic activities. If asked to perform a squat, demonstrate compensatory strategies, including increased hip/trunk flexion with limited knee flexion and dorsiflexion. Demonstrate poor neuromuscular control of the lower extremity during single-leg activities.

**Grading:** The rubric below outlines a basic template. While students should demonstrate skill in each area and choose appropriate interventions, individual student plans may widely vary and will be scored based on how well the goals are addressed/achieved through the interventions selected in each **bold** category shown in the rubric.

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| **Modality/Parameter Selection** | | | | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| **Manual Therapy** | | | | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| **ROM/Flexibility Exercises** | | | | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| **Strengthening Exercises** | | | | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| | 2 | 1 | 0 | |
| **Proprioceptive Exercises** | | | | |
| | 2 | 1 | 0 | |
| **Communication** | | | | |
| Effective through out | 2 | 1 | 0 | |
| **Avoided Contraindicated Interventions** | 2 | 0 | 0 | |

## Emergency Management

- Score = / Points vary by scenario
- 10% of Total Grade

**Verbal Instructions:** For the Emergency Management portion of the exam, you will be presented with a scenario requiring you to diagnose and manage a particular condition. Treat the patient as if this was an authentic situation. You will have 15 minutes to complete this portion of the exam. Please be thorough but work quickly in the diagnosis and management of this condition.

**Student Instructions:** During a college basketball game, a player comes to the sideline in acute distress. Provide a diagnosis and management plan. You will have 8 minutes to complete this task.

**Model Notes:** The condition is a *splenic rupture*.

Present common signs and symptoms of a spleen rupture, secondary to a mononucleosis infection and splenomegaly. Your chief complaint at first should be pain in your left side after getting elbowed in the side earlier in the game. You continued playing for about 10 more minutes, but the pain continues to get worse and worse. If asked about previous illness, you can state you haven't felt great for a couple weeks. Primarily, you've had a sore throat and have been overly fatigued. If asked, you went to the health center last week, and they thought you had strep throat, but you tested negative. You will be painful to palpation in the upper left quadrant, especially on the lateral aspect below the ribs, but only if the student palpates correctly. If asked about pain anywhere else, you should state you are having some pain in your left shoulder that you have not previously experienced. Do not forfeit information unless prompted. You should deny all other known medical conditions.

- If measured properly, stats should be indicated as follows:
  - **Pulse** is 96 BPM after several minutes of rest in the ATR
    - If asked, the model does not know his normal resting heart rate.
  - **Blood Pressure** is 102/64
    - If asked, the model does not know his normal blood pressure.
  - **Respirations** are 20/min (and shallow due to pain with deep inhalation)
  - **$SPO_2$** is 97%

- If not measured properly, the test evaluator should state 'The results are inconclusive based on the demonstration.'

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMEN | NO | COMMENTS |
|---|---|---|---|---|
| Establishes communication with patient | 1 | 0 | 0 | |
| Collects a complete history of the recent events | 2 | 1 | 0 | |
| Collects a thorough past medical history | 2 | 1 | 0 | |
| Positions patient and properly performs necessary palpations (i.e., ribs, spleen, kidneys) | 2 | 1 | 0 | |
| Properly assesses pulse | 2 | 1 | 0 | |
| Properly assesses pulse blood pressure | 2 | 1 | 0 | |
| Properly assesses respirations | 2 | 1 | 0 | |
| Formulates accurate assessment | 2 | 1 | 0 | |
| Effectively communicates plan with patient | 2 | 1 | 0 | |

| | | | | |
|---|---|---|---|---|
| Proceeds through evaluation in the appropriate, systematic method | 2 | 0 | 0 | |
| Completes assessment in timely manner | 2 | 1 | 0 | |

## Orthopedic Evaluation

- Score = / Points vary by scenario
- 20% of Total Grade

**Verbal Instructions:** For the Orthopedic Evaluation portion of the exam, you will be presented with a scenario requiring you to diagnose a musculoskeletal pathology. Treat the patient as if this was an authentic situation. You will have a maximum of 20 minutes to complete this portion of the exam. Please be thorough but understand the time limitation in this scenario.

**Student Notes:** You are working with a college basketball team, and one of the players comes to see you prior to practice.

**Model Notes**: The condition is a partial PCL tear in collegiate basketball player.

You can report right knee pain and stiffness that has increased over the past 24 hours. The injury occurred yesterday with five minutes left in practice, and you were able to finish, despite some pain in the knee. You believed you could 'walk it off,' but it appears to have become worse over the past 24 hours. If asked about a specific mechanism, you can state you were going for a free ball on the court and dove forward, landing hard on your right knee. You thought it was just a bruise or sore from landing on it, but it seems a bit swollen today. Provide basic symptoms associated with a PCL sprain and joint effusion throughout the student's questioning and clinical testing. Make sure to communicate both verbally and non-verbally as the student moves and tests the knee (i.e., grimacing as the student takes you through passive knee flexion).

