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Comparison of Student Success Between Graduate and Undergraduate Students on the Missouri Content Assessments at a Private Midwestern University

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by

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A Dissertation submitted to the Education Faculty of Lindenwood University

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at Lindenwood University by the School of Education

Dr. Beth Kania-Gosche, Dissertation Chair	7-23-18 Date
Dr. Roger Nasser, Committee Member	7/23/2018 Date
Dr. Travis Bracht, Committee Member	7-23-18 Date

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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Signature:  **Date:** 7/23/18

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Abstract

This study analyzed the results of undergraduate and graduate teacher candidate scores on the Elementary Missouri Content Assessment at a private Midwestern University. The intent was to examine the possibility of a difference between pre-service teachers who satisfied coursework requirements through an undergraduate program or through a graduate program. This study focused on the content knowledge domain of teacher knowledge that had been the focus of teacher competency studies since Lee Shulman's research in 1986. This study used pre-service teacher Missouri Content Assessment scores, subtest scores, number of attempts to earn a passing score, number of years since a college math or science class was taken, cumulative grade point average, and grade point average in each content area in order to determine if any correlation existed between academic performance and performance on the Elementary Missouri Content Assessment.

The researcher anticipated that pre-service teachers with higher GPA would receive higher scores on the Missouri Content Assessment. The 12 hypotheses in this study tested the relationship of both undergraduate and graduate pre-service teacher academic performance and performance on the Missouri Content Assessment. The site of the study was a medium-sized Private Midwestern University. A random sample of 50 undergraduate and 35 graduate pre-service teachers were selected from a total population of 205 graduates, which included 169 undergraduate candidates and 36 graduate candidates. The study was quantitative utilizing the Pearson Product-Moment Correlation Coefficient and a *z*-test for difference in means. The analysis of the 12 hypotheses revealed no statistically significant correlation between academic performance and the

Missouri Content Assessment scores. The lack of a significant correlation suggests that further studies are conducted to determine what factors could be indicators that both the Researched University and future pre-service teachers enrolled at the Researched University use as predictors of readiness and success on the MoCA. Because the MoCA assessment has a limited implementation of four years, it may be beneficial to examine what changes the research university has made in course and program design to meet the requirements and then examine the MoCA scores after the changes.

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Chapter One: Introduction

At the time of this writing, the educational path for elementary pre-service teachers to gain certification required a state licensure test. In the state of Missouri, the Missouri Content Assessment (MoCA) was the licensure test required by the Missouri State Board of Education (MOSBOE). Missouri began using the MoCA in September 2014. This set of exit exams were aligned to state and national content standards (Missouri Department of Elementary and Secondary Education [MODESE], 2105). Licensure assessments served as one accountability measure to ensure the quality of both individuals pursuing certification and the Educator Preparation Programs (EPPs) (Angus, 2001; Blackford, Olmstead, & Stegman, 2012; Cochran-Smith, Piazza & Power, 2013; Cochran-Smith et al., 2016; Crowe, 2011; Feuer, Floden, Chudowsky, & Ahn, 2013; Ginsberg & Kingston, 2014; Goldhaber, 2015; U.S. Department of Education [USDOE], 2016).

"The Missouri Standards for the Preparation of Educators (MoSPE) outline the expectations for programs that are preparing educators for certification in Missouri" (MODESE, 2016b, p. 1). The quality of a certification program was measured using data based on MoSPE, including MoCA pass rates and program completers' content grade point average (MODESE, 2017a). The Annual Performance Report for Educator Preparation Programs (APR-EPP) provided the data on certification programs to MOSBOE to determine accreditation, to the EPPs for improvement and to the public (MODESE, 2017a). This study compared undergraduate and graduate student scores on the MoCA and students' grade point average (GPA) in content courses to determine if a correlation existed.

Background of the Study

On November 8, 1965, The Higher Education Act (HEA) was signed into law under President Johnson "to strengthen the educational resources of our college and universities and to provide financial assistance for students in postsecondary and higher education" (Government Accountability Office [GAO], 1965, p. 1219). The HEA provided financial assistance for postsecondary education, grants to improve teacher quality, and resources for institutions. Under this Act, each state completed a yearly report on teacher preparation to the U.S. Secretary of Education. Included in these reports were the processes and criteria states used to determine if teacher preparation programs were low-performing or at risk (USDOE, 2016a).

In 2015, a report published by the U.S. Government Accountability Office (GAO) cited the requirements of the HEA for individual states. The results of the report indicated a number of states improperly determined if teacher preparation programs were low performing (GAO, 2015). According to the 2016 Secretary's Annual Report, out of the 2,171 teacher preparation providers, a total of 45 programs were classified as low-performing or at risk in 2014 (USDOE, 2016b, p. 52), a decrease from 2013, when a total of 59 programs were classified as low-performing or at-risk (USDOE, 2016b, p. xvii). The low number of identified programs raised concern about the rigor and consistency of state evaluation.

The No Child Left Behind (NCLB) Act signed into law by President Bush in 2002, reauthorized the Elementary and Secondary Education Act and defined criteria for a 'highly qualified' teacher. To be highly qualified, an elementary teacher would possess a bachelor's degree, a passing score on the state test of subject knowledge and teaching

skills in reading, writing, and mathematics (USDOE, 2002). With this definition of highly qualified, teacher content knowledge, as opposed to pedagogical knowledge, became the focus for state licensure tests and teacher preparation programs (USDOE, 2002). Before NCLB, only 29 states "required teacher candidates to pass a relatively simple subject matter test that would provide an objective measure of teacher knowledge" (National Council on Teacher Quality, 2011, p. 3).

In 2016, the U.S. Department of Education (USDOE) released the Teacher Preparation Regulations with the goal to "help ensure that novice teachers are ready to succeed in the classroom and that every student is taught by a great educator" (USDOE, 2016b, p. 1). The rules included rigorous teacher preparation program reporting standards under the HEA for "stronger outcomes for all programs" (USDOE, 2016b, p. 1). This step increased the expectations of teacher preparation programs and created an urgency in programs, states, and professional organizations to evaluate the new goals and regulations to ensure compliance with the increased standards (USDOE, 2016b). Although these regulations were ultimately not passed, some states had already begun work to revise their accountability systems for educator preparation.

In the state of Missouri, the Constitution of the state granted the MOSBOE "the general authority for public education, within limits set by the General Assembly" (MODESE, 2017c, para. 1). The Governor appointed eight citizens to eight-year terms with the responsibility of overseeing all levels of education in the state. "The Board does not have direct authority over higher education institutions. However, the Board sets standards for and approves courses and professional programs for teachers and school administrators in Missouri's public and private higher education institutions" (MODESE,

2017c, para. 3). The Board's responsibilities included "appointing the Commissioner of Education and setting policies for the Department of Elementary and Secondary Education and establishing requirements for the education, testing, assessment, certification and recertification of all public school teachers and administrators" (MODESE, 2017c, para. 6). While the Board did not control the degree-granting authority of institutions, the purpose of elementary education degrees, and similar licensure programs, was for the student to receive a state teaching certificate at the conclusion of the program.

The MODESE mission statement focused on “the superior preparation and performance of every child in school and in life” (MODESE, 2017d, para. 2). In order to accomplish this mission, MODESE established both expectations for teachers and teacher preparation programs.

> In June 2010, Senate Bill 291 was passed, directing public school districts in Missouri to adopt teaching standards. While the districts are responsible for actually adopting standards, MODESE was given the task of offering model standards for districts to use. (MODESE, 2011, p. 3)

The nine teaching standards and 36 indicators "outline what educators should know and be able to do to ensure that students in Missouri public schools continually grow and improve. The standards . . . represent best practices for helping students be successful" (MODESE, 2011, p. 3). The first standard addressed the teacher understanding of content knowledge (see Table 1) (MODESE, 2011, p. 5). In 2014, MODESE created the Missouri Standards for the Preparation of Educators (MoSPE) for EPPs in Missouri. The MoSPE included six standards that communicated the state's expectations for EPPs.

Educator preparation was the focus of MoSPE Standard 1, requiring teacher candidates to "demonstrate knowledge and application of general education, content knowledge, and pedagogy" (MODESE, 2013, p. 3).

Table 1

Content Knowledge Aligned with Appropriate Instruction

Teacher Level	Description of Content Knowledge and academic language
Candidate	"Demonstrates knowledge of the academic language of the appropriate discipline applicable to the certification area(s) sought as defined by the Subject Competencies for Beginning Teachers in Missouri"
Emerging Teacher	"Knows and can demonstrate breadth and depth of content knowledge and communicates the meaning of academic language into learning activities"
Developing Teacher	"Delivers accurate content learning experiences using supplemental resources and incorporates academic language into learning activities"
Proficient Teacher	"Infuses new information into instructional units and lessons displaying solid knowledge of the important concepts of the discipline"
Distinguished Teacher	"Has mastery of taught subjects and infuses new research-based content knowledge into instruction continuously"

Note. Source: MODESE (2011).

Another step MODESE took to meet the goal of improving the EPP was to reform the pre-service teacher assessments. MODESE contracted with the Evaluation Systems group of Pearson to create the pre-service teacher assessments for entry into a teacher

preparation program and state certification, commonly referred to as the Missouri Educator Gateway Assessments (MEGA) (Pearson, 2016).

The MEGA test framework identified the knowledge and skills to be included on each content assessment. Pre-service teachers participated in a comprehensive assessment to ensure pre-service teachers met the state expectations for being a teacher (MODESE, 2015c). This process began with the Missouri Educator Profile (MEP), which measured an individual's work style and occurred once a student entered an EPP (MODESE, 2015c). Before beginning an EPP, pre-service teachers took an assessment of content knowledge and pedagogical skills, the Missouri General Education Assessment (MoGEA). Candidates were required to pass the five subtests of the MoGEA assessment before admission into an undergraduate EPP (MODESE, 2014c). After coursework was completed, the pre-service teacher took the Missouri Content Area Assessments (MoCA). The MoCA replaced the Praxis exam in September 2014 as the exit exam required for all teacher candidates in Missouri (MODESE, 2015a). When comparing the past Praxis exam to the new MoCA assessment, Katnik, Assistant Commissioner in the office of Quality Schools stated, "The exam is more rigorous than the previous exams. The ultimate goal is to have effective teacher who understand the content and can help our students succeed" (MODESE, 2015a, para. 5). A candidate must pass the MoCA to obtain certification. All elementary education teacher candidates received certification with a passing score of 220 in each of the four subtests of English Language Arts, Mathematics, Science, and Social Studies (MODESE, 2016a)

In 2014, the MOSBOE approved the formation of the Missouri Advisory Board for Educator Preparation (MABEP). According to the MOSBOE August 2014 agenda,

“The purpose of MABEP would be to advise the State Board of Education and the Coordinating Board for Higher Education to foster meaningful and substantial collaboration and transparency among all stakeholders in the interest of improving the quality of teacher preparation in Missouri” (MODESE, 2014a, p. 4). The State Board of Education utilized the initial approval process for EPPs in Missouri. Initial approval was required for each certificate program "before they are able to offer preparation in Missouri that leads to a Missouri educator certificate" (MODESE, 2014a, p. 4). After EPPs gained initial approval, all certification areas were reviewed on an annual basis. MoSPE utilized the APR-EPP to "measure the performance of educator preparation programs (EPPs) in valid, accurate, and meaningful ways" (MODESE, 2014a, p. 2). The APR-EPP provided EPP progress towards meeting the MoSPE standards; specifically the performance of pre-service educators on the Missouri Content Assessments (MoCA) (MODESE, 2016b).

The Annual Performance Reports (APRs) had three main purposes, "accredit the certification programs, provide annual data to guide continuous improvement of certification programs and inform the public about program quality" (MODESE, 2017b, p. 3). The three indicators to measure EPP performance included MoSPE Standard 1: Academics; MoSPE Standard 2: Field and Clinical Experiences; and MoSPE Standard 3: Candidates to Beginning Educators. For the purpose of this study, the focus was on the elementary education certification area of academics (see Table 2). When determining the APR-EPP, data from program completers over a three-year time period were analyzed (MODESE, 2014a).

Table 2

Elementary Education Certification APR-EPP Academic Standard Requirements

Data Source	Indicator	Benchmark
MoCA	Certification Assessment Pass Rate of 220	80% of program completers pass the state certification assessment by the 2nd attempt.
Completer Demographics	Grade Point Averages	85% of program completers meet the content GPA standard required for certification

Note. Source: MODESE (2014a); MODESE (2017b).

In 2015, the MABEP published the pass rates for Elementary MoCA assessments. The qualifying scores for the Elementary Education, 1-6, certification was set at 220. Of the 696 test takers, 40% passed all four subtests on the first attempt; a 51% pass rate (MODESE, 2015a, p. 31). At the January 2015 meeting, the members of the MABEP examined the then-current APR for EPPs and decided, due to changes in the Title II reporting criteria, EPPs performance would be reported in four levels; a change from reporting EPPs performance as met or not met (MODESE, 2015b). Changing the APR reporting to four levels allowed for an increased level of specificity of the programs offered by EPPs. The revised system highlighted the strengths of the EPPs, while also identifying the weakness to be addressed (MABEP, 2016a).

In March 2017, MODESE announced for the first time to the public the APR-EPP. Certificate areas earned points based on the quality indicators. There were four APR quality indicators combined to find the EPPs' points, out of 60 total points, in the four-tier point system. The content assessment pass rate and content coursework GPA indicators had a value of 20 possible points. The first-year teacher survey and principal survey of first-year teacher indicators had a value of 10 possible points (MODESE, 2017a). Each of the indicators must have had 15 or more candidate participants in order to be calculated. In addition, at least two of the four indicators were required to calculate

an APR (see Table 3) (MODESE, 2017a, p. 3). Based on this calculation, certification programs received a rating in one of four tiers.

Table 3

Missouri APR Certification Program Rating

Rating	Performance of the Candidates in the Programs
Tier 1 (90% to 100%)	Exceeds expectations
Tier 2 (70% to 89.9%)	Meets expectations
Tier 3 (50% to 69.9%)	Approaching expectations
Tier 4 (0 to 49.9%)	Does not meet expectations
N/A	15 candidates or fewer completed the program in the past 5 years and/or data were available for fewer than 2 of the APR indicators

Note. Source: MODESE (2017a)

To calculate the tier rating for a certification program, the total number of points a program received was divided by the total points possible (see Table 4). The 2016, APR 1.5 was a starting point for teacher preparation programs and would be used for future comparisons. "More importantly, this data is used by programs to improve its quality of preparation" (MODESE, 2017a, p. 3).

Table 4

APR-EPP Four Tier Point System

APR Quality Indicator	Possible Points
Content Assessment Pass Rate	20
Content Coursework GPA	20
1st Year Teacher Survey	10
Principal Survey of 1st Year Teacher	10

Note. Source: MODESE (2017a)

Purpose of the Study

This study may contribute research to support Missouri EPPs in the use of the APR-EPP data to make teacher preparation program improvement decisions. Both traditional and non-traditional teacher program success was determined using the APR-

EPP process. The research data will provide feedback on how the programs at one private Missouri University were meeting the MoSPE Standard 1: Academics requirements, as measured by the APR-EPP.

The purpose of this quantitative study was to analyze the results of both undergraduate and graduate student scores on the newly adopted Missouri Content Assessments (MoCA) and compare these with the students' GPAs in the respective content courses to see if there was a correlation. At the time of this study, the Researched University offered both undergraduate and graduate programs for elementary education. These resulted in the same certification and required the same assessments. However, graduate students may have earned an undergraduate degree many years prior. The faculty speculated that graduate students may score lower or need more attempts to pass the exam, since these students took content courses potentially many years prior.

The study aimed to identify if there were differences between graduate candidates and undergraduate scale scores in the subtests of mathematics, science, and social studies. The researcher also compared both undergraduate and graduate student GPA in content areas to the scale score earned in the corresponding MoCA subtest. The researcher also investigated length of time between when the last college course was taken and the time the test was attempted.

Hypotheses

Hypothesis 1: There is a relationship between the number of attempts on the elementary Missouri Content Assessment (MoCA) and cumulative GPA for undergraduate students.

Hypothesis 2: There is a relationship between the number of attempts on the elementary MoCA and cumulative GPA for graduate students.

Hypothesis 3: There is a relationship between the score on the elementary MoCA math subtest and GPA in math courses for undergraduate students.

Hypothesis 4: There is a relationship between the score on the elementary MoCA math subtest and GPA in math courses for graduate students.

Hypothesis 5: There is a relationship between the score on the elementary MoCA science subtest and GPA in science courses for undergraduate students.

Hypothesis 6: There is a relationship between the score on the elementary MoCA science subtest and GPA in science courses for graduate students.

Hypothesis 7: There is a relationship between the score on the elementary MoCA social studies subtest and GPA in social studies courses for undergraduate students.

Hypothesis 8: There is a relationship between the score on the elementary MoCA social studies subtest and GPA in social studies courses for graduate students.

Hypothesis 9: There is a relationship between the year the last math course was originally taken and the MoCA mathematics subtest score for graduate students.

Hypothesis 10: There is a relationship between the year the last science course was originally taken and the MoCA science subtest score for graduate students.

Hypothesis 11: There is a difference between graduate candidates and undergraduate scale scores in the subtests of mathematics, science, and social studies.

Hypothesis 12: For graduate and undergraduate students, there is a relationship between student GPA and MoCA scale score when comparing GPA in the content area to the corresponding MoCA subtest.

Limitations

Several limitations to the study existed. The study focused on the results from the Missouri Content Assessments, implemented as part of the teacher certification assessment process in 2014 (MODESE, 2016a, para. 2). This exam was not nationally normed and was only used in the state of Missouri. The scope and sample size of the study consisted of Researched University elementary pre-service teacher candidates who participated in the MoCA assessment 2014 through 2017. Therefore, the results are not generalizable beyond that context.

At the Researched University, a 4.0 grading system was utilized to determine GPA. Cumulative GPA included only coursework grades completed at the Researched University (Researched University, 2017, para. 1). According to the grading system, "A grade of A represents work of outstanding quality; it indicates that the student has shown initiative, skill, and thoroughness and has displayed originality in thinking" (Researched University, 2017, para. 2). GPA was calculated the same for all students; however, the grading system in various coursework varied.

Definition of Terms

Annual Performance Reports for Education Preparation Programs (APR-EPP): A performance report created by MoSPE to measure educator preparation programs (MODESE, 2016a).

Missouri Department of Elementary and Secondary Education (MODESE): Administered primary and secondary public education in the state of Missouri. (MODESE, 2016a)

Missouri Content Assessments (MoCA): Exams completed by pre-service teachers in each area of certification aligned with state and national standards. At the time of this study, each assessment included subtests in English Language Arts, mathematics, science, and social studies and required a minimum passing score for a candidate to become a certified elementary teacher (MODESE, 2016a).

Missouri Standards for the Preparation of Educators (MoSPE): The expectations for pre-service teacher preparation programs in Missouri (MODESE, 2016a).

Non-traditional teacher program: A post-baccalaureate degree teacher preparation program for professional school personnel without professional education preparation. Completion of program allows the pre-service teacher to meet the state certification requirements (MODESE, 2014b).

Traditional teacher program: Includes the general education curriculum, content and professional studies, and clinical experiences serving pre-service teachers who enter college after graduation from high school and results in a bachelor's or higher degree (MODESE, 2014b).

