The Effectiveness of Project-Based Learning and Exploring Theories Supporting 21st Century Learning Methods

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Abstract

This study aimed to examine if Project-Based learning or Competency-Based Education led to higher student achievement in the Missouri Assessment Program (MAP). The two independent variables included one, participation in a fully immersed Project Based Learning (PjBL) environment, and two, learning from Competency-Based Education instructional methods. The researcher sought to determine if a significant difference in the dependent variable, a composite score change resulted. This study utilized a quasi-experimental quantitative research design. The study sample included approximately 50 students from a fully immersed PjBL school and about 50 randomly picked peers from the same school district that received Competency-Based Education (CBE) instructional methods.

An independent sample *t*-test was utilized for hypothesis testing to determine if either independent variable affected the dependent variable and if there was an interaction between the two independent variables which affected the dependent variable. Data analysis indicated that participation in a fully immersed PjBL program did not necessarily have a statistically significant positive effect on the change in the annual MAP. Specifically, the results of this study showed no significant difference existed in the ELA or Science portions of the MAP Assessment between GWE and VE students. However, the Math MAP portion showed that a statistically significant difference existed.

Recommendations for further research included replicating the study at JPS with other groups of students in grades 3-5 in the future years, as well as conducting follow-up studies to determine if PjBL methods continue to result in higher academic performance evaluated by the Missouri MAP Assessment.

Dedication

To my late parents, your love, guidance, and support have made me who I am today. I can only imagine the sacrifices you made that allowed me to be where I am in this big world. Being raised by you, I learned the importance of hard work, dedication, continuing my education, and having fun along the way. Invaluable, your encouragement and support have led me to a life filled with meaning and purpose. I love you both and know that I would not have been able to achieve this accomplishment without you.

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Table of Contents

List of Tables

List of Figures

Chapter One

Introduction

The question of how America's public schools are performing is a fundamental component of any contemporary education policy discussion. The examination of policies in public education is also notoriously difficult to address. With nearly 100,000 schools spread across approximately 13,000 districts, the scale of the enterprise is beyond what any set of individuals can see and experience (Schneider, 2018). The Every Student Succeeds Act (ESSA), the 2015 reauthorization of the Elementary and Secondary Education Act (ESEA), gives policymakers and educators the ability to leverage resources with the backing of the law to close opportunity gaps and improve learning outcomes for all students ("ESSA │ Equity in Education," 2018).

ESSA 2015 utilizes the Universal Design for Learning (UDL) definition found in the Higher Education Opportunity Act (2008). Additionally, UDL is required by new federal-level governance. According to the Center for Digital Education, Congress mandated that states should adhere to the principles of UDL as they develop student assessments. The law also calls for states to create comprehensive literacy instruction plans and incorporate UDL principles into those plans.

ESSA also stipulates that federal money can be used for technology that supports the strategy. UDL is for any student, but it is particularly crucial for students with disabilities, English-language learners (ELL), and others who might struggle with more traditional methods of teaching and testing. ESSA 2015 defines the term ELL as synonymous with the current phrase English Language Development (ELD) and provides guidelines for how its principles can be incorporated into teacher training (Samuels,

2016). These additions include the National Education Technology Plan of 2016, the Ed Tech Developer's Guide (2015), and the National Education Technology Plan of 2010.

Background

Public education continues reforming at a rapid rate. During these reforms, elementary students across the United States keep struggling to learn. Ninety-three million adults in the U.S., or 63 percent of the U.S. population, read at or below the basic level needed to contribute successfully to society. Unfortunately, 65 percent of fourth graders read at or below the primary level ("Literacy-Facts-Stats," 2017). As curriculum advances, these children will fall behind ("Literacy-Facts-Stats," 2017). According to the ESSA 2015, the U.S. Congress stated schools should adhere to principles of UDL as they develop student assessments.

When reviewing the endorsement of UDL and connecting this to assist struggling elementary students, essential questions for schools in Missouri arise. Missouri administrators and educators continue to explore how students can increase student achievement on the annual Missouri Assessment Program (MAP) assessment. These professionals emphasize how students can improve their academic achievement in the subjects of English Language Arts (ELA), Math, and Science.

This study focused on two elementary schools in the Midwest, one using traditional competency-based instructional methods and the other using non-traditional instructional methods. One elementary, Voyage Elementary (VE), was a member of Jonesberry Public Schools (JPS). The second school, George Washington Elementary (GWE), was a member of the Trinity School District (TSD). JPS serves the residents of approximately 85 square miles in Clay County, Missouri. Located just northeast of

Kansas City, Missouri, the school district serves more than 12,583 students in preschool through the 12th grade (“Explore Jonesberry School District,” 2021). In St. Louis County, TSD is located just west of the city of St. Louis and serves approximately 4,600 students in grades PK-12 (Explore Trinity School District, 2019). Both JPS and TSD had a student-teacher ratio of 15 to 1.