| SKILL/OBJECTIVE | YES | NEEDS IMPROVEMENT | NO | COMMENTS |
|---|---|---|---|---|
| Collects a complete history of the present condition | 2 | 1 | 0 | |
| Collects a thorough past medical history | 2 | 1 | 0 | |
| Performs palpations (as necessary) | 2 | 1 | 0 | |
| Assesses active ROM | 2 | 1 | 0 | |
| Assesses passive ROM | 2 | 1 | 0 | |
| Assesses resisted ROM | 2 | 1 | 0 | |
| Performs manual muscle tests | 2 | 1 | 0 | |
| Performs ACL tests | 2 | 1 | 0 | |
| Performs PCL tests | 2 | 1 | 0 | |
| Performs tests for MCL/LCL | 2 | 1 | 0 | |

| | | | | |
|---|---|---|---|---|
| Performs tests for posterior lateral corner | 2 | 1 | 0 | |
| Performs meniscus tests | 2 | 1 | 0 | |
| Performs tests for patellar instability | 2 | 1 | 0 | |
| Formulates an accurate assessment | 2 | 0 | 0 | |
| Effectively communicates with patient | 2 | 1 | 0 | |
| Proceeds through evaluation in the appropriate, systematic method | 2 | 0 | 0 | |
| Completes assessment in timely manner | 2 | 1 | 0 | |

## Appendix B: Survey on Student Perceptions of the Comprehensive Clinical Examination and BOC Examination

**Please answer the following background questions.**

What is your biological sex?

- ○ Male
- ○ Female

What was your age at the time of graduation?

_____

Did you enter Lindenwood University's athletic training program as a traditional first-time freshman or transfer student?

- ○ First-time freshman (traditional)
- ○ Transfer

The professional phase of the athletic training program is designed to be completed over six semesters. How many semesters were you enrolled in the athletic training program at Lindenwood University? This should only include the number of semesters *after* formally being accepted into the program. Thus, traditional students who came to Lindenwood University directly after high school would not include their freshman (pre-professional) year.

- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8

What was your highest composite ACT score?

_____

What was your cumulative GPA at the time of graduation?

_____

How many times did you attempt the comprehensive practical examination (i.e., Senior OP) conducted by the Lindenwood University athletic training program?

- 1
- 2
- 3
- More than 4

Have you successfully completed the Board of Certification (BOC) examination?

- Yes
- No

How many times did you attempt the Board of Certification (BOC) examination?

- 1
- 2
- 3

**The following questions are being used to assess your perception of the comprehensive clinical examination (i.e., Senior OP) and the BOC examination. Please answer the following questions based on your past experiences.**

The comprehensive clinical examination (i.e., Senior OP) is an important component of the athletic training program.

- Completely Agree
- Mostly Agree
- Slightly Agree
- Slightly Disagree
- Mostly Disagree
- Completely Disagree

My preparation process for the comprehensive practical examination (i.e., Senior OP) improved my athletic training skills and abilities.

- Completely Agree
- Mostly Agree

- Slightly Agree
- Slightly Disagree
- Mostly Disagree
- Completely Disagree

My preparation process for the comprehensive practical examination (i.e., Senior OP) improved my athletic training knowledge.

- Completely Agree
- Mostly Agree
- Slightly Agree)
- Slightly Disagree
- Mostly Disagree
- Completely Disagree

My preparation process for the comprehensive practical examination (i.e., Senior OP) positively influenced my performance on the BOC examination.

- Completely Agree
- Mostly Agree
- Slightly Agree
- Slightly Disagree
- Mostly Disagree
- Completely Disagree

Successfully completing the comprehensive practical examination (i.e., Senior OP) improved my overall confidence for the BOC examination.

- Completely Agree
- Mostly Agree
- Slightly Agree
- Slightly Disagree
- Mostly Disagree
- Completely Disagree

Successfully completing the comprehensive practical examination (i.e., Senior OP) improved my overall confidence to practice as an entry-level athletic trainer.

- ○ Completely Agree
- ○ Mostly Agree
- ○ Slightly Agree
- ○ Slightly Disagree
- ○ Mostly Disagree
- ○ Completely Disagree

Reading information (textbook, lecture notes, research articles) is an effective way for me to learn.

- ○ Completely Agree
- ○ Mostly Agree
- ○ Slightly Agree
- ○ Slightly Disagree
- ○ Mostly Disagree
- ○ Completely Disagree

Hearing information (lectures, instructor presentations) is an effective way for me to learn.

- ○ Completely Agree
- ○ Mostly Agree
- ○ Slightly Agree
- ○ Slightly Disagree
- ○ Mostly Disagree
- ○ Completely Disagree

Kinesthetic learning (tactile, hands-on) is an effective way for me to learn.

- ○ Completely Agree
- ○ Mostly Agree
- ○ Slightly Agree
- ○ Slightly Disagree
- ○ Mostly Disagree
- ○ Completely Disagree

**The following questions will give you an opportunity to further elaborate on your preparation process for the comprehensive practical examination (i.e., Senior OP) and the BOC examination. Please answer as fully and accurately as possible.**

On average, how much time do you believe you spent studying for the comprehensive practical examination (i.e., Senior OP)? Hours per week? Number of weeks?