Summary

The basis for this study was to determine if a correlation existed between pre-service teacher performance in undergraduate and graduate studies, as measured by GPA, and GPA in content areas related to how pre-service teacher performed on the Missouri

Content Assessment. If a significant correlation existed between pre-service teacher performance on the MoCA and a candidate's academic performance, the academic performance could be a predictor of candidate success; and thereby, ultimately help improve pre-service teacher preparation. By completing quantitative analyses of the comparisons, the researcher hoped to accomplish the following: provide feedback regarding the effectiveness of the undergraduate teacher education program and graduate program in preparing students for the MoCA; examine the effectiveness of teacher education coursework in content areas; and determine next steps for instructional changes in either teacher education program.

In Chapter Two, a review of literature is presented. A review of the research on teacher content knowledge, including the impact teaching standards and teacher licensure assessment is presented. Issues facing teacher licensure are outlined. An overview of the teacher certification process, both at the federal and state level, is examined. The research on the correlation of grade point average on success on teacher licensure assessments and on student achievement are presented. Finally, teacher preparation programs are examined, including the evaluation process.

Chapter Two: The Literature Review

Introduction

The teacher certification process serves as a crucial step to ensuring the readiness of educators. At the time of this writing, one required component of the teacher certification process was receiving a passing score on the teacher licensure assessment. Receiving a passing score indicated that the candidate had the necessary knowledge required of a teacher. With the many path choices, pre-service teachers could pursue to gain certification; the teacher licensure assessment ensured a minimal level of quality regardless of the path an educator chose.

Preparing pre-service teachers to become highly qualified teachers was the goal of teacher education programs. According to the NCLB Act, an elementary teacher that was highly qualified must hold at least a bachelor's degree and pass the required state licensure assessment, which included an assessment of both subject knowledge and teaching skills (USDOE, 2016a). Colleges and universities were evaluated based on the results of teacher licensure assessments.

Organization of the Literature Review

The literature reviewed in Chapter Two reveals the research on teacher content knowledge, including the impact on teaching standards and teacher licensure assessment. Issues facing teacher licensure are outlined. An overview of the teacher certification process both at the federal and state levels are examined. The research on the correlation of grade point average on success on teacher licensure assessments and on student achievement are presented. Finally, the teacher preparation programs are examined including the evaluation process.

Teacher Content Knowledge

The premise that teachers possess strong content knowledge was not a new idea in the field of education. "Pennsylvania may have been the first state to specify subjects, requiring in 1834 that teaching candidates be shown to be competent in reading, writing, and arithmetic" (Angus, 2001, pp. 8-9). In 1986, Shulman identified three different types of content knowledge: subject matter content knowledge, pedagogical content knowledge, and curricular knowledge. Content knowledge (CK), is "the amount and organization of knowledge" (Shulman, 1986, p. 9). According to Shulman (1986), "The teacher need not only understand that something is so, the teacher must further understand why it is so" (p. 9). Pedagogical content knowledge was defined as the understanding a teacher needs in order to support students in learning the content, including how to represent the ideas and knowing what areas of the content might cause a student difficulties in learning (Shulman, 1986). Shulman (1986) suggested pedagogical content knowledge was where the "research on teaching and on learning coincide most closely" (p. 10). Shulman (1986) explained curricular knowledge as "the full range of programs designed for the teaching of particular subjects and topics at a given level" (p. 10). Understanding of the curriculum also included the knowledge of being able to connect the learning to other subject areas. Based on this definition, Shulman (1986) proposed that the process and structure of pre-service teacher assessments were examined to ensure that both a teacher's content and process understanding were assessed. Shulman's in depth definition of content knowledge laid the groundwork for future studies in the area of teacher CK.

Loewenberg-Ball, Thames, and Phelps (2008) revisited Shulman's pedagogical CK work hypothesizing, "Shulman's content knowledge could be divided into common content knowledge and specialized content knowledge and his pedagogical content knowledge could be divided into knowledge of content and students and knowledge of content and teaching" (p. 399). Common CK was defined as solving a mathematical task (Loewenberg-Ball, Thames, & Phelps, 2008). Loewenberg-Ball et al. (2008) researched specialized CK in order to expand the definition and understanding. The definition was explained as "specialized content knowledge is the mathematical knowledge and skill unique to teaching" (Loewenberg-Ball et al., 2008, p. 400). The third area studied was knowledge of content and teaching, defined as "knowing about teaching and knowing about mathematics" (Loewenberg-Ball et al., 2008, p. 401). The study concluded, "Content knowledge is immensely important to teaching and its improvement. Instead of taking pedagogical content knowledge as given, however, we argue that there is a need to carefully map it and measure it" (Loewenberg-Ball et al., 2008, p. 404).

An increasing body of research focused on the importance of teacher knowledge of subject matter (Grossman, Schoenfeld & Lee, 2005; Hill, Schilling & Ball, 2004; Loewenberg-Ball, 1990; Loewenberg-Ball et al., 2008). Only a few studies indicated the opposite, finding teachers need only to be able to read directions from teacher manuals (Lawson, 1991; Noh & Webb, 2015). "There is broad agreement that teacher knowledge of disciplinary content directly and positively affects classroom practice and, ultimately, student learning" (Smith & Esch, 2012, p. 2). Loewenberg-Ball's (1990) study focused on the CK of mathematics teachers and found the CK preservice teachers "learned in their precollege mathematics classes is unlikely to provide adequate subject matter

preparation for teaching mathematics for understanding" (p. 142). The researchers found, math majors could compute a simple fraction problem, but only a few could explain the underlying mathematical principles utilized to solve the computation (Loewenberg-Ball, 1990). In 2004, Hill, Schilling, and Ball researched elementary teachers' CK and pedagogical CK. By designing and piloting a multiple-choice mathematics content assessment for elementary teachers, the researchers found "evidence of multidimensionality in these measures, suggesting that teachers' knowledge of mathematics for teaching is at least partly domain specific rather than simply related to a general factor such as overall intelligence, mathematical ability, or teaching ability" (p. 26). The researchers devised the term mathematical knowledge for teaching (Hill et al., 2004). Grossman, Schoenfeld, and Lee (2005) made a supporting claim "to argue that teachers need to know the subject matter they teach seems almost tautological; for how can we teach what we do not understand ourselves?" (p. 205).

Kleickmann, Richter, Kunter, Elsner, Besser, Krauss and Baumert (2013) revealed differences (e.g., cognitive ability and high school grade point average) in the preservice teachers enrolled in the studied teacher education programs. Roy (2014) studied elementary pre-service teacher scores on the mathematics portion of two teacher assessments, CBASE and Elementary Praxis II, to determine if the number of mathematics courses impacted the score received. The researcher found there to be no significant difference in the mathematics scores and found that "the teacher candidates who entered college that de-emphasized algebra proved to not be at a disadvantage for passing the tests needed for obtaining teacher credentials in Missouri" (Roy, 2014, p. iv). The International Teacher Education and Development Study (TEDS-M; Tatto et al.,

2012), was a comparative study of mathematics teacher preparation with a goal of defining the relationship between the difference in teacher education programs and teachers' CK. "The TEDS-M data reveal a substantial relationship between the strength of these quality assurance arrangements and the quality of graduates as measured by tests used in the TEDS-M study" (Tatto et al., 2012, p. 54).

Many studies found the teacher as a critical factor in determining student achievement. (Cantrell & Kane, 2013; Campbell et al., 2014; Smith & Esch, 2012). "There is broad agreement that teacher knowledge of disciplinary content directly and positively affects classroom practice and, ultimately, student learning" (Smith & Esch, 2012, p. 2) Campbell et al.'s (2014) study concluded teachers of middle grades content and pedagogical knowledge was positively correlated with student mathematics achievement. "There was a statistically significant positive relationship ($\alpha = .05$) between teachers' CK and their students' performance on standardized state mathematics achievement tests for both the upper-elementary and middle-grades students" (Campbell et al., 2014, p. 445). "We demonstrate how one could use a testing policy evaluation framework to examine the use of VAMs [value added measure] in estimating TPP [teacher preparation programs] effectiveness" (Evans & Lee, 2016, p. 15). "We found that there are many unanswered questions about the feasibility, unintended harm, and overarching fairness of implementing (or continuing to implement) value-added assessment policies" (Evans & Lee, 2016, p. 15).

Schacter and Thum (2004) identified teacher CK as one of the teacher practices connected to elementary student achievement in reading, mathematics, and language. Measures for Effective Teaching (MET) project researchers investigated Content

Knowledge for Teaching (CKT) tests developed by Educational Testing Services (ETS, 2017). Results indicated "the CKT tests studied by the MET project did not pass our test for validity. MET project teachers who performed better on the CKT tests were not substantively more effective in improving student achievement on the outcomes we measured" (Cantrell & Kane, 2013, p. 15). The researchers noted "these results, however, speak to the validity of the current measure still early in its development in predicting achievement gains on particular student assessments not to the importance of content-specific pedagogical knowledge" (Cantrell & Kane, 2013, p. 15).

A study was completed of new math teachers in Delaware, Maryland, and Pennsylvania, which "identified a significant relationship between upper-elementary teachers' mathematical content knowledge and their students' mathematics achievement" (Campbell et al., 2014, p. 419). In this study, the researchers "investigated whether there is a relationship between student achievement and teachers' perceptions, by which we mean teachers' beliefs regarding mathematics teaching and learning and teachers' awareness of their students' mathematical dispositions" (Campbell et al., 2014, p. 421).

According to the Race to the Top and Teacher Preparation report, "Every state promised to use student achievement as an outcome indicator for teacher education programs. . . . Yet only five states say they will use the teacher effectiveness of program graduates as an accountability measure, publicly reporting the results and using them to hold programs accountable" (Crowe, 2011, p. 4). In 2011, "Five of the 12 funded states make clear commitments to use evidence of teacher effectiveness for program accountability" (Crowe, 2011, p. 11).

A few studies reported a relationship between the number of subject matter courses taken at the university level and beginning teacher CK. (Boyd, Grossman, Lankford, Loeb & Wyckoff, 2009; Kleickmann et al., 2013). Kleickmann et al. (2013) studied both preservice and active teacher CK and pedagogical content knowledge (PCK) mathematics knowledge using a paper-and-pencil test. The results suggested, "CK and PCK [pedagogical content knowledge] were significantly predicted by gender, GPA, nonverbal cognitive abilities (KFT), interest in mathematics, and enrollment in mathematics courses" (Kleickmann et al., 2013, p. 97). A 2009 study investigated how teachers from different New York teacher preparation programs performed based on their content coursework in mathematics and English Language Arts (ELA). When comparing the programs, the researchers found "for math and ELA course requirements, programs range from no course requirements during preservice preparation to four in math and from zero to eight in ELA" (Boyd et al., 2009, p. 431). The study of math coursework was "positively associated with teachers' value added in the 2nd year, but not consistently in the 1st year with small effects (about 0.02)" (Boyd et al., 2009, p. 431). The study of ELA "has a small positive and significant effect in the 2nd year, but not in the 1st year" (Boyd et al., 2009 p. 431).

The International Association for the Evaluation of Educational Achievement (IEA) Teacher Education and Development Study of Mathematics (TEDS-M) was an international research study of elementary teacher preparation. "The study investigated the pedagogical and subject-specific knowledge that future primary and lower-secondary school teachers acquire during their mathematics teacher education" (Ingvarson et al. 2013, p. 5). The report found the countries in which the teacher developed the greatest

mathematics teaching knowledge "placed greatest emphasis on policies that enable the teaching profession to compete for high ability secondary school graduates, . . . ensure a rigorous system of assessment/accreditation of teacher education programs, and set high standards for entry to the profession after graduation" (Ingvarson et al. 2013, p. 5). The researchers stated, "We found a strong relationship between the strength of these quality-assurance arrangements and the quality of graduates, as measured by the tests of mathematics content knowledge (MCK) and mathematics pedagogical content knowledge (MPCK) used in TEDS-M" (Ingvarson et al. 2013, p. 238).

Teacher Content Knowledge in Standards

TPPs received accreditation from agencies, such as The Council for the Accreditation of Educator Preparation (CAEP). In 2013, the CAEP identified five accreditation standards required of TPPs seeking accreditation. In order to develop these standard, “university and P-12 officials, teachers, parents, representatives of non-traditional programs, chief state school officers, . . . and others with a broad range of perspectives reached a historic consensus around what is necessary to produce high-performing teachers that reflect expectations for the field” (Council for the Accreditation of Educator Preparation [CAEP], 2016, p. 10). “CAEP’s new standards are intended to make the accreditation process more rigorous and outcome-focused by setting minimum criteria for program admissions and requiring programs to demonstrate their graduates’ impact on student achievement" (Feuer et al., 2013, p. 3).

Evidence exists, throughout the teaching standards, on the importance of CK. According to the USDOE *10th Report on Teacher Quality*, “in 2014, 48 states, Puerto Rico, American Samoa, Guam, Northern Mariana Islands, and Virgin Islands reported

that they had a policy that aligns teacher credentialing standards with challenging academic content standards for k – 12 students" (USDOE, 2016, p. xvii). Content and pedagogical knowledge was the focus of CAEP Standard 1, which required TPPs to "ensure that candidates apply content and pedagogical knowledge" (CAEP, 2016, p. 14). As part of the licensure process, providers were required to "report pass rates by times attempted, overall performance scores, subscales, and cohort average performance compared with state and/or national population, as applicable" (CAEP, 2016, p. 16) on licensure assessments.

In order to compare the programs and requirements of EPPs across the United States "the Council for the Accreditation of Educator Preparation (CAEP) presented a challenge to Teacher Preparation Analytics (TPA) to develop a comprehensive framework for analyzing the state of assessment and accountability for educator preparation in the United States" (Allen, Coble, & Crowe, 2014, p. iii). TPA aimed at answering the question, "How do we identify high-performing preparation programs that produce routinely effective teachers and programs that do not?" (Allen et al., 2014, p. 1). The Teacher Preparation Program 2020 Key Effectiveness Indicators provided "grounding for solid annual state reports on teacher preparation programs" (Allen et al., 2014, p. 5). Knowledge and skills for teaching was one of the assessment categories and included an assessment and report of "the academic content knowledge of program completers as measured through nationally normed assessments of college-level content knowledge" (Allen et al., 2014, p. 9).

Assessment of Teacher Content Knowledge

"As policies increasingly hold teachers accountable for their performance, calls for holding the preparation programs that prepare them accountable for their performance have also increased" (Coggshall, Bivona & Reschly, 2012, p. 2). According to the Teacher Preparation Analytics Report, "There appears to be no current examination of pedagogical CK (content knowledge for teaching) that meets the goal of a rigorous examination that tests for broad and deep knowledge of how to teach specific subjects." (Allen et al., 2014, p. 9). This report investigated how well different states assessed a pre-service teacher's CK. One concern noted by the researchers "is that there are multiple variations of a licensure test in the same subject, even by the same test developer" (Allen et al., 2014, p. 10). One example of this could be seen in the area of math CK for elementary teachers; discrepancy existed between the CK being measured by different states. Hill et al. (2004) closely examined the elementary teacher mathematics content assessment and found a wide range of content being examined. "Some exams assess individuals' ability to solve middle-school-level mathematics problems, others the ability to construct mathematical questions and tasks for students and still others the ability to understand and apply mathematics content to teaching" (Hill et al., 2004, p. 12). "Secretary Duncan's annual reports to Congress on teacher quality have identified more than 1,000 teacher tests in use across the 50 states with over 800 content knowledge tests alone" (Allen et al., 2014, p. 10).

Another concern noted by the Teacher Preparation Analytics Report was "states set their own passing scores (or "cut scores") that diverge widely and undermine confidence that all candidates who pass the examinations truly have an adequate grasp of

their teaching subject." (Allen et al., 2014, p. 9). According to *A Primer on Setting Cut Scores on Tests of Educational Achievement*, "cut scores are selected points on the score scale of a test. The points are used to determine whether a particular test score is sufficient for some purpose" (Zieky, Perie, & Livingston, 2006, p. 2). "Depending on the cut score, receiving a passing score on the assessment may not mean the same thing as having a significant degree of content knowledge" (USDOE, 2016b, p. 65).

The USDOE utilized scaled scores to compare initial teacher licensure assessment scores across states. "A scaled score is a conversion of a raw score on a test or version of the test to a common scale that allows for a numerical comparison between test takers" (USDOE, 2016b, p. 65). By analyzing a state's cut score, average score earned, and the gap between the two, the USDOE was able to offer a comparison between states and offer insight on whether the cut score requirement for the state was rigorous. "A large gap between the cut score and the average test takers for a given state could suggest a relatively low bar may be being set for pre-service teachers in that state" (USDOE, 2016b, p. 65). The comparison of all state cut scores found "they are significantly lower than the average score by test takers for nearly all states and program types, suggesting that the bar may be set relatively low across the board" (USDOE, 2016b, p. 68).

ETS and Pearson, the two main teacher certification test developers, believed that the certification assessments were valid.

Teacher Licensure Assessments

Teacher Licensure Assessments were one measure of teacher quality. An analysis of data from 50 states "suggests that policies adopted by states regarding teacher education, licensing, hiring, and professional development may make an important

difference in the qualifications and capacities that teachers bring to their work" (Darling-Hammond, 2001, p. 1).

In 1996, The National Commission on Teaching and America's Future, along with professional teacher organizations, such as the National Commission on Teaching and America's Future (NCTAF), the National Council for Accreditation of Teacher Education (NCATE), and the National Board for Professional Teaching Standards (NBPTS), worked together to increase certification requirements for teacher licensure (Darling-Hammond, 1997). "The rationale for licensing is often based on consumer protection. Policymakers want to keep charlatans out of the profession and ensure a minimum quality of goods or services for consumers" (Shuls & Trivitt, 2013, p. 4). In the late 1990s, professional teacher organizations, such as NCTAF, NCATE, and NBPTS, argued for even stricter certification requirements (NCTAF 1996). "The goal of pre-service teacher assessment is, ultimately, to judge the readiness and competence of new teachers with respect to their performance in real classroom situations" (Evans, Kelly, Baldwin, & Arnold, 2016, p. 151). According to *The Secretary's 10th Report on Teacher Quality*, "in AY 2013-2013, all states and jurisdictions except Montana, Micronesia, Marhall Islands and Palau assessed candidates for an initial teacher credential through state testing" (USDOE, 2016b, p. xvii).

Each state made the decision of what assessment to use for teacher certification assessment. "Most states use a set of assessments developed by the ETS called the Praxis Series. Other states work with Pearson to develop assessments aligned to state standards, so assessments offered in different states vary" (USDOE, 2016b, p. 65). In addition,

decisions about the required cut score for each area of certification were decided at the state level.

Some studies showed teacher qualifications, such as higher scores on licensure tests, influenced student achievement (Boyd et al., 2007; Clotfelter, Ladd, & Vigdor, 2007; Hanushek, 1997). Clotfelter, Ladd, and Vigdor (2007) studied "data on statewide end-of-course tests in North Carolina to examine the relationship between teacher credentials and student achievement" (p. 2). The researchers concluded, "Teacher credentials matter in a systematic way for student achievement at the high school level and that the magnitudes are large enough to be policy relevant" (Clotfelter et al., 2007). Likewise, Hanushek (1997) found teacher test scores were a more consistent predictor of student achievement than other teacher qualifications, such as years of experience and a master's degree. A 2007 study of New York City teachers "suggest that recruiting teachers with stronger observed qualifications, e.g., math SAT scores or certification status, could substantially improve student achievement" (Boyd et al., 2007, p. 2).