JPS has 11 elementary schools, four middle schools, two high schools, an alternative secondary school, and an early childhood center. As of spring of 2018, JPS was recognized as a high-performing school district for all 12 years that the state of Missouri presented the Distinction in Performance Award. This recognition made it one of only 6% of Missouri school districts to be placed in this category (Jonesberry Public Schools, April 15, 2018). TSD, a highly rated public-school district, was recognized as number 12 of 453 in “Best School Districts in Missouri (Explore Trinity School District, 2019). TSD has a family center, six elementary schools, one middle school, and one high school.

Table 1

District Comparison Data

Category	JPS	TSD
Community Population	31,507	22,889
PK-12 enrollment	12,600	4,600
Student-teacher-ratio	16:1	15:1
Number elementary schools	11	5
Number elementary computer schools	0	1
Number middle schools	4	1
Number sixth grade centers	0	1
Number high schools	2	1
Alternative secondary school	1	0
Early Childhood/Family Center	1	1

Note: Missouri Comprehensive Data System - District and School Information. (2018). Retrieved 4, 2018, from https://mcds.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx?RootFolder=%2Fquickfacts%2FSchool%20Finance%20Data%20and%20Reports%2FFree%20and%20Reduced%20Lunch%20Percentage%20by%20Building&FolderCTID=0x012000B3EF86959C3A824680BF44E0680ED1F4&View={0E813976-3BD6-4D9B-9112-5D0C54B515E8}

According to the Missouri Comprehensive Data System (MCDS) (2017), JPS had one of the lowest socioeconomic status (SES) rankings in the state (Missouri Comprehensive Data System - District and School Information, 2018). Specifically, JPS had an estimated 5% poverty rate of children 5 to 17 years old according to their enrollment of 11,948 (Mid-America Regional Council, 2017). As of the 2018 census, the local population (31,507) was made up of (92%) White, (88.6%) White alone, not Hispanic or Latino, (5.0%) Hispanic or Latino, (4.0%) Black or African American,

(0.5%) Asian. Of the total population, (24.6%) was comprised of persons under the age of 18. Locally, the annual median household income (in 2017 dollars) from 2013 to 2017 was $70,066 (U.S. Census Bureau QuickFacts: Jonesberry, Missouri, 2019).

Comparatively, in 2017, TSD had a higher SES than JPS, yet was low compared to the rest of Missouri schools (Missouri Comprehensive Data System - District and School Information, 2018). Specifically, TSD had an estimated 16% poverty rate of children 5 to 17 years old according to their enrollment of 4,681 (Mid-America Regional Council, 2017). In 2018, Trinity had a local population of (22,889). Their community was made up of (88.8%) White, (87.4%) White alone, not Hispanic or Latino, (2.0%) Hispanic or Latino, (7.5%) Black or African American, and (1.3%) Asian. Of the total population, (25.7%) were made up of persons under age 18. Locally, the annual median household income (in 2017 dollars) from 2013 to 2017 was $88,619 (U.S. Census Bureau QuickFacts: Trinity, Missouri, 2019).

Table 2

County Demographic Data

Category	Clay County Missouri	St. Louis County
Poverty Rate	5%	16%
Median Household Income, 2013-2017	$70,066	$88,619
% under 18	24.6	25.7
% White, non-Hispanic or Latino	88.6	87.4
% Hispanic or Latino	5	2
Black or African American	4	7.5
Asian	0.5	1.3

Note: Missouri Comprehensive Data System - District and School Information. (2018). Retrieved 4, 2018, from https://mcds.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx?RootFolder=%2Fquickfacts%2FSchool%20Finance%20Data%20and%20Reports%2FFree%20and%20Reduced%20Lunch%20Percentage%20by%20Building&FolderCTID=0x012000B3EF86959C3A824680BF44E0680ED1F4&View={0E813976-3BD6-4D9B-9112-5D0C54B515E8}

Statement of the Problem

Despite the undeniable change in 21st-century learning and technological innovation, basic educational practices in most American schools have remained unchanged from the traditional teacher-centered lecture experience (Penikas, 2019). An essential yet unresolved pedagogical question is whether discovery-oriented or direct instruction methods lead to greater learning and transfer (Chase & Klahr, 2017). The 2018 results of Missouri's annual assessments did not suggest much improvement from 2017 in students' performance in math and reading (Pendergrass, 2019). While schools across the state instruct under the expectations of the Missouri Learning Standards, only a few schools have explored using Project Based Learning (PjBL) to engage and transform student achievement (Vander Ark, 2017). The continued emergence of research findings

to support PjBL as a valid instructional method for all students is promising (Kingston, 2018). However, little empirical evidence exists as it relates to PjBL and student academic achievement in Missouri. Educational researchers could then ask, "is there a difference between students' academic achievement (i.e., ELA, Math, and Science MAP scores) in schools employing more traditional instruction and PjBL as a primary model of instruction?"