_____
_____

How would you describe your method for preparing for the comprehensive practical examination (i.e., Senior OP)? For instance, did you review textbooks? Did you study with a partner? Did you practice skills on others? Did you make sample scenarios/exams with others? Please provide as much detail as possible to best describe your preparation process.

_____

On average, how much time do you believe you spent studying for the BOC examination? Hours per week? Number of weeks?

_____

How would you describe your method for preparing for the BOC examination? For instance, did you read textbooks? Did you take practice exams? Did you follow a study calendar? Did you focus on weaknesses, as determined by practice exams and/or a review of the educational competencies in athletic training education? Please provide as much detail as possible to best describe your preparation process.

_____

Please describe how your preparation process for the comprehensive practical examination (i.e., Senior OP) impacted your preparedness for the BOC examination. In other words, did the steps you took to prepare for the comprehensive practical examination have a positive or negative impact on your preparedness for the BOC examination, and if so, how?

_____

Please describe how the comprehensive practical examination (i.e., Senior OP), including your preparation process for the practical examination, impacted your confidence level for professional practice.

_____

_____

Do you believe athletic training programs should use a comprehensive clinical examination (i.e., Senior OP) as a graduation requirement? Please provide statements to support your response.

_____

## Appendix C: Survey Participation Request Letter

Athletic Training Program Graduates,

I hope this e-mail finds you all doing well, and I would like to request your help in finalizing the last phase of my dissertation research on the benefits of a comprehensive skills-based examination in an athletic training program. The primary purpose of this study is to determine if there is a correlation between student performance on the comprehensive practical examination and the Board of Certification (BOC) examination. Additionally, the survey portion of the study is designed to explore the student perceptions of the practical examination. Participation in this study is voluntary, and you may discontinue at any time without penalty.

The survey consists of introductory questions that gather demographic data and relevant information about your academic background. The survey then includes a line of questioning about your experience with the comprehensive skills-based examination. This includes questions about your past academic performance, your preparation for the practical examination, your perception of the test's content, your perception of the test's impact on your preparation for the BOC examination, and your overall opinion of the examination. The survey should take about 10-15 minutes to complete. The general nature of these questions is to determine the overall impact and utility of a comprehensive skills-based examination in an athletic training program.

If you have any questions about the study, please contact Tom Godar at 636-949-4628 or tgodar@lindenwood.edu. If you have questions about research participants' rights, contact the Lindenwood University Institutional Review Board at 636-949-4730.

To take the survey, please CLICK HERE.
Or, you can copy/paste the following URL to take the survey:

Thank you for considering being in this study.

Sincerely,

Tom Godar MS, ATC, LAT
Doctoral Candidate
Lindenwood University
209 S. Kingshighway
St. Charles, MO 63301
tgodar@lindenwood.edu
Phone: 636-949-4628

## Appendix D: Survey Consent Form

You are being asked to participate in a survey being conducted by Tom Godar, under the guidance of Dr. Cynthia Schroeder at Lindenwood University. We are doing this study to determine the potential benefits of the comprehensive clinical examination used in the athletic training program and determine if there is a positive correlation between this examination and the Board of Certification examination. It will take about 10 minutes to complete this survey.

Your participation is voluntary. You may choose not to participate or withdraw at any time by simply not completing the survey or closing the browser window.

There are no risks from participating in this project. We will not collect any information that may identify you. There are no direct benefits for you participating in this study.

**WHO CAN I CONTACT WITH QUESTIONS?** If you have concerns or complaints about this project, please use the following contact information: Tom Godar – tgodar@lindenwood.edu

If you have questions about your rights as a participant or concerns about the project and wish to talk to someone outside the research team, you can contact Michael Leary (Director - Institutional Review Board) at 636-949-4730 or mleary@lindenwood.edu.

By clicking 'I consent', I confirm that I have read this form and decided that I will participate in the project described above. I understand the purpose of the study, what I will be required to do, and the risks involved. I understand that I can discontinue participation at any time by closing the survey browser. My consent also indicates that I am at least 18 years of age.

You can withdraw from this study at any time by simply closing the browser window.

○ I Consent

Appendix E: University Request to Use Secondary Data

# LINDENWOOD

November 5, 2018

Dr. Cynthia Schroeder,

Please accept this written request for permission to use Lindenwood University information in the completion of a Lindenwood University research dissertation in the School of Education. The purpose of this research is to investigate the potential benefits of a comprehensive skills-based examination in the athletic training program, especially as it pertains to the Board of Certification {BOC) examination in athletic training. As part of the quantitative aspect of this research, the primary investigator {PI) requests permission to utilize student scores on the comprehensive skills-based examination from the following academic years: 2016-2017, 2017-2018, 2018-2019, and 2019-2020. The PI also requests permission to utilize student scores on the BOC examination. Following approval from the Institutional Review Board, a formal request will be provided to the BOC for student examination scores. There will be no student identifiers used in the development of this project.

I, Cynthia Schroeder (printed name), approve the use of the above information as it specifically pertains to the completion of this research dissertation.

Cynthia Schroeder 5/22/19

Signature Date