A committee of the National Academy of Education completed an analysis of the then-current ability of teacher preparation programs to produce high quality teachers. The committee reported "many aspects of the relationship between teacher preparation and instructional quality are not fully understood, and existing approaches to TPP evaluation are complex, varied, and fragmented" (Feuer et al., 2013, p. 1). The committee also cited "variations in how these tests are developed and used make it difficult to generalize about them or compare results across states. For example, even states that use the same test often set different cut scores for passing" (Feuer et al., 2013, p. 32).

Some critics contended, "Passing these tests is intended primarily to signal that candidates have a minimum level of knowledge and competency, rather than to predict their future effectiveness in the classroom" (Feuer et al., 2013, p. 2). Other critics of teacher licensure assessments cited “for decades, high-stakes and standardized examinations have had an adverse impact on the employment and education opportunities afforded to people of color” (Floden, Richmond, Drake & Petchauer, 2017, p. 360).

The ETS had a long history of producing teacher licensure assessments. ETS introduced the National Teacher Examinations (NTE) in the 1930s. These assessments focused mainly on assessing a pre-service teacher’s CK. In 1993, ETS introduced the Praxis tests to replace the NTE assessments. These tests were designed to evaluate pre-service teacher knowledge and skills (Educational Testing Services [ETS], 2017). These assessments added assessment of a candidate’s understanding of the teaching and learning process (Gitomer & Qi, 2010 p. 3). “Performance on Praxis is used by the majority of states as one of several criteria for licensing new teachers and by many colleges and universities to admit students into teacher education degree programs” (Nettles, Scatton, Steinberg, & Tyler, 2011, p. 2).

The Praxis test was one assessment used by states for teacher licensing and certification. Three different types of Praxis tests were offered by ETS, Praxis Core Academic Skills for Educators (CORE), Praxis Subject Assessments, and Praxis Content Knowledge for Teaching Assessments (CKT). Each of these assessments was used for specific purposes in the teacher licensure and certification process. The CORE assessments “measure academic skills in reading, writing and mathematics. They were designed to provide comprehensive assessments that measure the skills and content

knowledge of candidates entering teacher preparation program" (ETS, 2017, para. 2). The Praxis Subject Assessments "measure subject-specific content knowledge, as well as general and subject-specific teaching skills, that you need for beginning teaching" (ETS, 2017 para. 3). The CKT assessments "measure subject-specific content knowledge, with a focus on specialized content knowledge used in K-12 teaching" (ETS, 2017 para. 4).

"While the Praxis II tests are used across states, every state creates its own teacher certification testing program. States select the particular Praxis II tests they will use from more than 100 test titles that are part of the Praxis program" (Gitomer & Qi, 2010, p. 2). States decided on the passing score for the Praxis tests that was used for licensure and certification, resulting in different passing score standards in each state. (Gitomer & Qi, 2010, p. 2). "Tests are designed to measure knowledge of content, general pedagogy and content-specific pedagogy and are used to satisfy state licensure requirements. Over 140 Praxis II test titles are offered, covering the entire range of content-specialty areas and pedagogy domains" (Tyler et al., 2011, p. 14).

In 2010, The USDOE studied the trends and scores from the Praxis II Licensure tests. "The study served simply as an effort to examine trends in a systemic outcome that all of these policies have aimed to influence-the CK of prospective teachers" (Gitomer & Qi, 2010, p. xv). The focus of the study was to "identify trends in Praxis scores on a select number of tests across recent years and across as many states as possible" (Gitomer & Qi, 2010, p. xv). This study included both of the Praxis elementary education licensure assessments. Gitomer & Qi (2010) found the scores of candidates that passed the Praxis assessments were significantly higher than those who did not pass. The

researchers contributed higher scores to two main factors. First, "licensure tests are filtering out individuals who attain very low scores on tests of content knowledge" (Gitomer & Qi, 2010, p. xvii). Second, "it is unlikely that many of these low scoring individuals will achieve a passing score simply through taking the test multiple times without learning more of the content that is measured on the test" (Gitomer & Qi, 2010, p. xvii).

The admissions criteria used by college and universities had implications on teacher licensure assessment scores. "Given that Praxis I is a series of basic skills tests, it is more likely that test-takers attending more selective colleges and universities would achieve higher scores on Praxis I than their contemporaries attending less selective institution" (Nettles et al., 2011, p. 19). In the 2014 comparison study of teacher candidates attending moderately selective and selective institutions, scores on the MoGEA assessment subtest, “reveals the mean and median scores from moderately selective institutions are lower on all five subtests than those from selective institutions. On average, the mean scores from moderately selective institutions are 5.4 points lower than those from selective institutions” (Edmonds, 2014, p. 108). The Impact of Admissions and Licensure Testing report overviewed the 1999 research completed by the ETS. The study concluded “teacher academic ability varies widely by type of licensure sought, with those candidates seeking licenses in academic subject areas having the highest college admissions test scores, and those in non-academic fields like elementary education having the lowest scores” (Gitomer & Latham, 1999, p. 3). “Teacher education programs need to critically examine their admission criteria to make sure that those

criteria, along with the preparation they provide, will lead to their graduates being successful beginning teachers" (Casey & Childs, 2007, p. 14).

Research comparing performance and passing rate gaps for Praxis I tests showed large discrepancies between minority race groups and White test takers (Camara & Schmidt, 1999; Tyler et al., 2011). In 2005, The National Education Association (NEA) and the ETS completed research focusing "on the disparate performance between minority and non-minority teacher candidates on licensure tests. The data show that minority teacher candidates score lower on average on their licensure tests" (Tyler et al., 2011, p. 3). In an analysis of Praxis I candidate scores from 2005-2009, "the pattern for both African American and White test takers on each of the three Praxis I tests was that the more selective the colleges and universities, the higher the mean scores were" (Nettles et al., 2011, p. 19).

Nettles, Scatton, Steinberg, & Tyler's (2011) research of Performance and Passing Rate Differences of African American and White Prospective Teachers on Praxis Examinations found "the differences . . . may be at least in part related to their differences in UGPA, teacher education program enrollment status, their own educational attainment, their parental educational attainment, undergraduate major, and selectivity of attending institution" (p. 21). A study of the MoGEA subtest scores found "the passing rates for teacher candidates who self-identified as Black, NonHispanic or Hispanic/Latino were consistently lower on all five MoGEA subtests, regardless of decile, than were the scores of teacher candidates in the other ethnic groups" (Edmonds, 2014, p. 114).

The Teachers Performance Assessment (edTPA) was "a more rigorous initial licensure for teacher education graduates in general and special education to certify their

competence for providing all students with rigorous content instruction" (Kirchner, 2012, p. 33). Evans, Kelly, Baldwin, and Arnold (2016) found a statistically significant relationship between the relationship between overall GPA and performance on the edTPA for early childhood pre-service teachers (2016). "[Forty] states and over 600 institutions have adopted edTPA since it went public in 2013" (Floden et al., 2017, p. 360). The edTPA assessment influenced TPPs in the states that were implementing, because of the increased level of requirements required of candidates. In turn, TPPs in states using this measure were faced with revising TPP programs and curriculum to meet the requirements. (Floden et al., 2017, p. 360).

Many studies on the effects of teacher licensure tests on teacher quality existed. In 2015, Larsen found the use of a subject-area knowledge assessment for licensure resulted in an increase of teacher quality

Teacher Certification

The requirements for teacher certification changed throughout history. Angus (2001) traced the history of the teacher certification system, which revealed at the beginning of the 20th Century, "Examinations were far and away the primary means of determining the competence of aspiring teachers. By mid-century certification, examinations had all but disappeared. As the century closed we were placing much more emphasis on examinations again" (Angus, 2001, p. 2). Initial teacher certification requirements increased throughout the 20th Century. "As late as 1921, 30 states still had no definite prior schooling requirements for initial certificate" (Angus, 2001, p. 17). The amount of schooling required for initial teacher certification gradually increased through the years. "By 1937, five states required for their initial certificate four years of college,

eight required three years of college" (Angus, 2001, p. 17). "By 1938, all states required some professional training for one or more of the certificates they offered, with the average being about 12 credit hours for the elementary certificate" (Angus, 2001, p. 18). “In 2014, all states and jurisdictions except Palau reported they had standards that prospective teachers must meet in order to attain an initial teacher credential” (USDOE, 2016b, p. xvii).

As part of the teacher certification process, and required by Title II of HEA, states “set standards for prospective teachers to meet in order to be eligible for an initial teaching credential. These standards define the skills and abilities teachers need to possess in order to effectively prepare their students for success” (USDOE, 2016b, p. 40). The national standards from organizations, such as the Interstate Teacher Assessment and Support Consortium (InTASC) and NCATE supported states in the development of the expectations for pre-service teachers. (USDOE, 2016b, p. 40). These standards became a focus of colleges and universities. In 2002, 85% of the teacher education programs reported using both NCATE accreditation standards to determine expectations for the outcome measures and expectations for teacher candidates completing the program. (Salzman, Denner, & Harris, 2002, p. 22).

One theory among the improvement of teacher certification controversy was the "deregulation agenda aimed to eliminate most requirements for entry into teaching and to dismantle state licensing/certification apparatus. Proponents of deregulation advocated multiple entry routes, with student test scores the bottom line for determining who should teach" (Cochran-Smith et al., 2013, p. 9)

It was the responsibility of individual states to monitor the effectiveness of TPPs operating within the state. As part of the requirements in Title II of the Higher Education Act of 1965, states were required to identify and report to the USDOE any low-performing TPPs operating within the state (Emrey-Arras, 2015, p. 2). In order for a teacher to be classified as highly qualified under NCLB, the teacher must hold state certification or licensure.

Teacher candidates in the State of Missouri could seek certification from MODESE through six routes: traditional, alternative or innovative, temporary authorization, out-of-state certified, American Board of Certification for Teacher Excellence (ABCTE), and doctoral. All of these certification routes, except out-of-state certification, required passing at least one basic knowledge or content examination. (MODESE, 2014b).

The USDOE 2014 report on teacher quality analyzed Missouri teacher licensure assessments and found that the average cut score for teacher assessments in the state of Missouri was 60.5% and the average scaled score was 75.2%, resulting in a gap of 14.7%. The National average cut score was 60.2%, with an average scaled score of 74.4% and a gap of 14.3%, revealed that Missouri's scores were close to the national average (USDOE, 2016b, pp. 66-67).

The results of the 2016 APR of 1.5 for the studied university indicated that eight certification areas scored in the Tier 1 level. Ten of the certification areas scored in the Tier 2 level. (MODESE, 2017a, p. 12). The studied university's Elementary Education, Grades 1-6, Program earned 14 of the 20 possible points for Indicator 1.1, certification

assessment pass rate. Of the 373 students who took the assessment, 309 passed, resulting in an 82.8% pass rate. (MODESE, 2017b, p. 2).

Grade Point Average

Grade point average (GPA) "is consistently used by teacher education programs to determine pre-service teacher admittance, continuance, and success in the program" (Evans et al., 2016, p. 151). GPA "is generally believed to measure academic ability and so is thought to predict success in the instructional parts of the programs" (Casey & Childs, 2007, p. 7). However, GPA can be influenced by a number of different factors including "test-taking ability, attendance, performance on written work, instructor judgment, study skills, etc." (Evans et al., 2016, p. 151)

Research focused on determining if a relationship existed between pre-service teacher GPA and teacher quality had mixed results. Using six years of data from new teachers in the New York City Public Schools, Kane, Rockoff, and Staiger (2008), found "the initial certification status of a teacher has small impacts on student test performance" (p. 615). Nevertheless, other research found that teachers' overall undergraduate GPA did predict student achievement. (Dobbie & Fryer, 2011; Jacob, Rockoff, Taylor, Lindy, & Rosen, 2016; Kukla-Acevedo, 2009).

A study conducted in the Washington DC Public Schools of teacher quality found "that several background characteristics (e.g., undergraduate GPA) as well as screening measures (e.g., applicant interview scores) strongly predict teacher effectiveness" (Jacob et al., 2016, p. 3). Chaney (1995) researched the relationship between teacher preparation programs in mathematics and science and student scores on standardized tests. "The study uses the base-line data collected in 1988 for the National Education Longitudinal

Study, a national study of 24,599 students in eighth grade" (Chaney, 1995, p. 4). One of the factors the researchers examined was teacher grade point average during teacher preparation. "An estimated 12 percent of science students had teachers with science GPAs of 3.6 or higher, while 50 percent had teachers with GPAs ranging from 2.6 to 3.5, and 38 percent had teachers with GPAs of 2.5 or lower" (Chaney, 1995, p. 8). In the area of mathematics, "A slightly higher proportion of mathematics students had teachers with mathematics GPAs of 3.6 or higher (19 percent), while 49 percent had teachers with GPAs ranging from 2.6 to 3.5, and 31 percent had teachers with GPAs of 2.5 or lower" (Chaney, 1995, p. 8). In the area of mathematics, the data showed students "performed better if their teachers had high GPAs in mathematics (51.9) than if their teachers had low GPAs (49.2)" (Chaney, 1995, p. 10). In the area of science, "students performed better if their teachers had high GPAs in science (51.4) than if they had low GPA (49.2)" (Chaney, 1995, p. 10).

A 2005 study of Praxis I scores completed by the ETS and NEA compared the undergraduate grade point average (UGPA) of test takers. The researchers noted, "The difference in UGPA matters because, on average, scores on the Praxis I tests increased as UGPA increased" (Tyler et al., 2011, p. 13). The implications for TPP programs and teacher licensure candidates were stated as

> UGPA should generally be a useful gauge of students' readiness to test. . . . If a student is achieving a C average or less, his or her chances of passing the required licensure tests are significantly lower than a student with an A or B average. (Tyler et al., 2011, p. 13)

An analysis of Praxis I candidate scores from 2005-2009 also revealed a correlation between UGPAs and Praxis I scores. The researchers found, "As the UGPAs increase, the score gaps grow wider, such that the largest Praxis I score gaps are found among test-takers in the highest UGPA ranges" (Nettles et al., 2011, p. 10). The researchers concluded, “Having a UGPA above 3.0 as opposed to below 3.0 or having a major other than education gives test-takers about a two to three point average increase in scores” (Nettles et al., 2011, p. 23).

A study of the MoGEA subtest scores found that “as teacher candidates’ cumulative GPAs increase, so do their MoGEA scores. Especially if the coursework a teacher candidate has completed at the time she or he plans to take the MoGEA is predominantly composed of general education courses” (Edmonds, 2014, p. 124). Edmond’s 2014 study of MoGEA included GPA as one of the analyzed characteristics. The study found “there is a direct relationship between a student’s GPA at the time the student’s highest reported score on the MoGEA was obtained and that student’s MoGEA scores” (Edmonds, 2014, p. 133).

One key challenge for teacher preparation programs was developing effective practices and policies in light of the mixed and inconclusive findings in the research base regarding which qualifications and components of teacher preparation produced effective teachers (Aldeman & Mitchel, 2016). Another challenge “is that programs that require high GPAs for admission necessarily have a restricted range of GPAs among their preservice teachers, making it difficult to detect a significant relationship between GPA and any other variable” (Casey & Childs, 2007, p. 12).

Teacher Preparation Programs

Numerous organizations participated in the many decisions related to teacher preparation programs. "Teacher education policy is developed and enacted by professional organizations, and national and regional accreditors, as well as by individual higher education institutions and alternate providers of preparation" (Cochran-Smith et al., 2013, p. 8). According to the USDOE report on teacher quality, "States reported a total of 26,589 teacher preparation programs in 2014" (p. xiv). Teacher preparation programs have seen a decrease from 2010-2013 as shown in Table 5.

Table 5

Enrollment in Teacher Preparation Programs

Year	Enrollment
2010-2011	684,801
2011-2012	623,190
2012-2013	499,800

Note. Source: USDOE, 2016b, p. xv.

"Traditionally, an education degree with a student teaching experience and passage of licensure exams were necessary for licensure. In the 1980s, alternative paths to certification developed" (Shuls & Trivett, 2013, p. 1). "Roughly 460,000 individuals were enrolled in traditional and alternative route to certification teacher preparation programs in 2013-14" (USDOE, 2016b, para. 3). According to the National Center for Education Statistics (NCES) 2016 report, of the 72,400 newly hired public school teachers in 2011-2012, 49% held a bachelor's degree, 37% held a master's degree and 19.2% received alternative certification. (Warner-Griffin, Noel & Tadler, 2016, p. 22) According to the findings from the IEA Teacher Education and TEDS-M, "Since 1998/1999, the number of teachers licensed through alternate routes has climbed steadily: in 2004/2005, approximately 50,000 teachers (about 33% of all teachers hired that year)

entered through such routes" (Ingvarson et al. 2013, p. 72-73). The USDOE's *10th Report on Teacher Quality* categorized types of teacher preparation programs into three categories, traditional, alternative route provided through an institution of higher education (IHE), and alternative route not offered by an IHE. In 2014, the total number of programs reported by states included "1,497 (69 percent) classified as traditional teacher preparation providers, 473 (22 percent) alternative route teacher preparation providers based at IHEs, and 201 (9 percent) alternative route teacher preparation providers not based at IHEs" (USDOE, 2016b, p. xiv). Table 6 compares the number of students in each of the three types of preparation programs.

Table 6

Enrollment in Types of Teacher Preparation Programs

Type of preparation	Percentage of completers	Total number
Traditional	89%	447,116
Alternative route provided by IHE	5%	25,135
Alternative route not based at IHE	6%	27,549

Note. Source: USDOE, 2016b, p. xv.

"Improving teacher preparation is a proactive solution that will benefit teachers in training before they are teachers of record" (Kirchner, 2012, p. 39). "Alternative certification programs continue to be one of the most popular trends for luring individuals into the classroom" (Koehler, Feldhaus, Fernandez & Hundley, 2013, p. 46). According to the USDOE, 2014 report on teacher quality, "[Forty-seven] states, the District of Columbia, Puerto Rico, and Virgin Islands reported having approved alternative routes to teaching credentials" (USDOE, 2016b, p. 8). "Alternatively certified teachers must pass the same licensure exams as traditionally certified teachers (Shuls & Trivitt, 2013, p. 2). Although "alternative pathways range in quality and include teachers who enter with

emergency certifications or enter through a highly competitive program, such as Teach for America (TFA)" (Shuls & Trivitt, 2013, p. 6).

Ingersoll, Merrill, and May (2014) studied the NCES Schools and Staffing Survey to determine how the different types TPP preparation impacted attrition. The researchers concluded,

> Some aspects of the education and preparation that beginning teachers received were significantly associated with attrition, while others were not. Specifically, the type of college, degree, entry route or certificated mattered little. What did matter was the substance and content of new teacher's pedagogical preparation. (Ingersoll, Merrill, & May, 2014, p. 1)

A 2013 study of teacher perception of preparation of teachers who received alternative certification found that participants perceived themselves as most prepared in the areas of assessment and content. "The survey results indicated that individuals without industry experience and individuals who did not have a graduate degree perceived themselves as being more prepared when creating lesson plans than those individuals with graduate degrees" (Koehler et al., 2013, p. 51).

In the report, An Evaluation of Teachers Trained Through Different Routes to Certification, completed by the USDOE, researchers comparing routes to certification found "there was no statistically significant difference in performance between students of alternative route to certification (AC) teachers and those traditional route to certification teachers (TC) " (Constantine et al., 2009, p. xviii). Because the AC routes could vary in the amount of coursework required, the researchers compared both high and low amount of coursework required and found "neither AC group had a statistically

significant difference from its TC counterpart group in terms of college entrance exam scores or educational attainment" (Constantine et al., 2009, p. xxvii). Furthermore, "Students of AC teachers did not perform statistically differently from students of TC teachers" (Constantine et al., 2009, xxviii).