Purpose of the Study

This study examined if there was a difference in annual Missouri Assessment Program (MAP) assessment scores between students from two different Missouri elementary schools receiving separate styles of instructional methods. Specifically, the purpose of this study was to examine if there was a difference in students' ELA, Math, and Science MAP assessment scores between VE students attending school in a PjBL-focused setting and GWE students attending school in a Competency-Based Education (CBE) focused, or more traditional, environment.

Significance of the Study

The results of this study may contribute valuable insight and theory into the determination between competency-based education and universally designed learning to meet the needs of all students. The results of this study could provide school leaders with a direction to create practical professional development sessions for teachers while allowing students to sustain their knowledge as they progress through their grade levels.

Furthermore, this study may assist schools in assessing their students' performance potential based on different modes of instruction. Overall, exploring strategies in both the PjBL and the framework of UDL could provide a valuable

extension (Universal Design for Learning (UDL): Reaching All, Teaching All. 2004) for educational leaders to offer additional instructional methods to more learners. In other words, by studying the procedures and practices of UDL principles in K-12 public school inclusive classrooms, researching UDL could be one step toward bridging the gap from a good idea to a solidified best practice. Building level administrators should embrace the possibilities for how PjBL can potentially help students learn from a different instructional framework while also meeting expectations of incorporating UDL principles into assessments and lessons. Ultimately, the significance of this study further supports teachers in designing lessons to accommodate all learners.

Delimitations

According to Lunenburg and Irby (2008), delimitations are self-imposed boundaries set by the researcher on the purpose and scope of the study. As mentioned below, the delimitations of this study include:

1. This study is limited to two elementary schools and their academic progression from the third to the fifth grade: Approximately 50 VE elementary students immersed in a PjBL-focused environment and approximately 50 GWE elementary students receiving CBE instruction in a traditional elementary environment.
2. The time delimitation of this study included three 9-month American school years' student academic achievement data. The years were 2015, 2016, and 2017.
3. Science scores were only for one academic year, 2016, and not 2015 or 2017, as was the case for ELA and Math.

4. Missouri Assessment Program (MAP) scores were the only assessment scores used in this study.

Assumptions

"Assumptions are postulates, premises, and propositions that are accepted as operational for purposes of research" (Lunenburg & Irby, 2008, p. 135). The following statements are the assumptions made within this study:

1. It was assumed that the data collected were accurate as of the time and year of expectations, regulations, or policies in place.
2. It was believed that each participating school provided accurate and reliable information.
3. It was assumed there would be variance between the school district's policies and procedures due to the different makeup of every board of education (BOE) and their district's socioeconomic status.

Research Questions

Research questions, in the quantitative tradition, explore the relationships between and among variables (Heppner & Heppner, 2004; Heppner, Kivlighan, & Wampold, 1999). Within this study, the following research questions were utilized to examine the topic:

RQ1. Is there a difference in the ELA MAP assessment scores between Voyage Elementary (VE) students receiving a PjBL-focused means of instruction and George Washington Elementary (GWE) students receiving a CBE means of instruction?

RQ2. Is there a difference in the Mathematics MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction?

RQ3. Is there a difference in the Science MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction?

Definition of Terms

To avoid confusion, this study provided definitions of standard terms utilized throughout the research and written work.

Brain-based research. The term relates to studies that have explored how the brain responds to events and tasks; modularity and plasticity of the brain during the learning process have also been studied (Driscoll, 2005; Posner & Rothbart, 2007).

Collaborative learning. This term is "an umbrella term for a variety of educational approaches involving a joint intellectual effort by students, or students with teachers together" (Pascarella & Terenzini, 2005, p. 102).

Competency-Based Education (CBE). CBE is a concept of allowing students to learn at their own pace and awarding credit for the evidence of proficiency, not for time spent in a classroom. CBE may also be referred to as mastery-based learning or proficiency-based learning. Although CBE is often linked to higher education, some states have adopted CBE practices in their K-12 education systems (Potts, 2016).

English Language Arts (ELA). English language arts education incorporates the teaching and learning of reading, writing, speaking, listening, and viewing (Language arts overview – Oklahoma, 2022).

ESSA. The Every Student Succeeds Act (ESSA) is the federal K-12 education law of the United States. ESSA was signed into law in 2015 and replaced the previous education law called No Child Left Behind. ESSA extended more flexibility to states in education and laid out expectations of transparency for parents and communities ("What is the Every Student Succeeds Act?", 2020).

IDEA. The Individuals with Disabilities Education Act (IDEA) is a law that makes available a free appropriate public education to eligible children with disabilities throughout the nation and ensures special education and related services to those children. The IDEA governs how states and public agencies provide early intervention, special education, and related services to more than 7.5 million (as of the school year 2018-19) eligible infants, toddlers, children, and youth with disabilities ("About IDEA," 2022).

Item Response Theory (IRT). Also known as the latent response theory, IST refers to a family of mathematical models that attempt to explain the relationship between latent traits (unobservable characteristic or attribute) and their manifestations (i.e., observed outcomes, responses, or performance) (Item response theory, n.d.).

Learning Styles Theory (LST). LST suggests individualizing learning content or providing a pathway following learner preferences. A key concept of LST is matching teaching and learning styles to promote a meaningful learning experience (Pashler et al., 2009).

Individualized Education Plan (IEP). An Individualized Education Plan (or Program) is also known as an IEP. This is a plan or program developed to ensure that a child with an identified disability who is attending an elementary or secondary

educational institution receives specialized instruction and related services ("What is an Individualized Education Plan? | AccessComputing", 2006).

Personalized Learning (PL). PL is "an omnipresent phrase to refer to efforts to tailor lessons to students of different ability levels—an appealing concept, given the pressures schools face to raise the achievement of students coming to academic topics from very different starting points" (Cavanagh, 2014, p. 1).

Problem-Based Learning (PBL). Problem-based learning (PBL) is an instructional approach that has been used successfully for over 30 years and continues to gain acceptance in multiple disciplines. It is an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem (Savery, 2006).

Project-Based Learning (PjBL). "PjBL is more than just a teaching method. It is a revitalization of education for students so that they can develop intellectually and emotionally. By using real-world scenarios, challenges, and problems, students gain useful knowledge and skills that increase during their designated project periods." ("What is Project-Based Learning? Discover Here | Educators of America," 2019, p. 1).

Socioeconomic Status (SES). Socioeconomic status (SES) is the social standing or class of an individual or group. It is often measured as a combination of education, income, and occupation (APA, 2022).

Standards-Based Grading (SBG). SBG is an intentional way for teachers to track their student's progress and achievements while focusing on helping students learn and reach their highest potential. It is based on students showing signs of mastery or

understanding of various lessons and skills ("Standards-Based Grading: What To Know for the 2021-2022 School Year," 2022).

Universal Design for Learning (UDL). Universal design for learning (UDL) is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn ("CAST: About Universal Design for Learning," 2019)

Organization of the Study

This dissertation is divided into five chapters. Chapter 1 includes the introduction, background, and statement of the problem. Additionally, the significance of the study is described along with the purpose statement, delimitations, and assumptions underlying the analysis. The chapter concludes by listing the research questions that guided the study and the definition of terms. Chapter 2 provides the reader with a review of the literature related to government mandates, trends in school reform, and the role of building and district leadership in student achievement. Chapter 3 describes the methodology, including the research design, population, data collection and analyses, and limitations. Chapter 4 shows the results of the analysis of the data. Chapter 5 provides a summary of the study related to the literature, an interpretation of the results of the data analysis, a statement of a conclusion drawn, and recommendations for further research.

Chapter 2

Review of the Literature

Throughout history, a controversy has existed regarding theories of best practices to meet public education goals. Some learning theorists of the 21st-century believe that Competency-Based Education (CBE) is best for preparing K-12 students for the future ("Competency-Based Education (CBE) Experiment Reference Guide," 2015). Conversely, Project-Based Learning (PjBL) practitioners and other experiential approaches to education continue to be applauded and explored ("A Review of Research on Project-Based Learning | Project Based Learning | BIE," 2000).

For decades, the model for many American schools has been the traditional unit with occasional culminating projects, such as in a Social Studies class where students would experience a cycle of lectures, activities, and quizzes, ending in an individual, team, or class project ("Competency-Based Education and Project-Based Learning in Johnston County Public Schools," 2021). PjBL, rooted in the progressive education movement, advocates for more student-centered approaches that support "deeper learning" (Pellegrino and Hilton, 2012).