Ingersoll et al. (2012) completed a study of preservice teacher preparation programs to answer the question, "Do the kinds and amounts of education and preparation that new teachers receive before they begin teaching affect whether they remain in teaching?" (Ingersoll et al., 2012, para. 4). Using data from the NCES from the 2003-2004 Schools and Staffing Survey, the researchers examined first year teacher data. The authors concluded that the teacher preparation program significantly affected teacher attrition. The researchers found "some features of teacher education and preparation have a strong barrier on retention of new teachers. Most striking, those who have received more pedagogical training are far more likely to stay in teaching after their first year" (Ingersoll et al., 2012, para. 25).

Harris and Sass (2007) studied the effects of teacher preparation programs to positively impact student achievement and found no relationship between preservice teacher training and student outcomes.

The comparison of teacher preparation programs should also take in to account the program recruitment results. "Some programs may appear stronger not because they provide better opportunities for students to learn to teach but because they are able to attract better teacher candidates" (Boyd et al., 2009, p. 433). Entry and exit requirements could also vary between various teacher preparation programs. In 2014, "The three most commonly reported requirements for admission into traditional undergraduate teacher

preparation programs were minimum GPA; transcript; and minimum number of courses, credits, or semester hours completed" (USDOE, 2016b, p. 5). Furthermore, "The three most commonly reported requirements for exiting traditional postgraduate teacher preparation programs were minimum number of courses, credits, or semester hours completed; minimum GPA; and minimum GPA in professional education coursework" (USDOE, 2016b, p. 5).

Teacher Preparation Program Evaluation

According to the National Academy of Education report on the evaluation of teacher preparation programs, "Evaluating the quality and effectiveness of TPPs is a necessary ingredient to improved teaching and learning" (Feuer, Floden, Chudowsky & Ahn, 2013, p. 1). "Historically, TPPs have been evaluated based primarily on the components of the preparation program itself, including required coursework, faculty who teach the courses, and the nature and types of experiences that preservice teachers receive" (Henry, Kershaw, Zulli & Smith, 2012, p. 336). "Nationwide, evaluation of teacher preparation programs involves primarily state program approval processes, which vary substantially" (Meyer, Brodersen & Linick, 2014, p. 2). The TPP evaluation standards focused mainly on TPP program process, with very few states focusing on the quality of the graduates of the programs (Crowe, 2011).

The evaluation process for TPP was also a focus of national efforts. In 2011, the USDOE published the Plan for Teacher Education Reform and Improvement (USDOE, 2011). "This plan begins with finally providing prospective teacher candidates, hiring school districts, and teacher preparation programs themselves with meaningful data on program quality to inform academic program selection, improvement, and

accountability" (USDOE, 2011, p. 9). The plan focused on outcome-based measures instead of the traditional input-based measures states were traditionally required to report as part of the Higher Education Act. These outcome-based measures included: "student growth of elementary and secondary school students taught by program graduates, . . . job placement and retention rates, . . . surveys of program graduates and their principals" (USDOE, 2011, p. 10). Arne Duncan, U.S. Secretary of Education, stated that the Teacher Education Reform and Improvement plans provides "clear standard of quality that includes but is not limited to their record of preparing and placing teachers who deliver results for P-12 students. The best programs will be scaled up and the lowest-performing will be supported" (USDOE, 2011, p. 2). "Under the current reporting system, states set their own criteria for evaluating the performance of all three types of teacher preparation program" (USDOE, 2016b, p. 49). Table 7 shows the number of states using various types of criteria.

Table 7

State Teacher Preparation Program Criteria

Type of indicator	Number of states
"Pass rates on state assessments"	41
"Indicators of teaching skills"	46
"Increasing state Highly Qualified Teacher Percentage"	23
"Increasing professional development opportunities for current teachers"	25
"Improving student academic achievement"	31
"Raising standards for entry into teaching"	29
"Other"	23

Note. Source: USDOE, 2016, p. 50.

State criteria for identifying low-performing teacher preparation programs varied. Some states used multiple data sources, while others used only one data source; and

furthermore, the data sources used to evaluate the effectiveness of the teacher preparation programs varied widely. Each state utilized a unique set of criteria to determine if a program was low performing. In 2014, "A total of 45 programs were classified as low-performing or at risk in 2014" (USDOE, 2016b, p. 52).

Teacher preparation programs applied for accreditation as a way of "quality assurance through external peer review. When an institution or specialized program is accredited, it has demonstrated that it meets standards set by organizations representing the academic community, professionals, and other stakeholders" (CAEP, 2017) para. 2). "National systems of program accreditation have gained prominence, especially as many states have begun to require national accreditation" (Floden et al., 2017, p. 360). Regardless of the type of program, all programs were held accountable for accreditation requirements. "Under Title II of the HEA, institutions of higher education (IHEs) that conduct teacher preparation programs, whether traditional or alternative route programs, must annually collect and submit information to their respective states" (USDOE, 2016b, p. ix). These data were used at both the federal and state levels to plan for changes and evaluate programs. In 2014, a report of how seven of the Regional Educational Laboratory (REL) states evaluated TPPs was completed. The researchers found many states were "implementing or planning changes to how they evaluate teacher preparation programs. Most changes involve paying more attention to the performance of program graduates, developing common data collection tools and data systems, and developing new ways to report evaluation data" (Meyer et al., 2014, p. i)

With the increased use and evaluation of teacher preparation program data, Kirchner (2012) provided evidence to proceed with caution.

> Despite the potential importance of teacher preparation as a point of intervention in education, current decision making by policy makers and teacher educators is based on study results lacking evidence that the data are predictive of educational outcomes for students. (Kirchner, 2012, p. 39)

Furthermore, the use of program data was varied across states. "Some states provide general guidelines, while others mandate specific requirements concerning liberal arts courses, subject-matter courses, and pedagogy courses." (Ingvarson et al. 2013, p. 73). The lack of consistency across states in how teacher preparation data were analyzed and utilized was evident.

One flaw in using licensure tests as a measure of TPP effectiveness was "candidates take the tests at different points in their preparation program and thus have completed varying amounts of coursework and student teaching experience at the time of testing" (Feuer et a., 2013, p. 32). Teacher candidates in the state of Missouri participated in multiple assessments referred to as The MEGA. The last exam required for teacher candidates to pass was the MoCA. A passing score was required for a pre-service educator to gain certification (MODESE, 2015c). "Among the many current controversies are questions about what goals should drive state, federal, and professional accountability policies; which assessments to use; who should conduct assessments; and what the consequences should be for failure to perform" (Cochran-Smith et al., 2013, p. 7).

Summary

Teacher content knowledge literature indicated the importance of teachers demonstrating a strong CK base. The literature also supported the importance of

pedagogical CK in subject areas, which resulted in increased student achievement. The literature furthermore revealed the teacher was the critical factor in determining student achievement. Because of the strong correlation between teacher CK and student achievement, the literature revealed an increased focus on accountability measures to ensure pre-service teachers demonstrated CK in all subject areas.

Exploration of the literature on the presence of the importance of teacher content in teacher standards revealed an increase in the rigor of the standards and a focus on specific pre-service teacher outcomes. The literature addressed the policies addressing the assessment of pre-service teacher CK. While there is evidence of the importance of teacher CK throughout policies, a lack of consistency was noted regarding how pre-service teacher CK is assessed. This area continued to be a focus for educational leaders and policy makers at both the state and federal levels, as well as for teacher certification test developers.

Universities preparing pre-service teachers had an important responsibility in preparing and designing programs to prepare quality teachers. The literature comparing performance and passing rates indicated discrepancies between minority race groups and White test takers. This concern, along with literature examining the admission criteria implications for some universities and the lack of consistency in developing cut scores gave critics reason to pause when thinking about the implications from the CK assessment data.

Finally, the literature suggested that GPA and teacher preparation programs were valid predictors of success on teacher licensure assessments. With this research, the

literature examines the many implications on the evaluation of teacher preparation programs at both the state and national levels.

Chapter Three includes a review of the purpose of this study. The hypotheses are revisited. The research design is described, and the population and sample are explained and defined. The process for data collection is analyzed and the process for data analysis is outlined.

Chapter Three: Methodology

Purpose

The purpose of this quantitative study was to determine the effectiveness of a private Midwestern University's teacher preparation program through examining the results of both undergraduate and graduate student scores on the MoCA, in order to determine if a relationship existed between overall GPA and coursework grades. The researcher sought to determine if teacher candidates who participated in the graduate or undergraduate program had congruent or different CK as measured by the MoCA. The study aimed to identify if there were differences between graduate candidates and undergraduate scale scores in the subtests of mathematics, science, and social studies. In order to compare the ability of the undergraduate and graduate teacher education programs to prepare students for success on the MoCA, the researcher investigated the results of graduate and undergraduate students on each of the subtests to determine if there was a significant difference. The GPA for graduate and undergraduates in specific courses was analyzed to determine if there was a correlation between the GPA and the student performance on the MoCA. The researcher also compared both undergraduate and graduate student GPA in content areas to the scale score earned in the corresponding MoCA subtest.

By completing quantitative analyses through comparison, the researcher sought to accomplish the following: provide feedback regarding the effectiveness of the undergraduate teacher education program versus a graduate program in preparing students for the MoCA, examine the effectiveness of teacher education coursework in content areas, and determine if instructional changes were needed in either teacher

education program. Additionally, this study aimed to identify characteristics of TPP candidates at the Researched University that might serve as predictors of success on the MoCA. If predictor variables were determined, university staff could identify which of their education students would most likely require additional support and preparation for the MoCA.

Methodology

This quantitative study utilized the Pearson Product-Moment Correlation Coefficient (PPMCC) to test each null hypothesis and measure the strength of the possible linear association between the two variables contained in each null hypothesis. "The Pearson product-moment correlation coefficient (or Pearson correlation coefficient, for short) is a measure of the strength of a linear association between two variables and is denoted by *r*" (Laerd Statistics, 2015, "What does this test do?" para. 1). Laerd Statistics (2015) explained the PPMCC test as an attempt to draw a line of best fit through the data points of two variables, and the PPMCC, *r*, indicated how far away all the data points were from the line of best fit. This study utilized the PPMCC methodology to analyze data for Null Hypotheses 1-10 and 12, in order to measure the association of the variables and draw conclusions that could provide information to the Researched University regarding how the variables examined in this study related to student performance on the MoCA.

The Institutional Review Board at Lindenwood University granted approval for the study. Because only extant data were used, informed consents were neither applicable nor required. Written permission was obtained from the Associate Dean at the research site.

The sampling method used was the Random method. Subjects were selected by random numbers generated through a computer web-based service, Research Randomizer.

1) Random samples of undergraduate student cumulative GPAs and number of attempts on the elementary MoCA were evaluated in order to determine the strength of the relationship between the two. The researcher calculated the PPMCC and checked for significance of the value at the alpha level of 0.05.
2) Random samples of graduate student cumulative GPAs and number of attempts on the elementary MoCA were evaluated in order to determine the strength of the relationship between the two. The researcher calculated the PPMCC and checked for significance of the value at the alpha level of 0.05.
3) Random samples of undergraduate student elementary MoCA math subtests and GPAs in math courses offered by the math department were evaluated in order to determine the strength of the relationship between the two. The researcher calculated the PPMCC and checked for significance of the value at the alpha level of 0.05.
4) Random samples of graduate student elementary MoCA math subtests and GPAs in math courses offered by the math department were evaluated in order to determine the strength of the relationship between the two. The researcher calculated the PPMCC and checked for significance of the value at the alpha level of 0.05.
5) Random samples of undergraduate student elementary MoCA science subtests and GPAs in science courses offered by the science department were evaluated in

order to determine the strength of the relationship between the two. The researcher calculated the PPMCC and checked for significance of the value at the alpha level of 0.05.

6) Random samples of graduate student elementary MoCA science subtest scores and GPAs in science courses offered by the science department were evaluated in order to determine the strength of the relationship between the two. The researcher calculated the PPMCC and checked for significance of the value at the alpha level of 0.05.
7) Random samples of undergraduate student elementary MoCA social studies subtest scores and GPAs in social studies courses offered by the social studies department were evaluated in order to determine the strength of the relationship between the two. The researcher calculated the PPMCC and checked for significance of the value at the alpha level of 0.05.
8) Random samples of graduate student elementary MoCA social studies subtest scores and GPAs in social studies courses offered by the social studies department were evaluated in order to determine the strength of the relationship between the two. The researcher calculated the PPMCC and checked for significance of the value at the alpha level of 0.05.
9) Random samples of graduate student elementary MoCA math subtest scores and the year the last math class was taken were evaluated in order to determine the strength of the relationship between the two. The researcher calculated the PPMCC and checked for significance of the value at the alpha level of 0.05.

10) Random samples of graduate student elementary MoCA science subtest scores and the year the last science class was taken were evaluated in order to determine the strength of the relationship between the two. The researcher calculated the PPMCC and checked for significance of the value at the alpha level of 0.05.

Null Hypotheses

Null Hypothesis 1: There is no relationship between the number of attempts on the elementary Missouri Content Assessment (MoCA) and cumulative GPA for undergraduate students.

Null Hypothesis 2: There is no relationship between the number of attempts on the elementary MoCA and cumulative GPA for graduate students.

Null Hypothesis 3: There is no relationship between the score on the elementary MoCA math subtest and GPA in math courses for undergraduate students.

Null Hypothesis 4: There is no relationship between the score on the elementary MoCA math subtest and GPA in math courses for graduate students.

Null Hypothesis 5: There is no relationship between the score on the elementary MoCA science subtest and GPA in science courses for undergraduate students.

Null Hypothesis 6: There is no relationship between the score on the elementary MoCA science subtest and GPA in science courses for graduate students.

Null Hypothesis 7: There is no relationship between the score on the elementary MoCA social studies subtest and GPA in social studies courses for undergraduate students.

Null Hypothesis 8: There is no relationship between the score on the elementary MoCA social studies subtest and GPA in social studies courses for graduate students.

Null Hypothesis 9: There is no relationship between the year the last math course was originally taken and the MoCA score for graduate students.

Null Hypothesis 10: There is no relationship between the year the last science course was originally taken and the MoCA score for graduate students.

Null Hypothesis 11: There is no difference between graduate candidates and undergraduate scale scores in the subtests of mathematics, science, and social studies.

Null Hypothesis 12: For graduate and undergraduate students, there is no relationship between student GPA and MoCA scale score when comparing GPA in the content area to the corresponding MoCA subtest.

Limitations

Several limitations to the study existed. The study focused on the results from the Missouri Content Assessments, implemented as part of the teacher certification assessment process since 2014 (MODESE, 2016a, para. 2). The MoCA was a state certification test used in the state of Missouri and the findings may not be generalizable to other programs using other teacher certification assessments. The scope and sample size of the study consisted of the Researched University elementary pre-service teacher candidates who participated in the MoCA assessment in the years 2010 through 2017. Therefore, the results are not generalizable beyond that context. At the Researched University, a 4.0 grading system was utilized to determine GPA. Cumulative GPA included only coursework grades completed at the Researched University (Researched University, 2017, para. 1). According to grading system, “a grade of A represents work of outstanding quality; it indicates that the student has shown initiative, skill, and thoroughness and has displayed originality in thinking” (Researched University, 2017,

para. 2). GPA was calculated the same for all students; however, the grading system in various coursework varied. This study analyzed only one teacher education program and the results may not be generalizable to other teacher certification programs.

The Research Site and Participants

Participants in the study included both undergraduate and graduate students who took the MoCA assessment after completing coursework requirements in the School of Education at the Researched University. The Researched University had a mid-size total enrollment. Table 8 illustrates the demographics of the elementary education program completers from 2010 through 2013.

Table 8

Demographics of Completers 2010-2013

Semester	Certification and Level	Female	Male	White	Hispanic	Black
FA 2010	Elementary /Early BA	43	1	40	0	0
FA 2010	Elementary /Early MAT	7	0	4	0	1
SP 2011	Elementary /Early BA	56	7	51	4	4
SP 2011	Elementary /Early MAT	15	0	12	0	3
SP 2012	Elementary /Early BA	36	4	37	0	3
SP 2012	Elementary /Early MAT	14	4	16	0	2
FA 2012	Elementary /Early BA	45	3	44	2	1
FA 2012	Elementary /Early MAT	13	0	11	1	1
SP 2013	Elementary /Early BA	54	4	49	2	1
SP 2013	Elementary /Early MAT	15	4	11	1	5
Total		353	29	324	10	26

Note. Source: (Researched University, 2014, p. 13-14).

The composition of the total student population includes “36% male and 64% female with a minority population of 29%; African American students make up the largest portion of minorities (21.6%), and Hispanic students make up the second largest portion (3.5%)” (Researched University, 2014, p. 13). At the Researched University, “the MAT program population is more diverse than the undergraduate; overall 81.41% of Teacher Education completers from the past five years are White and 8.6% are Black or African American from the past five years” (Researched University, 2014, p. 14).

The Researched University “offers programs of study leading to Missouri Initial Certification at both the baccalaureate degree level (Bachelor of Arts with one program having a BS option) and graduate level through the Master of Arts in Teaching” (Kania-Gosche, 2014, p. 8). “These programs are delivered in many different ways: traditional day undergraduate courses, evening courses, MAT graduate-level courses, online courses, and a pilot program of MAT clusters” (Kania-Gosche, 2014, p. 9). Students chose to take the MoCA based upon the field of education in which they wished to obtain teacher certification from MODESE. The Higher Learning Commission accredits the EPP at the Researched University. It is a member of the Council for Higher Education Accreditation. "All certification programs in the Department of Teacher Education are approved by the Missouri Department of Elementary and Secondary Education" (Private University, n.d.b., para. 7).

In order for an elementary pre-service teacher to take the MoCA assessment, students must meet the requirements of Stage One. The teacher education program consists of two stages. In Stage One, undergraduate students must complete 10 hours of coursework; meet the GPA requirements of at least 2.75 cumulative, 3.0 content area

coursework and 3.0 professional education coursework; receive "criminal background clearances(s)"; completed the MEP; "demonstrate evidence of competence in communications"; "attained the qualifying cut scores on the Missouri General Assessment (MoGEA)" (Private University, n.d.b., paras. 3-18). Students are then become a part of Stage Two. In this stage, teacher candidates are required to complete the following steps prior to student teaching, earn a passing score on the MoCA, meet the GPA requirements of minimum 2.75 cumulative, 3.0 content course, and 3.0 professional education coursework (Private University, n.d.b., paras. 3-18).

Undergraduate program.

The undergraduate elementary education bachelor's degree at the Researched University includes 65-67 credit hours in elementary education, 21 credit hours in content area and 26-27 credit hours of additional coursework. (Researched University, 2017). "The program has three benchmarks: Admittance into Teacher Education, Application for Student Teaching, and Program Completion" (Research University's Catalog, 2014, pp. 9-10). Table 9 describes the requirements for each of the program benchmarks.

Table 9

Description of Elementary Education BA Program

Benchmark	Requirements
Prior to Benchmark 1	Complete 15 hours of education coursework and passing score on CBASE
Benchmark 1	Apply for admission to the teacher education program, complete disposition with advisor and cumulative GPA of 2.5 with a grade of C or above in all education and content coursework
Benchmark 2	Complete coursework, pass licensure assessments, complete student teaching requirements, cumulative GPA requirement of 2.5 with a grade of C or above in all education and content and pass the university writing proficiency assessment
Benchmark 3	Complete student teaching, complete portfolio and complete application for Missouri teaching certification

Note. Source: (Researched University, 2014, p. 9-10).

Table 10 displays the Elementary Education undergraduate course requirements at the Researched University.