History of Education and Project Methods

Historians have found evidence that the concept of "learning through projects" was developed in the 17th and 18th centuries (Knoll, 1997). Inspired by the philosophies of Dewey, Kilpatrick developed the "project method," cited as the first formalization of a PjBL model (Peterson, 2012). For Kilpatrick, the key to the "project method" lay in its being "an activity undertaken by students that interested them" (Ravitch, 2000, p. 179). Kilpatrick's ideas were disseminated widely among teachers and administrators during

the progressive education movement but have been significantly revised (Condliffe et al., 2017). The progressive education movement surfaced in the 1880s, and continued well into the 20th century. Progressive education in the 20th century embraced democratic concepts such as participation and engagement of all citizens, in ways that affected social, economic, and political benefits for all.

Further, in the 20th century, British sociologists Heath and Clifford (1990) explored class inequalities in education trends. They used long-linear models to test whether the relationship between a father's societal class and a respondent's education varied significantly by birth cohort. They concluded that the various educational reforms attempted in Britain over the prior 50 years had little impact on societal-class inequalities in education (Heath & Clifford, 1990).

Well into the 21st century, regardless of social class, technology has redefined the skills needed to prepare students to be productive workers. The global, interconnected workforce has changed from the Industrial Revolution to the need for service-based employment. Employers have found gaps in skills and looked for young professionals who possessed an agile mindset to think strategically ("Culture of 21st Century Education", 2019).

According to the Dancker Corporation (2018), 21st-century learning encompasses broad knowledge and skills to enable flexibility and adaptability. 21st-century learning focuses on mastering skills such as analytic reasoning, complex problem solving, and teamwork. Instead of concentrating on the three Rs (reading, writing, and arithmetic), the emphasis is now on teaching the four Cs: critical thinking, communication, collaboration, and creativity.

Student achievement in English before ESSA/UDL

Before ESSA, the No Child Left Behind Act (2002) (NCLB) required school districts and states to collect an unprecedented amount of data on U.S. public school students (Batt, Kim & Sunderman, 2005). Many policymakers and practitioners argued that several NCLB mandates were unrealistic, using only standardized assessments (Batt, et al.). Sterba (2004) suggested that standardized tests may not accurately reflect the knowledge of limited English proficient (LEP) students. Sterba continued that "schools with high numbers of students learning English have typically not been able to meet federal testing requirements" (p. 8).

According to Abedi (2004), standard questions might be unnecessarily linguistically complex or might assume a different cultural knowledge that was unfamiliar for newcomers to the United States. Specifically, Abedi asserted that standardized tests reflected lower content knowledge and language and an overall lack of cultural knowledge based on standard assessments. Since standardized tests were constructed and normed for native English speakers, they had low reliability and validity when used with LEP students.

School administrators and teachers continue to face the unique challenge of communicating effectively and offering appropriate instruction for today's students. Regarding literacy and English, the skills of nine-year-olds in the U.S. have increased modestly over the past forty years, while the skills of thirteen- and seventeen-year-olds have remained relatively flat (Reardon, Valentino & Shores, 2012). Literacy skills vary considerably among students, however. For example, the literacy skills of

roughly 10 percent of seventeen-year-olds are at the level of the typical nine-year-old (p. 17).

The current U.S. education agenda places unprecedented attention on improving the quality of its roughly fifteen hundred teacher preparation programs. The effort places considerable weight on measuring program effectiveness and includes a push to hold programs accountable for their graduates' effects on student performance. Concerns regarding the use of value-added methodologies for this purpose, combined with unsatisfactory measures historically in use (e.g., multiple-choice tests of teaching knowledge, surveys of program graduates), have led many states to adopt the use of a teaching performance measure (see, e.g., www.pacttpa.org and www.edtpa.aacte.org). States and programs have allocated significant resources to the use of multiple metrics in the quest for program accountability, but far less effort has been paid to the use of such metrics for program improvement (Sloan, 2015).

Through the lens of Universal Design for Learning (UDL) and the assessment of young children, the U.S. Department of Education described early childhood education (EDE) from birth through age 8 (Dalton & Brand, 2011). EDE reports have concluded that traditional approaches to curriculum, such as those emphasizing drill and practice of isolated, academic skills, are not in line with current knowledge of human learning and neuropsychology. These approaches fail to produce the higher-order thinking and problem-solving abilities that students need in the 21st century. Similar limitations in assessment process and scope also exist. Often, there is a poor match between the nature of young student learning and form of assessment.