Table 10

Elementary Education Undergraduate Course Requirements

Course Title	Credit Hours
Orientation to Educational Experiences	3
School Observation	1
Psychology of Teaching and Learning	3
Teacher Education Seminar 1	1
Children's Literature	3
Methods of Integrating Art, Music, and Movement in Elementary Education	3
Elementary Reading Methods	3
Elementary School Language Arts Methods	3
Analysis and Correction of Reading Difficulties	3
Practicum: Analysis and Correction of Reading Difficulties	2
Elementary School Mathematics Methods	3
Elementary School Social Studies Methods	3
Elementary School Science Methods	3
Elementary Classroom Teaching and Technology	3
Education of the Exceptional Child	3
Elementary School Differentiation and Classroom Management	3
Childhood Health, Nutrition and Safety	3
Pre-Student Teaching Practicum	1
Advanced Measurement and Evaluation to Enhance Learning	3
Student Teaching	12
TESOL Methods	2

Note. Source: (Researched University, 2017).

Table 11 displays the Researched University's mathematics course requirements.

Table 11

Elementary Education Undergraduate Math Course Requirements

Course Title	Credit Hours
Mathematical Structures for Teachers II	3
Mathematical Structures for Teachers I	4
or	
College Algebra	3

Note. Source: Researched University (2017).

Table 12 displays the Researched University's science course requirements.

Table 12

Elementary Education Undergraduate Science Course Requirements

Course Title	Credit Hours
Concepts in Biology	4
One Physical or Earth Sciences with Lab (Concepts in Chemistry, Physical Geology with Lab, Introductory Meteorology and Lab, Introductory Astronomy with Lab, or Concepts of Physics with Lab)	4

Note. Source: Researched University (2017).

Table 13 displays the Researched University's social studies course requirements.

Table 13

Elementary Education Undergraduate Social Studies Course Requirements

Course Title	Credit Hours
Geography course (World Regional Geography or Concepts of Geography)	3
US Government course (US Government: Politics and History or American Government: The Nation)	3
Economics course (Survey of Economics, Principles of Microeconomics, or Principles of Macroeconomics)	3

Note. Source: Researched University (2017).

Graduate program.

The Master of Arts elementary education, grades 1-6 degree at the Researched University includes 80-83 credit hours in elementary education (Researched University, 2017). "The biggest difference between the MAT and the BA program is that at the graduate level, candidates may become certified without completing the degree" (Researched University, 2014, p. 11). The benchmarks and requirements for completers of the MAT program are similar to the undergraduate program with the exception of MAT completers are not required to pass the CBASE, the coursework requirements are

different and practicum experiences are included in the required courses (Researched University, 2014).

Table 14 displays the Elementary Education graduate course requirements at the Researched University.

Table 14

Elementary Education Graduate Course Requirements

Course Title	Credit Hours
Analysis of Teaching and Learning Behavior	3
Educational Research	3
Conceptualization of Education or Conceptualization of Education for Beginning Teachers	3
Curriculum Analysis and Design or Master's Project	3
Foundations of K-12 Education	3
Psychology of Teaching and Learning	3
Elementary Reading Methods	3
Elementary School Language Arts Methods	3
Analysis and Correction of Reading Difficulties	3
Practicum: Analysis and Correction of Reading Difficulties	2
Teacher Education Seminar 1	0-3
Elementary School Classroom Teaching and Technology	3
Education of the Exceptional Child	3
Elementary Differentiation and Classroom Management	3
Pre K-8 Health, Nutrition and Safety	3
Methods of Integrating Art, Music, and Movement in Elementary Education	3
The Integrated Literature Curriculum	3
Advanced Measurement and Evaluation to Enhance Learning	3
Field Experience, Student Teaching	12

Note. Source: Researched University (2017).

Table 15 displays the Researched University's mathematics course requirements.

Table 15

Elementary Education Graduate Math Course Requirements

Course Title	Credit Hours
Elementary School Mathematics Methods	3

Note. Source: Researched University (2017).

Table 16 displays the Researched University's science course requirements.

Table 16

Elementary Education Graduate Science Course Requirements

Course Title	Credit Hours
Elementary School Science Methods	3

Note. Source: Researched University (2017).

Table 17 displays the Researched University's social studies course requirements.

Table 17

Elementary Education Graduate Social Studies Course Requirements

Course Title	Credit Hours
Elementary School Social Studies Methods	3

Note. Source: Researched University (2017).

Research site performance data. According to the 2017 APR from MODESE, the Researched University "offered 39 certification programs leading to certification to teach in Missouri" (para. 1). From the 2012-2016 school years, the university reported a total of 1,643 certification candidates.

Due to the size of the School of Education, random samples of students from both the undergraduate and graduate programs were selected. The researcher analyzed a random sample of 50 undergraduate and 35 graduate students. Bluman (2013) stated, "according to the central limit theorem, approximately 95% of the sample means fall within 1.96 of the standard deviations of the population mean if the sample size is 30 or more" (p. 358).

Summary

The purpose of this quantitative study is to compare the effectiveness of a private Midwestern University's teacher preparation program through examining the results of both undergraduate and graduate student scores on the MoCA to determine if a relationship existed between overall GPA and coursework grades. The researcher would like to determine if teacher candidates who participate in the graduate or undergraduate program have congruent or different CK as measured by the MoCA. The study aims to

identify if there are differences between graduate candidates and undergraduate scale scores in the subtests of mathematics, science and social studies. The study measured possible correlations between the number of attempts and cumulative GPA, GPA in specific coursework and performance on the related MoCA subtest for math, science and social studies, the year the last math or science course was taken and the MoCA subtest score for graduate students and if a difference existed between graduate and undergraduate candidates scale scores on the MoCA.

In Chapter Four, the collected data are explained. Tables and figures are used to enhance the understanding of the data. Chapter Five includes the findings, conclusions, and recommendations for future research.

Chapter Four: Results

Overview

This study analyzed the relationship between pre-service teacher performance in college classes as measured by overall GPA and GPA in content areas and performance on the Elementary MoCA. The purpose of this study was to determine if undergraduate and graduate pre-service teacher GPA at the Researched University was a predictor of success on the Elementary MoCA.

Description of the Population

The study population included a sample of both undergraduate and graduate students pursuing elementary education teacher licensure at a private Midwestern university during the 2015-2016, 2016-2017, and 2017-2018 school years. The total population of 205 graduates included 169 undergraduate candidates and 36 graduate candidates. A random sample of 35 graduate and 50 undergraduate teacher candidates were selected for the study. The degree choice for the population of graduates is shown in Table 18.

Table 18

Year Entering Student Teaching for Sample

	2015	2016	2017	2018
BA	6	14	20	5
MAT	1	18	9	4

Table 19 provides the demographics for the two samples.

Table 19

Demographics for Sample

	Total	Female	Male	American Indian or Alaska Native	Hispanic	Asian	Black or African American	Two or more races	White
BA	50	44	6	1	0	1	3	1	44
MAT	35	34	1	1	1	0	2	1	30

A PPMCC was utilized to test each null hypothesis to measure the strength of the linear association between the two variables for Null Hypotheses 1-10. The researcher applied a *z*-test for difference in means to data for Null Hypothesis 11. The following sections summarize the results of these tests:

Null Hypothesis 1

The data were analyzed to investigate if there was a relationship between the number of attempts on the elementary MoCA and cumulative GPA for undergraduate students.

Null Hypothesis 1*:* There is no relationship between the number of attempts on the elementary Missouri Content Assessment (MoCA) and cumulative GPA for undergraduate students.

Table 20

MoCA Elementary Subtest Undergraduate Student Descriptive Statistics

Number of Attempts	Math	Science	Social Studies	English
Mean	1.28	1.7	1.56	1.52
Standard Deviation	0.671	1.216	1.072	1.249
Range	3	5	4	6
Minimum	1	1	1	1
Maximum	4	6	5	7

Table 20 illustrates the descriptive statistics for the number of attempts on each of the MoCA Elementary subtests for the sample of n = 50 undergraduate students at the Researched University. The mean number of attempts for each subtest of the MoCA test revealed a range between 1.28 and 1.7.

Table 21 illustrates the cumulative undergraduate grade point average of students in the sample of n = 50. The mean cumulative undergraduate grade point average for the sample was 3.35.

Table 21

Undergraduate Descriptive Statistics

Cumulative GPA	
Mean	3.358
Standard Error	0.0545
Median	3.325
Mode	3.35
Standard Deviation	0.385
Range	1.33
Minimum	2.67
Maximum	4

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of cumulative GPA and each MoCA subtest score. The purpose of the PPMCC test was to see if a relationship existed for undergraduate students between the number of attempts on the elementary MoCA and a student's cumulative GPA. The outcomes could reveal if an undergraduate student's cumulative GPA could be used as a predictor of the number of attempts it may require to pass the elementary MoCA.

For the MoCA Math subtest, the PPMCC yielded a negative, non-significant correlation coefficient of -0.0861, with a critical value of 0.273. The researcher failed to

reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's cumulative GPA and number of attempts on the MoCA Math subtest.

For the MoCA Science subtest, the PPMCC yielded a negative, non-significant correlation coefficient of -0.0499, with a critical value of 0.273. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's cumulative GPA and number of attempts on the MoCA Science subtest.

For the MoCA Social Studies subtest, the PPMCC yielded a negative, non-significant correlation coefficient of -0.1281, with a critical value of 0.273. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's cumulative GPA and number of attempts on the MoCA Social Studies subtest. For the MoCA English subtest, the PPMCC yielded a negative, non-significant correlation coefficient of -0.1059, with a critical value of 0.273. The researcher failed to reject the null hypothesis.

Table 22

PPMCC Statistics for Null Hypothesis 1

Hypothesis	Correlation Coefficient	Critical Value	Significant?
MoCA Math	-0.086	0.273	No
MoCA Science	-0.049	0.273	No
MoCA Social Studies	-0.128	0.273	No
MoCA English	-0.105	0.273	No
Population	N= 169		
Sample	n= 50		

These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's cumulative GPA and number of attempts on the MoCA English subtest. The statistically significant correlation coefficients for the hypotheses are summarized in Table 22.

Null Hypothesis 2

The data were analyzed to investigate if there was a relationship between the number of attempts on each of the elementary MoCA subtests and cumulative GPA for graduate students.

Null Hypothesis 2*:* There is no relationship between the number of attempts on the elementary MoCA and cumulative GPA for graduate students.

The purpose of this PPMCC test was to see if a relationship existed for graduate students between the number of attempts on the elementary MoCA and a student's cumulative GPA. The outcomes could reveal if graduate student's cumulative GPA could be used as a predictor of the number of attempts it may require to pass the elementary MoCA.

Table 23 illustrates the descriptive data for the number of attempts for the sample of N=50 undergraduate students.

Table 23

MoCA Elementary Subtest Descriptive Statistics

MAT Number of Attempts	Math	Science	Social Studies	English
Mean	1.571	1.542	1.485	1.457
Standard Deviation	1.501	0.155	1.067	1.197
Range	8	4	4	6
Minimum	1	1	1	1
Maximum	9	5	5	7

The mean number of attempts for each subtest of the MoCA test reveals a range between 1.28 and 1.7.

Table 24 illustrates the cumulative graduate grade point average of students in the sample of N=35. The mean cumulative graduate grade point average for the sample was 3.35.

Table 24

Graduate Descriptive Statistics

Cumulative GPA	
Mean	3.48
Standard Error	0.056
Median	3.45
Mode	4
Standard Deviation	0.334
Range	1.13
Minimum	2.87
Maximum	4

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of cumulative GPA and number of attempts on each of the MoCA subtests. The purpose of this PPMCC was to see if a relationship existed for graduate students between the number of attempts on the elementary MoCA and a student's cumulative GPA. The outcomes could reveal if graduate student's cumulative GPA could be used as a predictor of the number of attempts it may require to pass the elementary MoCA.

For the MoCA Math subtest, the PPMCC yielded a negative, non-significant correlation coefficient of -0.107, with a critical value of 0.349. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no

significant relationship existed between a graduate student's cumulative GPA and score on the MoCA Math subtest.

For the MoCA Science subtest, the PPMCC yielded a negative, non-significant correlation coefficient of -0.139, with a critical value of 0.349. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between a graduate student's cumulative GPA and number of attempts on the MoCA Science subtest.

For the MoCA Social Studies subtest, the PPMCC yielded a negative, non-significant correlation coefficient of -0.020, with a critical value of 0.349. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's cumulative GPA and number of attempts on the MoCA Social Studies subtest.

For the MoCA English subtest, the PPMCC yielded a negative, non-significant correlation coefficient of -0.056, with a critical value of 0.349. The researcher failed to reject the null hypothesis.

Table 25

PPMCC Statistics for Null Hypothesis 2

Hypothesis	Correlation Coefficient	Critical Value	Significant?
MoCA Math	-0.107	0.349	No
MoCA Science	-0.139	0.349	No
MoCA Social Studies	-0.020	0.349	No
MoCA English	-0.056	0.349	No
Population	N= 36		
Sample	n= 35		

These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's cumulative GPA and number of attempts on the MoCA English subtest. The statistically significant correlation coefficients for the hypotheses are summarized in Table 26.

Null Hypothesis 3

The data were analyzed to investigate if there was a relationship between the score on the elementary MoCA math subtest and GPA in math courses offered by the math department for undergraduate students.

Null Hypothesis 3: There is no relationship between the score on the elementary MoCA math subtest and GPA in math courses for undergraduate students.

The purpose of this PPMCC test was to see if a relationship existed between a students' elementary MoCA math subtest and GPA in math courses offered by the math department for undergraduate students. The outcome could reveal if an undergraduate student's GPA in math courses offered by the math department could be used as a predictor of a student's score on the elementary MoCA math subtest.

Table 26 contains the undergraduate GPA in math courses and MoCA Math subtest scores.

Table 26

Undergraduate Data

GPA in Math Courses	Score on MoCA Math Subtest
1.00	220
1.40	283
1.50	238
1.67	282
2.00	251
2.00	226
2.00	226
2.00	220
2.00	288
2.00	202
2.13	257
2.17	220
2.25	226
2.33	232
2.33	226
2.40	269
2.50	269
2.50	263
2.67	251
2.67	232
2.67	226
3.00	232
3.00	263
3.00	257
3.00	263
3.00	263
3.00	238
3.00	226
3.20	245
3.25	238
3.33	251
3.33	232
3.33	269
3.33	245
3.33	282
3.40	220
3.50	226
3.50	275
3.67	275
3.67	238
4.00	238
4.00	232
4.00	282
4.00	275
4.00	275
4.00	245
4.00	263
4.67	220

Table 27 includes the descriptive statistics for both variables.

Table 27

Undergraduate Descriptive Statistics

	GPA in Math Coursework	Score on MoCA Math subtest
Mean	2.841	247.396
Standard Error	0.114	3.197
Median	3	245
Mode	3	226
Standard Deviation	0.787	22.150
Range	3	86
Minimum	1	202
Maximum	4	288

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of undergraduate student score on the elementary MoCA math subtest and GPA in math courses. The PPMCC yielded a positive, non-significant correlation coefficient of 0.224, with a critical value of 0.273. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's GPA in math coursework and subtest score on the Math MoCA assessment.

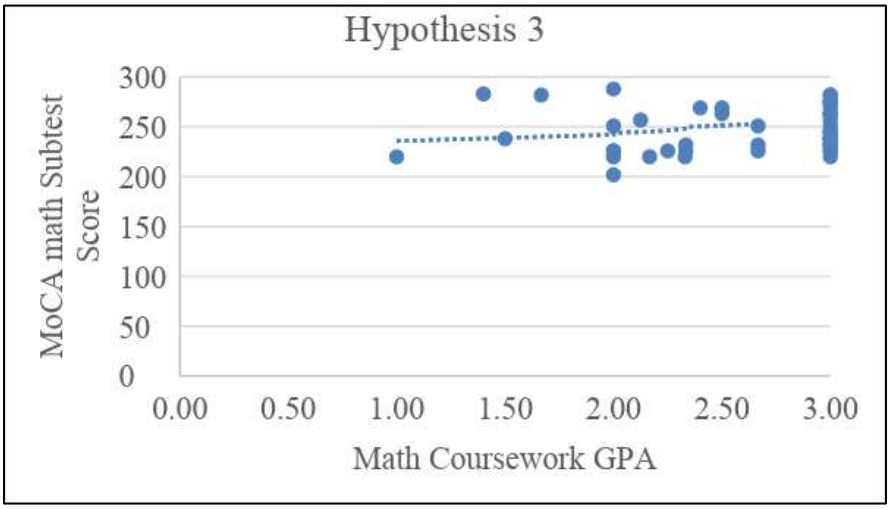

Figure 1. Pearson Product-Moment Correlation for Hypothesis 3.

Null Hypothesis 4

The data were analyzed to investigate if there was a relationship between the score on the elementary MoCA math subtest and GPA in math courses offered by the math department for graduate students.

Null Hypothesis 4*:* There is no relationship between the score on the elementary MoCA math subtest and GPA in math courses for graduate students.

The purpose of this PPMCC test was to see if a relationship existed between a students' elementary MoCA math subtest and GPA in math courses offered by the math department for graduate students. The outcome could reveal if a graduate student's GPA in math courses offered by the math department could be used as a predictor of a student's score on the elementary MoCA math subtest.

Table 28 contains the graduate GPA in math courses and MoCA Math subtest scores.

Table 28

Graduate Student Data

GPA in Math Courses	MoCAElMath
0.67	202
1.00	226
1.40	263
1.50	245
1.50	195
1.67	226
2.00	245
2.00	263
2.00	282
2.00	288
2.00	245
2.00	275
2.00	220
2.00	269
2.15	226
2.35	251
2.50	220
2.50	232
2.50	226
2.50	263
2.67	238
2.67	202
2.75	263
3.00	269
3.00	251
3.00	245
3.50	245
3.70	257
4.00	238
4.00	269
4.00	232
4.00	238
4.00	220
4.00	257

Table 29 includes the descriptive statistics for both variables.

Table 29

Graduate Student Descriptive Statistics

	GPA in Math Courses	MoCA Math Subtest Score
Mean	2.544608	243.7058824
Standard Error	0.1591	3.943344177
Median	2.5	245
Mode	2	245
Standard Deviation	0.927704	22.9934502
Range	3.333333	93
Minimum	0.666667	195
Maximum	4	288

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of graduate student score on the elementary MoCA math subtest and GPA in math courses.

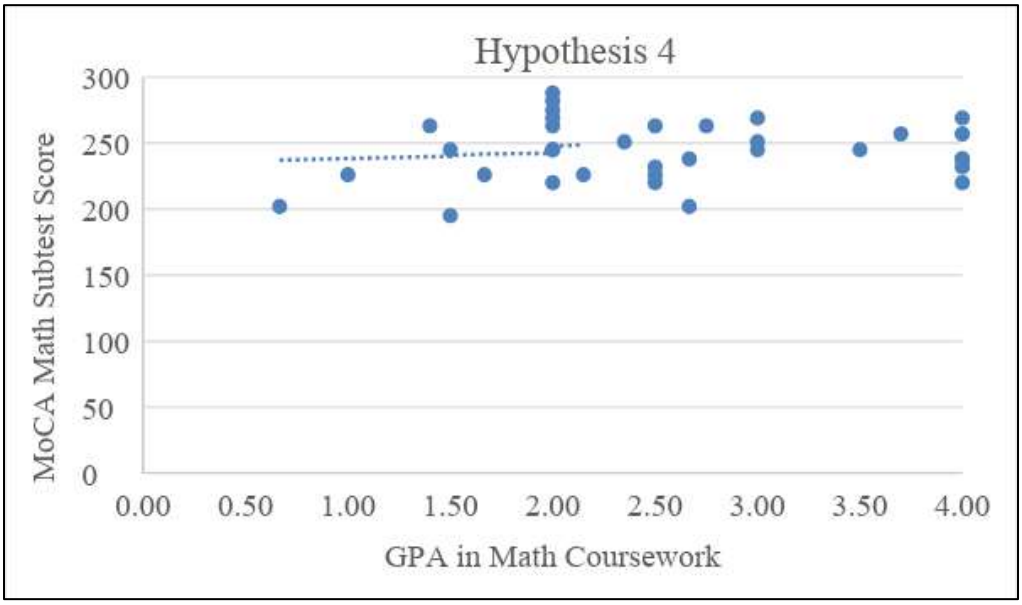

Figure 2. Pearson Product-Moment Correlation for Hypothesis 4.