In reading and writing, for example, experts have found informal observations and structured performance samples more appropriate than standardized tests for measuring early childhood literacy learning. These assessments are more consistent with developmental characteristics of young children. When considering childhood learning principles (i.e., children construct knowledge; children learn through play; children's interests motivate learning; child development and learning are characterized by individual variation; etc.), assessing the achievement of young children must be a multiply varied process that addresses all students' needs and capacities (Dalton & Brand, 2011). Interestingly, research exists regarding self-efficacy and student performance that may suggest a link between student achievement and instructor self-efficacy. High instructor self-efficacy has been linked with numerous benefits to daily life, such as resilience to adversity and stress, healthy lifestyle habits, improved employees' performance, and educational achievement (Lopez-Garrido, 2020).

Regardless of the mention of instructor self-efficacy, determining effective instruction and student achievement are constantly assessed to determine what is best for 21st century students. For example, an English and Language Arts report queried from the Missouri Comprehensive Data System (MCDS) indicated that the five years (2010 to 2014) before the ESSA of December 2015, Missouri fifth graders scored an average of 41.2% at the basic level and an average of 32.5% at the proficient level on the annual Missouri Assessment Program (MAP) ("Achievement Level 4 Report - Public - Historical", 2021). In other words, a contention could be made that select Language Arts educators in Missouri, just prior to implementation of the ESSA, could have emphasized self-efficacy and achievement of their students more.

Student Achievement in Math within UDL and PjBL

Butler (2014) posited that PjBL was a promising methodology for engaging and motivating students' learning while increasing their math skills. However, he claimed that assessing student performance during PjBL units was often tricky. Results garnered from his 2014 study showed that problem-solving performance did not improve with the addition of formative assessments, and gains on math computation performance were mixed (Butler, 2014).

Friesen's study (2016) used the design-based research (DBR) approach to investigate a mathematics geometry study. This study employed the principles of UDL within a discipline-based inquiry. Friesen's UDL disciplined DBR study which embedded assessment for learning, laid claim to impact student learning, and teacher education and instructional designs. Qualitative and quantitative data informed the research and indicated that all students showed significant improvement in achievement. Additionally, the same study found that all students could engage with challenging mathematical ideas when provided with assessment for learning (Friesen, 2016).

After an examination of both opinions, Friesen's study determined that introducing UDL and assessment for learning into the mathematics classroom could be a disruptive innovation. This study also created accessible mathematics classrooms consistent with UDL and review for teaching principles and practices, requiring increased teacher knowledge and support for ongoing professional development. So, proponents of UDL and specifically PjBL should consider the potential for mixed mathematics results.

In conjunction with Friesen's determination, Tanjung, Syahputra, and Irvan (2020) claimed that mathematics needs to be studied thoroughly, as well as students needing to have some abilities. Tang et al. found that,

> The initial step of students' preparation in following the learning process is that students must have initial abilities. Initial abilities are obtained based on prior knowledge. The initial ability illustrates the readiness of students to receive lessons delivered by the teacher, to find out how far students master the subject matter (Knecht-Sabres, 2013). So, with this initial ability the teacher can design learning better (Tanjung, Syahputra, & Irvan, 2020, p. 9).

More recently, a case study conducted by MIDA Learning Technologies, LLC (2021) compared elementary classes piloting PjBL with groups continuing to use a district's traditional math curriculum. Defined Learning, a web based PjBL supplementary curriculum resource, lauded their findings claiming that PjBL positively impacted how students learn math. Their quantitative analysis of post-test data for the control and experimental groups in the 2nd and 5th grades revealed significant differences in post-test success between the control and experimental groups in the second and fifth grades. In both levels, the experimental group, which received the PjBL curriculum from Defined Learning, outperformed the control group (Speziale, 2021). As state assessment programs have become practically universal and more uniform in terms of grades and subjects tested, the relative appeal of using state tests as a source of study outcome measures has also grown.

In Missouri, math instructors and school leaders could find these methods promising for raising overall math scores. As of the fall, 2021, a preliminary-public

Mathematics achievement report queried from the MCDS portal indicated that Missouri fifth graders scored an average of 33.8% at the basic level and an average of 21.3% at the proficient level on the annual Missouri Assessment Program (MAP) ("Achievement Level 4 Report - Public - Historical", 2021). Comparatively, Butler's 2014 study appears the most promising, resulting in mixed evaluations on mathematics assessments.

Student achievement in Science within UDL and PBL

According to the Journal of Research in Science Teaching, students in the U.S. have fallen further and further behind their international counterparts regarding science education proficiency. This includes an influx of science, technology, engineering, and math (STEM) focused, reformed K-12 schools, including schools focused on Problem-Based Learning (PBL). Craig & Marshall (2019) contended that although ample research suggests that PBL was advantageous for increasing STEM learning compared to conventional teaching approaches, there was a lack of studies randomly assigning students to receive PBL. They found that students taught through PBL, as a group, matched the performance of conventionally educated students on all science in the 11th grade. Craig & Marshall's (2019) contention then, seems to support conventional teaching approaches while they find it important to continue STEM learning approaches.