The PPMCC yielded a positive, non-significant correlation coefficient of 0.141, with a critical value of 0.349. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between a

graduate student's GPA in math coursework and subtest score on the Math MoCA assessment.

Null Hypothesis 5

The data were analyzed to investigate if there was a relationship between the score on the elementary MoCA science subtest and GPA in science courses offered by the science department for undergraduate students.

Null Hypothesis 5*:* There is no relationship between the score on the elementary MoCA science subtest and GPA in science courses for undergraduate students.

The purpose of this PPMCC test was to see if a relationship existed between an undergraduate students' elementary MoCA science subtest and GPA in science courses offered by the science department for undergraduate students. The outcome could reveal if an undergraduate student's GPA in science courses offered by the science department could be used as a predictor of a student's score on the elementary MoCA science subtest.

Table 30 contains the undergraduate GPA in science courses and MoCA Science subtest scores.

Table 30

Undergraduate Science GPA and MoCA Science Subtest Score

GPA in Science Courses	MoCA Science Subtest Score
1.00	226
1.33	226
1.33	203
1.43	232
1.50	226
1.50	220
1.67	226
1.67	237
2.00	220
2.00	257
2.00	232
2.00	220
2.00	238
2.00	251
2.00	263
2.00	220
2.33	245
2.33	238
2.33	226
2.50	220
2.50	226
2.50	245
2.50	251
2.50	220
2.50	220
2.67	263
2.67	226
3.00	232
3.00	232
3.00	220
3.00	238
3.00	245
3.00	245
3.25	226
3.25	237
3.33	282
3.50	232
3.50	226
3.50	214
3.50	251
3.67	226
3.75	238
4.00	226
4.00	282
4.00	251
4.00	237
4.00	231
4.00	226

Table 31 includes the descriptive statistics for both variables.

Table 31

Undergraduate Science Descriptive Statistics

	GPA in Science Course	MoCA Science Subtest score
Mean	2.667	234.875
Standard Error	0.123	2.329
Median	2.5	232
Mode	2	226
Standard Deviation	0.851	16.137
Range	3	79
Minimum	1	203
Maximum	4	282

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of undergraduate student score on the elementary MoCA science subtest and GPA in science courses.

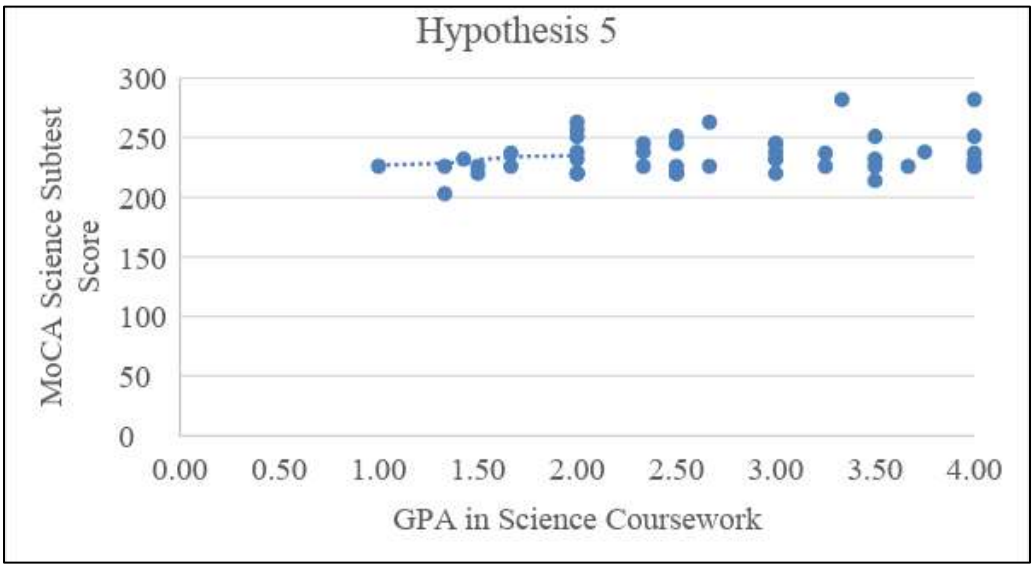

Figure 3. Pearson Product-Moment Correlation for Hypothesis 5.

The PPMCC yielded a positive, non-significant correlation coefficient of 0.252, with a critical value of 0.272. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between

an undergraduate student's GPA in science coursework and subtest score on the Science MoCA assessment.

Null Hypothesis 6

The data were analyzed to investigate if there was a relationship between the score on the elementary MoCA science subtest and GPA in science courses offered by the science department for graduate students.

Null Hypothesis 6*:* There is no relationship between the score on the elementary MoCA science subtest and GPA in science courses for graduate students.

The purpose of this PPMCC test was to see if a relationship existed between a students' elementary MoCA science subtest and GPA in science courses offered by the science department for graduate students. The outcome could reveal if a graduate student's GPA in science courses offered by the science department could be used as a predictor of a student's score on the elementary MoCA science subtest.

Table 32 contains the graduate GPA in science courses and MoCA Science subtest scores.

Table 32

Graduate Student Science Data

GPA in Science Courses	MoCA Science Subtest Score
2.00	226
2.00	226
2.00	238
2.00	288
2.00	237
2.00	209
2.10	263
2.15	220
2.23	226
2.24	226
2.33	243
2.40	220
2.50	245
2.50	251
2.54	263
2.75	180
2.80	226
3.00	202
3.00	251
3.00	245
3.00	251
3.25	288
3.30	251
3.30	263
3.50	238
3.50	266
3.50	220
4.00	226
4.00	232
4.00	245
4.00	251
4.00	251
4.00	238

Table 33 includes the descriptive statistics for both variables.

Table 33

Graduate Student Science Descriptive Statistics

	GPA in Science Courses	MoCA Science Subtest Score
Mean	2.876	239.545
Standard Error	0.126	3.909
Median	2.8	238
Mode	2	226
Standard Deviation	0.724	22.458
Range	2	108
Minimum	2	180
Maximum	4	288

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of graduate student score on the elementary MoCA science subtest and GPA in science courses.

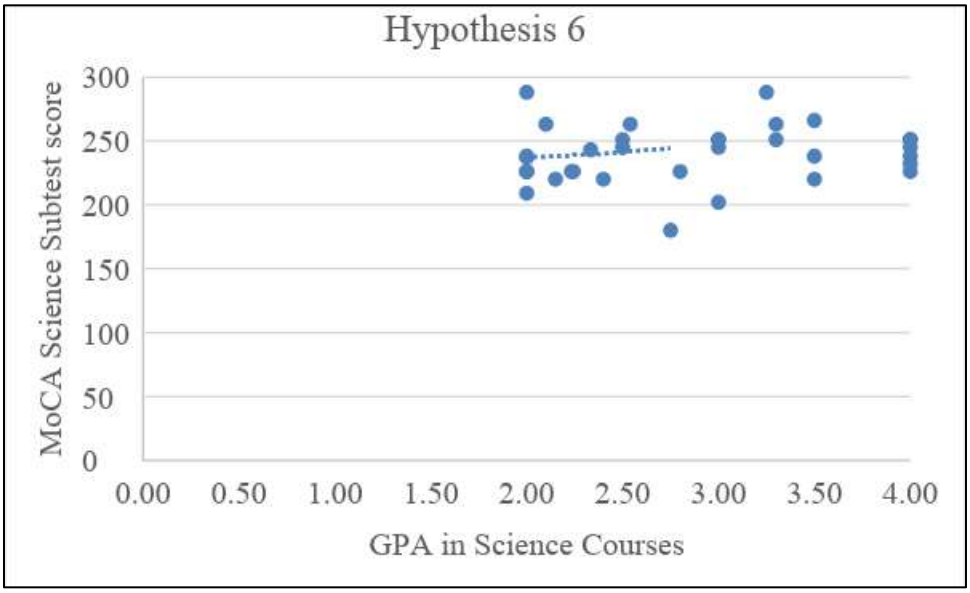

Figure 4. Pearson Product-Moment Correlation for Hypothesis 6.

The PPMCC yielded a positive, non-significant correlation coefficient of 0.131, with a critical value of 0.349. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between a

graduate student's GPA in science coursework and subtest score on the Science MoCA assessment.

Null Hypothesis 7

The data were analyzed to investigate if there was a relationship between the score on the elementary MoCA social studies subtest and GPA in social studies courses offered by the social studies department for undergraduate students.

Null Hypothesis 7: There is no relationship between the score on the elementary MoCA social studies subtest and GPA in social studies courses for undergraduate students.

The purpose of this PPMCC test was to see if a relationship existed between a students' elementary MoCA social studies subtest and GPA in social studies courses offered by the social studies department for undergraduate students. The outcome could reveal if an undergraduate student's GPA in social studies courses offered by the social studies department could be used as a predictor of a student's score on the elementary MoCA social studies subtest.

Table 34 contains the undergraduate student GPA in social studies courses and MoCA Social Studies subtest scores.

Table 34

Undergraduate Social Studies Student Data

GPA for Social Studies Coursework	MoCA Social Studies Subtest Score
1.67	263
1.71	257
1.80	226
1.80	232
2.00	226
2.14	208
2.20	275

Continued

Table 34. Continued

2.20	232
2.40	257
2.40	238
2.50	251
2.50	220
2.60	269
2.60	220
2.60	165
2.60	214
2.60	245
2.67	238
2.67	257
2.75	245
2.80	214
2.83	251
2.86	238
3.00	226
3.00	232
3.00	245
3.00	226
3.00	245
3.00	202
3.00	257
3.00	220
3.13	220
3.20	238
3.20	238
3.20	257
3.20	220
3.33	232
3.33	232
3.40	238
3.50	269
3.60	220
3.63	226
3.67	232
3.80	251
3.86	257
4.00	275
4.00	251
4.00	220

Table 35 includes the descriptive statistics for both variables.

Table 35

Undergraduate Social Studies Data Descriptive Statistics

	SS GPA	MoCA Social Studies Subtest Score
Mean	2.894	236.875
Standard Error	0.088	2.988
Median	3	238
Mode	3	220
Standard Deviation	0.611	20.702
Range	2.333	110
Minimum	1.667	165
Maximum	4	275

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of undergraduate student score on the elementary MoCA social studies subtest and GPA in social studies courses.

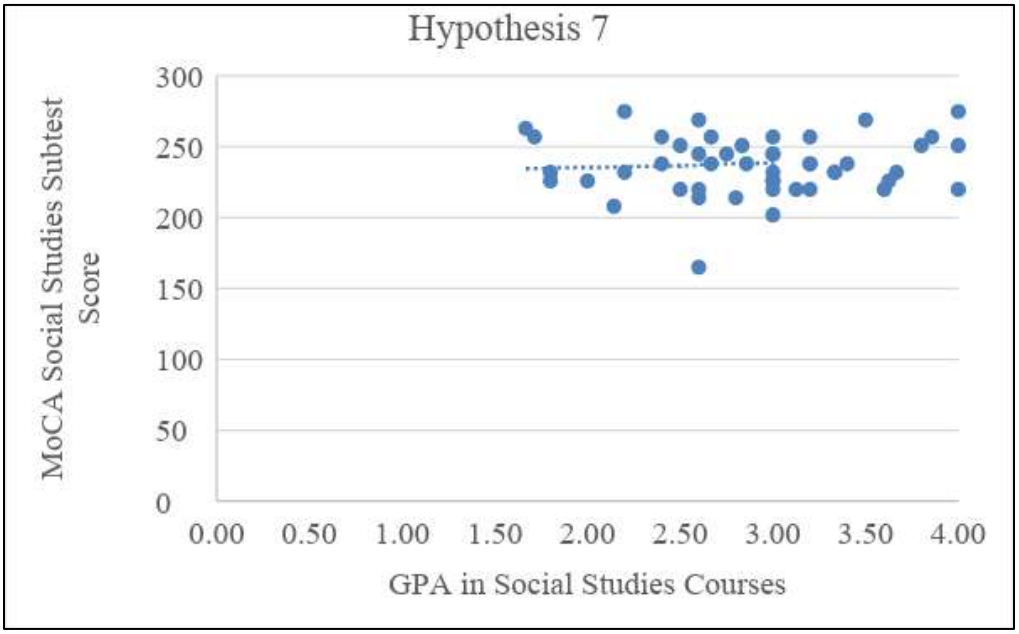

Figure 5. Pearson Product-Moment Correlation for Hypothesis 7.

The PPMCC yielded a positive, non-significant correlation coefficient of 0.056, with a critical value of 0.273. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between

an undergraduate student's GPA in social studies coursework and subtest score on the Social Studies MoCA assessment.

Null Hypothesis 8

The data were analyzed to investigate if there was a relationship between the score on the elementary MoCA social studies subtest and GPA in social studies courses offered by the social studies department for graduate students.

Null Hypothesis 8*:* There is no relationship between the score on the elementary MoCA social studies subtest and GPA in social studies courses for graduate students.

The purpose of this PPMCC test was to see if a relationship existed between a students' elementary MoCA social studies subtest and GPA in social studies courses offered by the social studies department for graduate students. The outcome could reveal if a graduate student's GPA in social studies courses offered by the social studies department could be used as a predictor of a student's score on the elementary MoCA social studies subtest.

Table 36 contains the graduate student GPA in social studies courses and MoCA Social Studies subtest scores.

Table 36

Graduate Student Social Studies Data

GPA in Social Studies Courses	MoCA Social Studies Subtest
4.00	238
2.40	226
2.40	238
2.33	220
4.00	232
3.80	220
2.25	183
3.75	232
3.40	238
2.50	238
3.40	202
2.33	269
3.33	257
3.00	220
2.48	257
3.00	232
1.50	282
3.00	226
2.85	226
4.00	269
3.00	245
2.75	251
3.50	245
1.75	269
3.25	220
3.00	245
3.00	226
3.25	263
2.54	269
3.40	226
2.00	245
2.61	183
3.67	238
3.33	226

Table 37 includes the descriptive statistics for both variables.

Table 37

Graduate Student Social Studies Descriptive Statistics

	MoCA Social Studies Subtest Score	GPA in Social Studies Courses
Mean	2.964	236.941
Standard Error	0.110	3.900
Median	3	238
Mode	3	226
Standard Deviation	0.643	22.742
Range	2.5	99
Minimum	1.5	183
Maximum	4	282

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of graduate student score on the elementary MoCA social studies subtest and GPA in social studies courses.

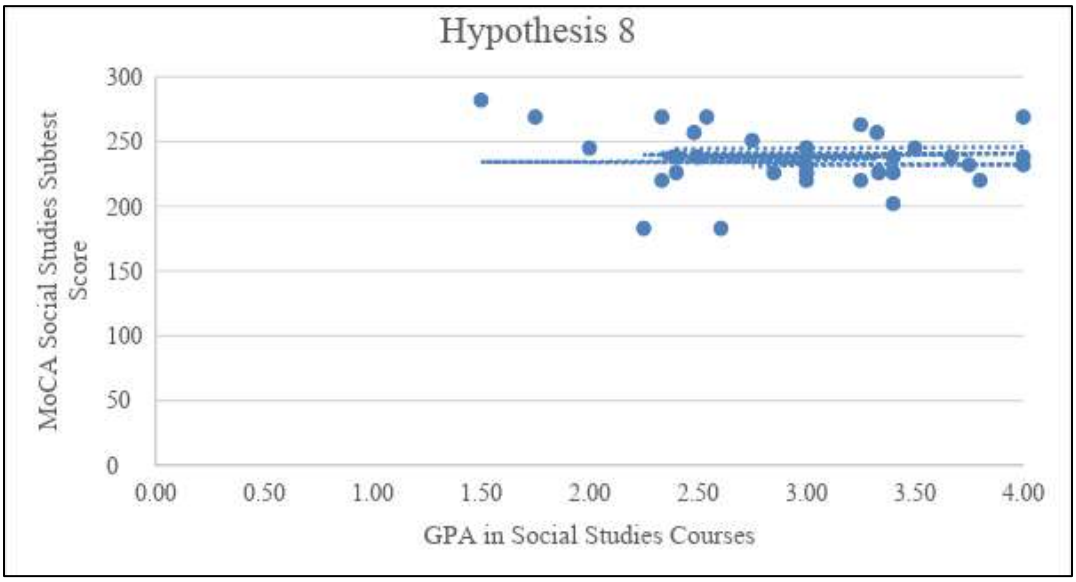

Figure 6. Pearson Product-Moment Correlation for Hypothesis 8.

The PPMCC yielded a negative, non-significant correlation coefficient of -0.165, with a critical value of 0.349. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between a graduate student's GPA in social studies coursework and subtest score on the Social Studies MoCA assessment.

Null Hypothesis 9

The data were analyzed to investigate if there was a relationship between the year the math course was originally taken and score on the elementary MoCA Mathematics subtest for graduate students.

Null Hypothesis 9*:* There is no relationship between the year the last math course was originally taken and the MoCA mathematics subtest score for graduate students.

The purpose of this PPMCC test was to see if a relationship existed between a students' elementary MoCA math subtest and the year the math course was originally taken. The outcome could reveal if the length of time between when the math course was originally taken and the MoCA test date could be used as a predictor of student's score on the elementary MoCA math subtest.

Table 38 contains the number of years between the last college math class taken and MoCA assessment data for graduate students and MoCA Mathematics subtest scores.

Table 38

Graduate Student Data: Number of Years Between Last College Math Class and MoCA

Number of Years between last college math class and MoCA assessment	MoCA Math Subtest Score
0	245
1	263
3	226
3	269
4	288
4	263
5	226
5	220
6	238
6	226
6	282
6	245
6	251
6	269
6	257
8	238
8	251
8	269
9	238
9	245
11	220
11	245
11	232
12	263
12	275
13	257
21	232
22	245
26	226

Table 39 includes the descriptive statistics for both variables.