Another study involving PBL and student achievement within science found inconsistencies in the definition of PBL, that is - problem or project-based learning. From their review, Merritt et al. found that although there was no consistent definition of PBL, PBL is an effective method of improving K-8 students' science academic achievement, including knowledge retention, conceptual development, and attitudes (Merritt, Lee, Rillero & Kinach, 2017). Since there is the potential for ambiguity in the

acronym of Problem-Based Learning (PBL), and Project-Based Learning (PjBL), it remains important for future researchers to specifically determine what they are studying.

Particularly, as science instructors in Missouri explore and utilize these popular STEM approaches and problem or project-based methods as suggested, a common practice is to monitor attainment of knowledge. In the Fall 2021, a preliminary-public Science achievement report queried from the MCDS portal indicated that Missouri fifth graders scored an average of 30.3% at the basic level and an average of 28.2% at the proficient level on the annual Missouri Assessment Program (MAP) ("Achievement Level 4 Report - Public - Historical", 2021). Unfortunately, the significance of this Missouri Science achievement report does not result in much improvement in STEM instructional approaches compared to recent years and to that of students' academic achievement differentiated with their peers in other countries. In comparison, "recently released data from international science assessments indicate that U.S. students continue to rank around the middle of the pack, and behind many other advanced industrial nations (DeSilver, 2020)."

Origins and Early Purposes of UDL in the 21st Century

Early in the 1990s, Anne Meyer and David Rose introduced and first launched principles of UDL, while also establishing the groundwork of its theory and practice ("CAST: About Universal Design for Learning," 2019). According to Meyer and Rose, UDL is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn. Based on neuroscience research, Kurzweil ("UDL: Three Principles," 2019) identified that UDL involved three primary neurological networks that impact learning.

Kurzweil's first principle recognized how the human network deals with incoming stimuli and affects "what" students learn. The second principle indicated that the strategic network mediates "how" students process incoming information based on experience or background knowledge. Finally, the affective network regulates students' attitudes and feelings about incoming data as well as their motivation to engage in specific activities — the "why" students want to learn and engage (Kurzweil, 2019).

Successful teaching and learning involve all three networks simultaneously. Based on the three neurological networks (CAST: About Universal Design for Learning 2019), UDL's three principles are (See [Figure 1]):

1. Multiple means of representation-give learners various ways of acquiring information and knowledge
2. Multiple means of expression-provide learners alternatives for demonstrating what they know
3. Multiple means of engagement tap into learners' interests, offer appropriate challenges, and increase motivation

UDL emerged from architectural design when federal legislation required universal access to buildings and other structures for individuals with disabilities. Architects began to design accessibility into buildings during their initial design stage rather than retrofitting standing systems. Using this architectural principle, UDL is a strategy to eliminate barriers that students may encounter learning ("Universal Design for Learning (UDL): Reaching All, Teaching All," 2004).

The term Universal Design for Learning was coined by the Center for Accessing Special Technologies (CAST). UDL includes Universally Designed Instruction (UDI) as

well as the concept of a universally designed curriculum (UDC) and Universal Design in Assessment (UDA). These concepts dealt with the idea that education, in general, should be created for access by all students, whether the curriculum, the instructional strategies, or the assessment.

The principles of UDL create learning environments that can be understood and used by all: "universal" in the sense that any individual–regardless of ability or age, for example – can engage or interact. UDL promotes teaching designed to respond to each child's needs – not universal in the sense of one-size-fits-all, but comprehensive in the sense whereby practices should be prepared to accommodate each child where they are. It is a concept that has gained popularity in education, boosted by its endorsement in the 2015 ESSA. A UDL environment is supposed to foster improved conditions for individually paced learning opportunities for all students ("Universal Design for Learning (UDL): Reaching All, Teaching All," 2004).

UDL is a natural complement to differentiated instruction strategies that match instructional approaches to students' learning needs. UDL also enhances the impact of initiatives, such as inclusive education and response to intervention (RTI). These initiatives provide targeted and intensive instruction to struggling students, and Partnership for 21st Century Learning (P21) (See [Figure 2]) projects focused on teaching essential language arts, mathematics, technology, and behavioral skills viewed as 21st-century skills. For example, instructional materials that include digital texts and media resources encourage students to learn and use 21st-century skills. When the curriculum and instructional materials are designed initially with UDL principles in mind, the need for time-consuming adaptations and retrofitting of materials is eliminated (Universal

Design for Learning (UDL): Making learning accessible and engaging for all students, 2008).