Table 39

Graduate Student Descriptive Statistics: Years between Last College Math Class and MoCA

	Number of Years between mathematics course and MoCA assessment	MoCA Math Subtest Score
Mean	8.552	248.414
Standard Error	1.114	3.513
Median	6	245
Mode	6	245
Standard Deviation	5.99754	18.9162
Range	26	68
Minimum	0	220
Maximum	26	288

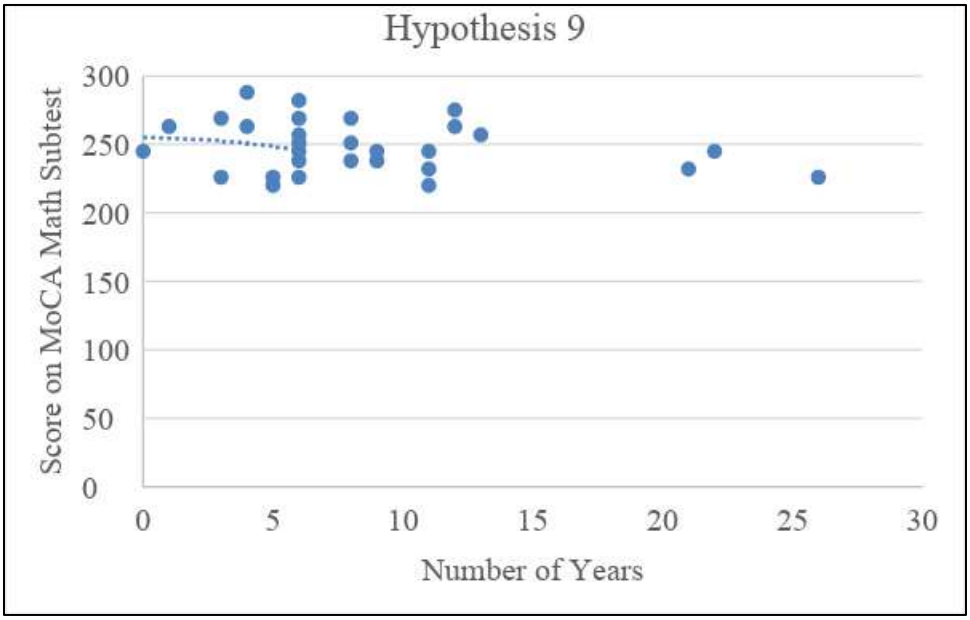

Figure 7. Pearson Product-Moment Correlation for Hypothesis 9.

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of number of years since a college mathematics class was taken and score on the elementary MoCA Mathematics subtest. The PPMCC yielded a negative, non-significant correlation coefficient of -0.253, with a critical value of 0.349. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between

the length of time between completing mathematics coursework and completing the MoCA mathematics subtest and a graduate student's score on the MoCA Mathematics assessment.

Null Hypothesis 10

This data were analyzed to investigate if there was a relationship between the year the science course was originally taken and score on the elementary MoCA Science Subtest for graduate students.

Null Hypothesis 10*:* There is no relationship between the year the last science course was originally taken and the MoCA Science subtest score for graduate students.

The purpose of this PPMCC test was to see if a relationship existed between a students' elementary MoCA science subtest and the year the science course was originally taken. The outcome could reveal if the length of time between when the science course was originally taken and the MoCA test date could be used as a predictor of student's score on the elementary MoCA science subtest.

Table 40 contains the number of years between the last college science class taken and MoCA assessment data for graduate students and MoCA Science subtest scores.

Table 40

Graduate Student Data: Years between Last College Science Class and MoCA

Number of Years between last college science class and MoCA assessment	MoCA Science Subtest Score
1	232
1	251
2	226
3	238
4	245
4	251
4	226
5	226
5	245
5	251
5	238
5	243
6	288
6	263
7	263
8	263
8	226
9	251
9	238
10	266
11	220
12	288
13	226
13	237
14	202
14	251
20	245
23	251
24	220

Table 41 includes the descriptive statistics for both variables.

Table 41

Graduate Student Years between Last College Science Class and MoCA

	Number of Years	MoCA Science Subtest Score
Mean	8.655	243.793
Standard Error	1.124	3.608
Median	7	245
Mode	5	251
Standard Deviation	6.055	19.432
Range	23	86
Minimum	1	202
Maximum	24	288

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of number of years since a college science class was taken and score on the elementary MoCA Science subtest.

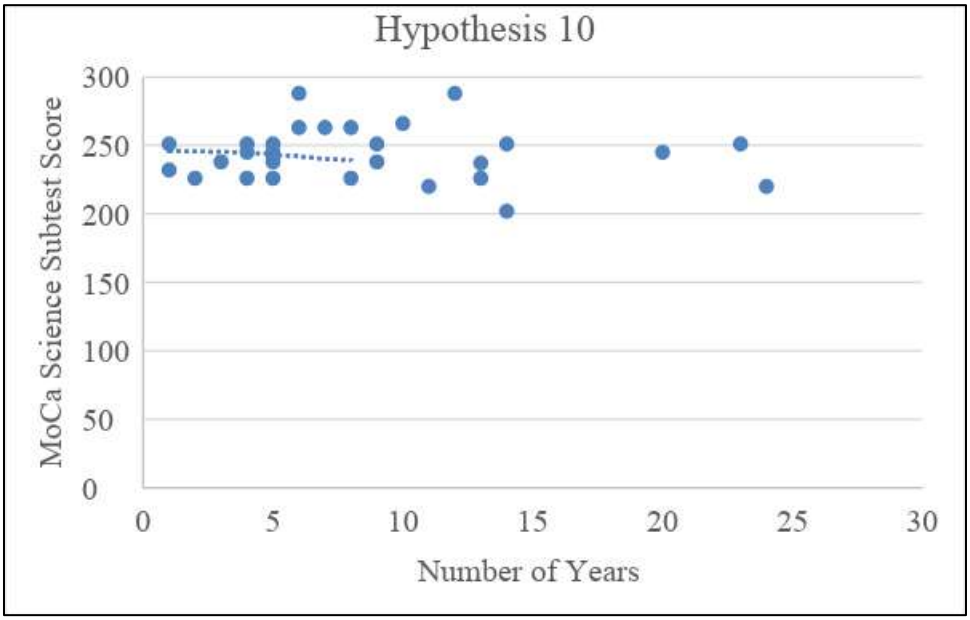

Figure 8. Pearson Product-Moment Correlation for Hypothesis 10.

The PPMCC yielded a negative, non-significant correlation coefficient of -0.100, with a critical value of 0.349. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between the length of time between completing science coursework and completing the MoCA science subtest and a graduate student's score on the MoCA Mathematics assessment.

Null Hypothesis 11

This data were analyzed to investigate if there was a difference between graduate candidates and undergraduate MoCA scale scores in the subtests of Mathematics, Science, Social Studies, and English. Both descriptive statistics and *z*-tests were used to analyze the random sample for each subtest.

Mathematics. In order to analyze whether the difference between undergraduate and graduate candidates scale scores on the mathematics subtest was statistically significant, descriptive statistics for the total sample, graduate sample, and undergraduate sample were calculated. Table 42 shows the statistics for the total, graduate and undergraduate groups.

Table 42

Descriptive Statistics for MoCA Mathematics Subtest

	Total	Graduate	Undergraduate
Mean	245.165	243.029	246.66
Median	245	245	241.5
Mode	226	245	226
Standard Deviation	22.358	23.004	22.0052
Range	93	93	86
Minimum	195	195	202
Maximum	288	288	288
Count	85	35	50

Next, a *z*-test for the difference in means using the hypothesized mean difference of zero was used to evaluate the random sample. The null hypothesis stated that there was no significant difference between the undergraduate and graduate scale scores in the mathematics subtest.

Table 43 shows the results of the *z*-test for difference in means for the random sample. Since the *z*-test value was smaller than the critical value of 1.95, the z value did

not fall into the critical regions on a bell curve; and thus, the researcher failed to reject the null hypothesis. This data did not support the hypothesis that a significant difference existed between graduate candidates' and undergraduate candidates' MoCA scale scores on the mathematics subtest scores, for mathematics.

Table 43

Quantitative Analysis for MoCA Mathematics Subtest

	Graduate	Undergraduate
Mean	243.029	246.66
Known Variance	529.205	484.229
Observations	35	50
Hypothesized Mean Difference	0	
Z	-0.729	
P(Z<=z) two-tail	0.466	
z Critical two-tail	1.960	

Science. In order to analyze whether the difference between undergraduate and graduate candidates scale scores on the science subtest was statistically significant, descriptive statistics for the total sample, graduate sample, and undergraduate sample were calculated. Table 44 shows the statistics for the total sample, graduate group and undergraduate group.

Table 44

Descriptive Statistics for MoCA Science Subtest

	Total	Graduate	Undergraduate
Mean	236.494	239.657	234.28
Median	232	238	231.5
Mode	226	226	226
Standard Deviation	18.885	22.114	16.122
Range	108	108	79
Minimum	180	180	203
Maximum	288	288	282
Count	85	35	50

Next, a *z*- test for the difference in means using the hypothesized mean difference of zero was used to evaluate the random sample. The null hypothesis stated that there was no significant difference between the undergraduate and graduate scale scores in the science subtest.

Table 45 shows the results of the *z*-test for difference in means for the random sample. Since the *z*-test value was smaller than the critical value of 1.960, the z value did not fall into the critical regions on a bell curve; and thus, the researcher failed to reject the null hypothesis. This data did not support the hypothesis that a significant difference existed between graduate candidates and undergraduate candidates MoCA scale scores on the science subtest.

Table 45

Quantitative Analysis for MoCA Science Subtest

	Graduate	Undergraduate
Mean	239.657	234.28
Known Variance	489.055	259.92
Observations	35	50
Hypothesized Mean Difference	0	
Z	1.228	
P(Z<=z) two-tail	0.219	
z Critical two-tail	1.960	

Social Studies. In order to analyze whether the difference between undergraduate and graduate candidates scale scores on the social studies subtest was statistically significant, descriptive statistics for the total sample, graduate sample, and undergraduate sample were calculated. Table 46 shows the statistics for all three groups.

Table 46

Descriptive Statistics for MoCA Social Studies Subtest

	Total	Graduate	Undergraduate
Mean	236.377	237.343	235.7
Median	238	238	235
Mode	220	226	220
Standard Deviation	21.665	22.531	21.243
Range	117	99	110
Minimum	165	183	165
Maximum	282	282	275
Count	85	35	50

Next, a *z*-test for the difference in means using the hypothesized mean difference of zero was used to evaluate the random sample. The null hypothesis stated that there was no significant difference between the undergraduate and graduate scale scores on the social studies subtest.

Table 47 shows the results of the *z*-test for difference in means for the random sample. Since the *z*-test value was smaller than the critical value of 1.960, the z value did not fall into the critical regions on a bell curve; and thus, the researcher failed to reject the null hypothesis. This data did not support the hypothesis that a significant difference existed between graduate candidates and undergraduate candidates MoCA scale scores on the social studies subtest.

Table 47

Quantitative Analysis for MoCA Social Studies Subtest

	Graduate	Undergraduate
Mean	237.343	235.7
Known Variance	507.643	451.275
Observations	35	50
Hypothesized Mean Difference	0	
Z	0.339	
P(Z<=z) two-tail	0.735	
z Critical two-tail	1.960	

English. In order to analyze whether the difference between undergraduate and graduate candidates scale scores on the English subtest was statistically significant, descriptive statistics for the total sample, graduate sample, and undergraduate sample were calculated. Table 48 shows the statistics for all three groups.

Table 48

Descriptive Statistics for MoCA English Subtest

	Total	Graduate	Undergraduate
Mean	241.529	246.114	238.32
Median	235	249	235
Mode	227	227	227
Standard Deviation	20.240	23.623	17.016
Range	95	95	60
Minimum	198	198	220
Maximum	293	293	280
Count	85	35	50

Next, a *z*-test for the difference in means using the hypothesized mean difference of zero was used to evaluate the random sample. The null hypothesis stated that there was no significant difference between the undergraduate and graduate scale scores in the English subtest.

Table 49 shows the results of the *z*-test for difference in means for the random sample. Since the *z*-test value was smaller than the critical value of 1.960, the z value did not fall into the critical regions on a bell curve; and thus, the researcher failed to reject the null hypothesis. This data did not support the hypothesis that a significant difference existed between graduate candidates and undergraduate candidates MoCA scale scores on the English subtest.

Table 49

Quantitative Analysis for MoCA English Subtest

	Graduate	Undergraduate
Mean	246.114	238.32
Known Variance	558.045	289.528
Observations	35	50
Hypothesized Mean Difference	0	
Z	1.672	
P(Z<=z) two-tail	0.095	
z Critical two-tail	1.960	

Null Hypothesis 12

Null Hypothesis 12*:* For graduate and undergraduate students, there is no relationship between student GPA and MoCA scale score when comparing GPA in the content area to the corresponding MoCA subtest.

The purpose of this PPMCC test was to see if a relationship existed for undergraduate and graduate students between the GPA in the content area and score on the MoCA subtest. The outcomes could reveal if a student's GPA in the content area could be used as a predictor of the corresponding MoCA subtest score.

Table 50

Descriptive Statistics for Undergraduate and Graduate Students

	GPA in Math Courses	MoCA Math Subtest Score
Mean	2.72	245.866
Standard Error	0.094	2.478
Median	2.667	245
Mode	2	226
Standard Deviation	0.855	22.437
Range	3.333	93
Minimum	0.667	195
Maximum	4	288

Table 50 illustrates the descriptive statistics for undergraduate and graduate GPA in math courses and MoCA Math Subtest scores.

A PPMCC was utilized to test the null hypothesis to measure the strength of the linear association between the two variables of GPA in the content area and score on the corresponding MoCA subtest.

For the MoCA Math subtest, the PPMCC yielded a positive, non-significant correlation coefficient of 0.196, with a critical value of 0.127. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between undergraduate and graduate GPA in the content area of mathematics and score on the MoCA Math subtest.

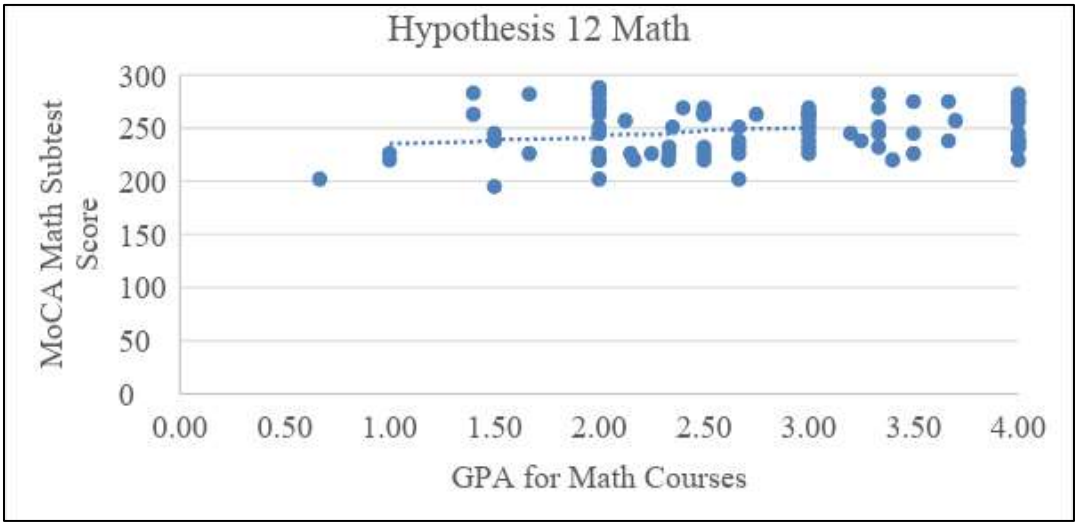

Figure 9. Pearson Product-Moment Correlation for Hypothesis 12; Math.

Table 51 illustrates the descriptive statistics for undergraduate and graduate GPA for science courses and MoCA Science Subtest scores.

Table 51

Descriptive Statistics for Undergraduate and Graduate Students in Science

	GPA in Science Courses	MoCA Science Subtest Score
Mean	2.752	236.778
Standard Error	0.089	2.108
Median	2.667	232
Mode	2	226
Standard Deviation	0.804	18.976
Minimum	1	180
Maximum	4	288

For the MoCA Science subtest, the PPMCC yielded a positive, non-significant correlation coefficient of 0.205, with a critical value of 0.127. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between undergraduate and graduate GPA in the content area of science and score on the MoCA Science subtest.

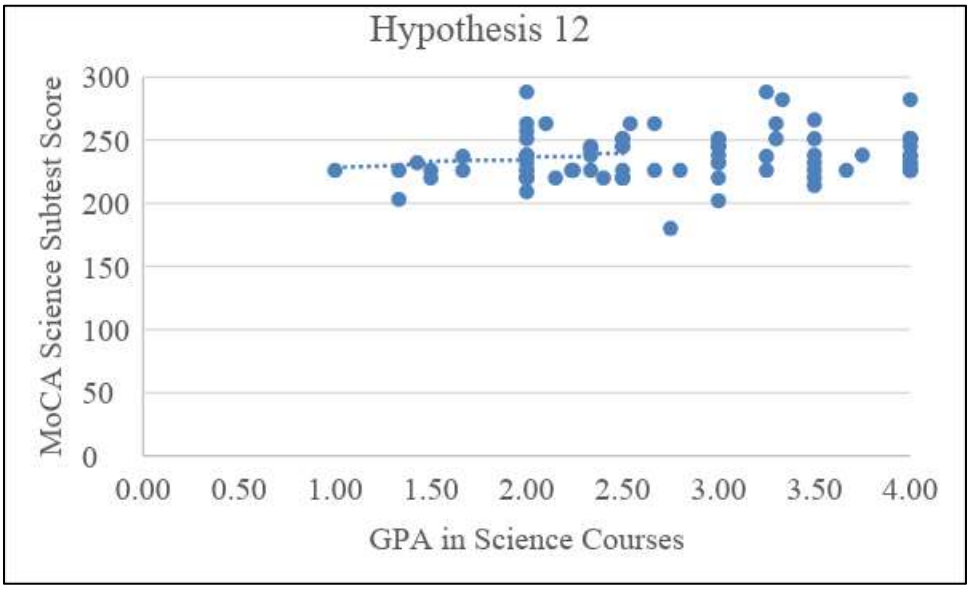

Figure 10. Pearson Product-Moment Correlation Coefficient for Hypothesis 12; Science.

Table 52 illustrates the descriptive statistics for undergraduate and graduate GPA for social studies courses and MoCA Social Studies Subtest scores.

Table 52

Descriptive Statistics for Undergraduate and Graduate Students- Social Studies

	GPA in Social Studies Courses	MoCA Social Studies Subtest score
Mean	2.888	237.072
Standard Error	0.0764	2.344
Median	3	238
Mode	3	226
Standard Deviation	0.696	21.359
Range	4	117
Minimum	0	165
Maximum	4	282

For the MoCA Social Studies subtest, the PPMCC yielded a positive, non-significant correlation coefficient of 0.056, with a critical value of 0.127. The researcher failed to reject the null hypothesis. These results suggested that at the Researched University, no significant relationship existed between undergraduate and graduate student's GPA in Social Studies coursework and the MoCA Social Studies subtest score.

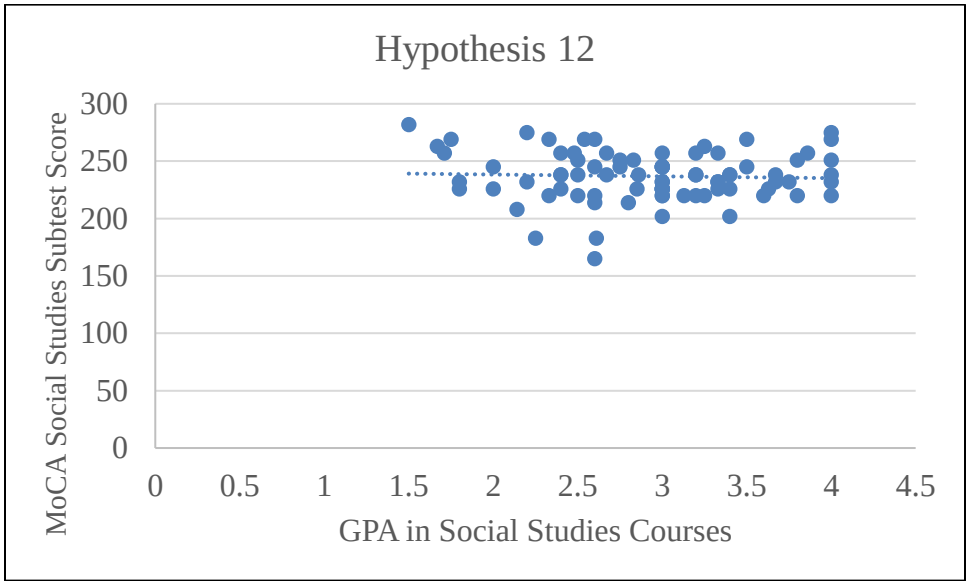

Figure 11. Pearson Product-Moment Correlation Coefficient for Hypothesis 12; Social Studies.

The statistically significant correlation coefficients for the Null Hypothesis 12 are summarized in Table 53.

Table 53

PPMCC for Null Hypothesis 12

Hypothesis	Correlation Coefficient	Critical Value	Significant?
MoCA Math	0.196	0.127	No
MoCA Science	0.205	0.127	No
MoCA Social Studies	0.056	0.127	No
Population	N= 205		
Sample	n= 83		

Summary

Both undergraduate and graduate student data from 2015 to 2018 were analyzed to determine if a relationship between pre-service teachers' performance in college classes and performance on the Elementary MoCA existed. Analyzing the data to determine if a relationship existed between the number of attempts on the elementary MoCA and a student's cumulative GPA revealed no statistical difference. No significant relationship existed when analyzing a student's cumulative GPA or GPA in the content area, compared to a student's performance on the MoCA. The number of years between the last math or science course and the MoCA test date also revealed no statistical difference. Chapter provides a discussion of the data, reflection of why a relationship was not evident, potential next steps to further investigate student performance, and recommendations for the Researched University.

Chapter Five: Discussion, Reflection, and Recommendations

Overview

Chapter Five includes the discussion, recommendations, implications, and future considerations resulting from the study of undergraduate and graduate student performance on the Elementary MoCA and academic performance. The study involved an examination of 50 randomly-sampled undergraduate students and 35 randomly-sampled graduate students at a private Midwestern university. Through the evaluation of students' MoCA results, along with both cumulative GPA and GPA in content coursework the researcher investigated if correlations existed. The review of literature included research citing the importance of preservice teachers demonstrating a strong understanding of content and connects student achievement to teacher pedagogical knowledge. This research led to an increased focus on accountability measures to ensure pre-service teachers possessed the necessary content knowledge.

In this chapter, the findings of the statistical analyses are reviewed. The redacted data were analyzed using statistical PPMCC frequency analysis for Hypotheses 1-10 and 12, and a *z*-test was utilized for Hypothesis 11.

The purpose of this study was to determine if the scores on the MoCA had a statistically significant relationship with undergraduate and graduate student academic performance in a teacher preparation program at a private Midwestern university. A PPMCC was utilized to test Hypotheses 1-10 and 12, to measure the strength of the potential linear association between the two variables contained in each hypothesis. A *z*-test was utilized to test Hypothesis 11 to compare the sample means.

For each hypothesis tested, the researcher anticipated a positive correlation between academic performance in the teacher preparation program and score on the MoCA, even if the correlation coefficients were not statistically significant.

Discussion

Hypothesis 1: There is a relationship between the number of attempts on the elementary Missouri Content Assessment (MoCA) and cumulative GPA for undergraduate students.

The first hypothesis examined the linear association between the number of attempts on each of the MoCA subtests and cumulative GPA for undergraduate students. In response to the number of attempts on the Mathematics subtest of the MoCA and cumulative GPA for undergraduate students, with a PPMCC of $r = -0.086$, the data revealed there was a negative correlation between the number of attempts on the elementary Mathematics MoCA subtest and cumulative GPA for undergraduate students. However, because $p = .0552$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's cumulative GPA and number of attempts on the MoCA Mathematics subtest.

In response to the number of attempts on the Science subtest of the MoCA and cumulative GPA for undergraduate students, with a PPMCC of $r = -0.049$, the data revealed there was a negative correlation between the number of attempts on the elementary Science MoCA subtest and cumulative GPA for undergraduate students. However, because $p = 0.735$, which is greater than the required statistical significance of

$p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's cumulative GPA and number of attempts on the MoCA Science subtest

In response to the number of attempts on the Social Studies subtest of the MoCA and cumulative GPA for undergraduate students, with a PPMCC of $r = -0.128$, the data revealed there was a negative correlation between the number of attempts on the elementary Social Studies MoCA subtest and cumulative GPA for undergraduate students. However, because $p = 0.376$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's cumulative GPA and number of attempts on the MoCA Social Studies subtest

In response to the number of attempts on the English subtest of the MoCA and cumulative GPA for undergraduate students, with a PPMCC of $r = -0.1059$, the data revealed there was a negative correlation between the number of attempts on the elementary English MoCA subtest and cumulative GPA for undergraduate students. However, because $p = 0.468$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between an undergraduate student's cumulative GPA and number of attempts on the MoCA English subtest

Hypothesis 2: There is a relationship between the number of attempts on the elementary MoCA and cumulative GPA for graduate students.

The second hypothesis examined the linear association between the number of attempts on each of the MoCA subtests and cumulative GPA for graduate students. In response to the number of attempts on the Mathematics subtest of the MoCA and cumulative GPA for graduate students, with a PPMCC of $r = -0.107$, the data revealed there was a negative correlation between the number of attempts on the elementary Mathematics MoCA subtest and cumulative GPA for graduate students. However, because $p = .0541$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between a graduate student's cumulative GPA and number of attempts on the MoCA Mathematics subtest.

In response to the number of attempts on the Science subtest of the MoCA and cumulative GPA for graduate students, with a PPMCC of $r = -0.139$, the data reveal there was a negative correlation between the number of attempts on the elementary Science MoCA subtest and cumulative GPA for graduate students. However, because $p = 0.426$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between a graduate student's cumulative GPA and number of attempts on the MoCA Science subtest

In response to the number of attempts on the Social Studies subtest of the MoCA and cumulative GPA for graduate students, with a PPMCC of $r = -0.020$, the data revealed there was a negative correlation between the number of attempts on the elementary Social Studies MoCA subtest and cumulative GPA for graduate students. However, because $p = 0.909$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between a graduate student's cumulative GPA and number of attempts on the MoCA Social Studies subtest

In response to the number of attempts on the English subtest of the MoCA and cumulative GPA for graduate students, with a PPMCC of $r = -0.056$, the data revealed there was a negative correlation between the number of attempts on the elementary English MoCA subtest and cumulative GPA for graduate students. However, because $p = 0.749$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between a graduate student's cumulative GPA and number of attempts on the MoCA English subtest

Hypothesis 3: There is a relationship between the score on the elementary MoCA math subtest and GPA in math courses for undergraduate students.

The third hypothesis examined the linear association between the score on the elementary MoCA math subtest and GPA in math courses offered by the math department for undergraduate students. In response to the score on the MoCA

Mathematics subtest and GPA for math courses for undergraduate students, with a PPMCC of $r = 0.224$, the data revealed there was a positive correlation between the score on the MoCA Mathematics subtest and GPA in math courses offered by the math department for undergraduate students. However, because $p = 0.118$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between the score on the MoCA Mathematics subtest and GPA in math courses offered by the math department for undergraduate students.

Hypothesis 4: There is a relationship between the score on the elementary MoCA math subtest and GPA in math courses for graduate students.

The fourth hypothesis examined the linear association between the score on the elementary MoCA math subtest and GPA in math courses offered by the math department for graduate students. In response to the score on the MoCA Mathematics subtest and GPA for math courses for graduate students, with a PPMCC of $r = 0.141$, the data revealed there was a positive correlation between the score on the MoCA Mathematics subtest and GPA in math courses offered by the math department for graduate students. However, because $p = 0.419$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between the score on the MoCA Mathematics subtest and GPA in math courses offered by the math department for graduate students.

Hypothesis 5: There is a relationship between the score on the elementary MoCA science subtest and GPA in science courses for undergraduate students.

The fifth hypothesis examined the linear association between the score on the elementary MoCA science subtest and GPA in science courses offered by the science department for undergraduate students. In response to the score on the MoCA science subtest and GPA for science courses for undergraduate students, with a PPMCC of r = 0.252, the data revealed there was a positive correlation between the score on the MoCA Science subtest and GPA in science courses offered by the science department for undergraduate students. However, because p = 0.077, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between the score on the MoCA Science subtest and GPA in science courses offered by the science department for undergraduate students.

Hypothesis 6: There is a relationship between the score on the elementary MoCA science subtest and GPA in science courses for graduate students.

The sixth hypothesis examined the linear association between the score on the elementary MoCA science subtest and GPA in science courses offered by the science department for graduate students. In response to the score on the MoCA science subtest and GPA for science courses for graduate students, with a PPMCC of r = 0.131, the data revealed there was a positive correlation between the score on the MoCA Science subtest and GPA in science courses offered by the science department for graduate students. However, because p = 0.453, which is greater than the required statistical significance of

$p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between the score on the MoCA Science subtest and GPA in science courses offered by the science department for graduate students.

Hypothesis 7: There is a relationship between the score on the elementary MoCA social studies subtest and GPA in social studies courses for undergraduate students.

The seventh hypothesis examined the linear association between the score on the elementary MoCA social studies subtest and GPA in social studies courses offered by the social studies department for undergraduate students. In response to the score on the MoCA social studies subtest and GPA for social studies courses for undergraduate students, with a PPMCC of $r = 0.056$, the data revealed there was a positive correlation between the score on the MoCA Social Studies subtest and GPA in social studies courses offered by the social studies department for undergraduate students. However, because $p = 0.699$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between the score on the MoCA Social Studies subtest and GPA in social studies courses offered by the social studies department for undergraduate students.

Hypothesis 8: There is a relationship between the score on the elementary MoCA social studies subtest and GPA in social studies courses for graduate students.

The eighth hypothesis examined the linear association between the score on the elementary MoCA social studies subtest and GPA in social studies courses offered by the social studies department for graduate students. In response to the score on the MoCA social studies subtest and GPA for social studies courses for graduate students, with a PPMCC of $r = 0.165$, the data revealed there was a positive correlation between the score on the MoCA Social Studies subtest and GPA in social studies courses offered by the social studies department for graduate students. However, because $p = 0.344$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between the score on the MoCA Social Studies subtest and GPA in social studies courses offered by the social studies department for graduate students.

Hypothesis 9: There is a relationship between the year the last math course was originally taken and the MoCA Mathematics score for graduate students.

The ninth hypothesis examined the linear association between the year the last math course was originally taken and the score on the elementary MoCA Mathematics subtest for graduate students. In response to the year the last math course was originally taken and the score on the elementary MoCA Mathematics subtest for graduate students, with a PPMCC of $r = -0.253$, the data revealed there was a negative correlation between the year the last math course was originally taken and the score on the MoCA Mathematics subtest. However, because $p = 0.143$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The

researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between the year the last math course was originally taken and the score on the elementary MoCA Mathematics subtest for graduate students.

Hypothesis 10: There is a relationship between the year the last science course was originally taken and the MoCA Science subtest score for graduate students.

The tenth hypothesis examined the linear association between the year the last science course was originally taken and the score on the elementary MoCA Science subtest for graduate students. In response to the year the last science course was originally taken and the score on the elementary MoCA Science subtest for graduate students, with a PPMCC of $r = -0.100$, the data revealed there was a negative correlation between the year the last science course was originally taken and the score on the MoCA Science subtest. However, because $p = 0.568$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between the year the last science course was originally taken and the score on the elementary MoCA Science subtest for graduate students.

Hypothesis 11: There is a difference between graduate candidates and undergraduate scale scores in the subtests of mathematics, science, and social studies.

A statistical analysis of a random sample of both undergraduate and graduate candidates MoCA scores from 2015 through 2017 in the subtests of mathematics, science, social studies, and English, was conducted to determine whether a significant

difference existed between the two data sets. *Z*-tests, using a 95% confidence interval, were used to evaluate the scale scores of each random sample taken for each of the various areas. The null hypothesis stated that no significant difference existed between the undergraduate and graduate MoCA scale scores. In the area of mathematics, the *z*-test indicated that there was not a significant difference in undergraduate and graduate candidate MoCA scale scores between 2015 and 2017. The researcher failed to reject the null hypothesis and failed to support the hypothesis. Because of this, one could conclude both the undergraduate and graduate elementary education programs at Researched University equally prepared candidates for the MoCA mathematics subtest.

In the area of science, the *z*-test indicated that there was not a significant difference in undergraduate and graduate candidate MoCA scale scores between 2015 and 2017. The researcher failed to reject the null hypothesis and failed to support the hypothesis. Because of this, one could conclude both the undergraduate and graduate elementary education programs at Researched University equally prepared candidates for the MoCA science subtest.

In the area of social studies, the *z*-test indicated that there was not a significant difference in undergraduate and graduate candidate MoCA scale scores between 2015 and 2017. The researcher failed to reject the null hypothesis and failed to support the hypothesis. Because of this, one could conclude both the undergraduate and graduate elementary education programs at Researched University equally prepared candidates for the MoCA social studies subtest.

In the area of English, the *z*-test indicated that there was not a significant difference in undergraduate and graduate candidate MoCA scale scores between 2015

and 2017. The researcher failed to reject the null hypothesis and failed to support the hypothesis. Because of this, one could conclude both the undergraduate and graduate elementary education programs at Researched University equally prepared candidates for the MoCA English subtest.

Hypothesis 12: For graduate and undergraduate students, there is a relationship between student GPA and MoCA scale score when comparing GPA in the content area to the corresponding MoCA subtest.

The twelfth hypothesis examined the linear association between an undergraduate and graduate student GPA in the content area and corresponding MoCA subtest scale score. In response to undergraduate and graduate GPA in the mathematics and MoCA mathematics subtest score, with a PPMCC of $r = -0.196$, the data revealed there was a positive correlation between the GPA in mathematics coursework and the MoCA mathematics subtest score. However, because $p = .072$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between undergraduate and graduate student GPA in mathematics and MoCA mathematics subtest scale score.

In response to undergraduate and graduate GPA in science and MoCA science subtest score, with a PPMCC of $r = 0.205$, the data revealed there was a positive correlation between the GPA in science coursework and the MoCA science subtest score. However, because $p = 0.060$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the

null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between undergraduate and graduate student GPA in science and MoCA science subtest scale score.

In response to undergraduate and graduate GPA in social studies and MoCA social studies subtest score, with a PPMCC of $r = 0.056$, the data revealed there was a positive correlation between the GPA in social studies coursework and the MoCA social studies subtest score. However, because $p = 0.611$, which is greater than the required statistical significance of $p < .05$, the correlation was not statistically significant. The researcher failed to reject the null hypothesis and failed to support the hypothesis. These results suggested that at the Researched University, no significant relationship existed between undergraduate and graduate student GPA in social studies and MoCA social studies subtest scale score.

Recommendations for Program

The MoCA assessment was a major change for universities beginning in 2016. According to the Missouri APR for EPPs, in 2016 the Researched University's elementary education certification program ranked in Tier 2, indicating that performance of the candidates in the program were meeting expectations. In order to achieve the criteria to rate the elementary education program in Tier 1, exceeding expectations, areas of improvement for the Researched University included content assessment pass rate and content coursework GPA (MODESE, 2017b). Ongoing study and analysis of both undergraduate and graduate student performance in both of these areas would support the university faculty's ability to make improvements to the then-current program.

After analyzing the mean number of attempts on the Elementary MoCA, one next area of inquiry is the difference between the mean number of attempts on the MoCA. The sample of undergraduate students revealed mean attempts ranging between 1.28 and 1.7. The mean attempt of 1.28 in the area of math seems to indicate undergraduate students who were prepared to pass the MoCA subtest, compared to the mean attempt of 1.7 in the area of science. The sample of graduate students revealed mean attempts ranging between 1.45 and 1.57. Next steps for the Researched University might be to examine how the coursework in each of these areas are aligned to the elementary MoCA subtest content for both the undergraduate and graduate programs. In addition, closer examination of the strategies implemented in the undergraduate math program in order to achieve a mean attempt range of 1.28 might provide strategies to implement in other content areas.

Another recommendation for the elementary education graduate program may be to investigate what support exists for students who are not required to take a math or science course at the Researched University as part of the graduate program. The researcher discovered for the graduate sample, the mean number of years between when the student last took a college math class was 8.5 years and a college science class was 8.6 years. The Researched University could explore the correlation between how students who have over five years since taking a college level math or science class perform on the respective subtest, in order to determine if additional supports may be needed for this group of students.

Recommendations for Future Research

The researcher prepared some recommendations for future research regarding undergraduate and graduate student indicators of success on the Elementary MoCA.

The first recommendation is to examine if a statistically significant relationship exists for pre-service undergraduate teachers who completed all coursework at the Researched University. One observation noted with the student math coursework was, 55 of the 85 students included in the sample took at least one college math class at a different university than the Researched University. The differences that occur in various university math courses may affect a student's understanding, resulting in an increase or decrease in the attainment of the required math CK for the MoCA.

The second recommendation to better assess a correlation between the course work at the Researched University and the score on the MoCA would be to analyze the pre-service teacher's first subtest score. In this study, the final scores were analyzed to determine if a statistical significance existed. If a candidate retook a subtest, the final passing score was the score that was utilized in calculating the Pearson Product-Moment Correlation Coefficient. The researcher wonders how the relationship would have differed if the first score was utilized in the calculation. Use of the first score might be a better indication of how well a candidate was initially prepared for the subtest, and therefore, a clearer picture of how well performance in the content coursework prepared the student for the MoCA.

An additional consideration for future research may be to study a new variable of subgroup data. Analyzing the performance of the gender and race subgroups, in order to investigate if any differences exist could lead to potential benefits. In order to support the

state and nation-wide goal of increasing diversity in the teaching workforce, the Researched University could utilize this data to analyze current performance and identify any potential next steps.

Another recommendation would be to investigate the potential impact test fatigue might have on MoCA test performance. It is noted that the Science and Social Studies MoCA mean scores were lower than the Math MoCA mean scores. Considering the test design placed these sub sections at the end of the four-hour test, test fatigue may be a factor that may be contributing to the lower scores. Additional studies comparing this result to other universities and the state results may yield possible next steps to support pre-service teachers, if test fatigue is determine as a factor in the lower mean scores.

A final area to examine for future research may be to study perceptual data from undergraduate and graduate program completers from the Researched University. Using perceptual data regarding how the university program prepared them for success on the Elementary MoCA may provide insight to the university curriculum for each individual program.

Conclusion

The purpose of this project was to determine if there was a correlation between undergraduate and graduate overall GPA and GPA in the content area and performance on the Elementary MoCA. The study was conducted using data from 2015 through 2017 at a Private Midwestern University. With the increased university accountability at both the state and federal level, the MoCA provided data on university performance preparing future educators.

Although findings in this study alluded to no relationship between the number of attempts on the elementary MoCA and cumulative GPA for undergraduate and graduate students, between the score on the elementary MoCA subtests and GPA in the content coursework for undergraduate and graduates students, between the year the last math or last science course was originally taken for graduate students and the MoCA subtest score, between graduate candidates and undergraduate MoCA scale scores on the subtests, and between student GPA and MoCA scale scores, additional studies are merited. The possibility of the Researched University being able to demonstrate a significant relationship would be attractive for potential students and potential employers seeking quality candidates for future positions as elementary teachers.

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