Comparatively, UDL is not the same as Individualized Education Plans or Programs (IEPs), a legal document mandated by the Individuals with Disabilities Education Act (IDEA, 1975) to provide special education services to support a public-school student's success in school. However, UDL practices can be a part of a child's IEP. Many intervention methods such as Project-Based Learning (PjBL) continue to be researched and practiced supporting all students' academic progress. Since the ESSA replaced the No Child Left Behind Act (NCLB, 2002), advancements in how public education progresses in providing educational offerings would seemingly include discussion of instructional methods that are universal for all students and that are unique from before (Edmonds, 2016).

For many years, the United States federal government has shown an interest in mandating equal access to education. Regarding educational offerings that are universal for all students, the ESSA of December 2015 instructed that UDL was to be utilized to contribute to the educational process for students in the U.S. Another popular example of a United States federal government educational mandate is Title I – Improving the Academic Achievement of the Disadvantaged ("Title I - Improving the Academic Achievement of the Disadvantaged," 1965). According to the U.S. Department of Education, Title I was created "to ensure economically disadvantaged children receive a fair, equitable, and high-quality education, by helping to close academic achievement gaps" (Title I Explained, 2021). Additionally, Title IX and gender equity policies are another U.S. federal mandate into U.S. educational offerings. Title IX states that "No

person in the United States shall, based on sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance" (Title IX and Sex Discrimination, 1972, para 2).

In 2015, the Elementary and Secondary Education Act (ESEA), previously known as NCLB, was replaced by the Every Student Succeeds Act (ESSA). The ESSA establishes–and limits–the federal government's role in education. The current study focuses on how to utilize successful methods of incorporating UDL techniques into classrooms that also meet federal mandates of ESSA. Specifically, this study aimed to determine successful strategies of incorporating instructional technologies, such as Project-Based Learning (PjBL) and UDL, while meeting federal mandates (PBL UDL, 2014).

Public schools have faced stakeholder pressure to guarantee student success. Layers of accountability continue from the federal government (ESSA, IDEA); state government (MAP); school districts (school, teacher, and student performance targets); school reformers (charter school operators, school voucher proponents); and parents (Collier, 2019). At the same time, education advocates have promoted the necessity of 21st-century learning skills. In contrast, other vital stakeholders have promoted various approaches to teaching and learning, such as project-based learning, or back to basics curricula (Fulton, 2003).

The Role of the Principal. Leading a school and its community can offer uplifting challenges, and at other times difficult situations. Both community patrons and stakeholders expect these same leaders to help American youth achieve, strive, and thrive

in today's world. Principals are in a paradoxical position and often they move on to other careers (DuFour & Mattos, 2013). Principals are vital for ensuring student success. Their actions help maintain a positive school climate, motivate school staff, and enhance teachers' practice. Therefore, principals play a major role in retaining effective teachers and ensuring their success in the classroom (Levin & Bradley, 2019). Research notes that principal turnover can be disruptive to school progress, often resulting in higher teacher turnover and, ultimately, lower gains in student achievement. Further, the relationship between principal turnover and declines in student outcomes is stronger in high-poverty, low-achieving schools—the schools in which students most rely on education for their future success (Levin & Bradley, 2019).

In addition to managing a building or a department, school administrators are expected to perform the core task of decision-making. This expectation requires synthesizing multiple cognitive processes to incorporate knowledge into creative solutions (Lunenburg & Irby, 2008). According to Ruby (2006), circumstances can affect the decision-making process, both the context in which the decision is made, such as the expectations of peers and the clarity of the goals involved. Decision makers' personal beliefs and interests also impact decision-making. Variations in these factors can cause decision-makers to place different values or moral weight on the decision-making process (Ruby, 2006). Constraints are often placed around the motivations of the decision-maker, created by the methods leaders use to establish objective standards and a clear understanding of the mission (Ruby, 2006). When limitations are placed on a school leader, their sense of self-efficacy affects their motivation, well-being, and sense of personal accomplishment (Lopez-Garrido, 2020).

A strong sense of self-efficacy is necessary to access skills and knowledge while at the same time remaining focused on the task in a complex environment (Bandura, 1997). Hoy (1998) proposed that self-efficacy is equally essential for administrators in the processes of communication, leading, and motivating others (Lunenburg & Irby, 2008, p. 116). Additionally, Hoy (1998) added: "The concept of administrator efficacy, unlike the concept of teacher efficacy, has been neglected in the educational arena" (p. 157). Therefore, one could argue that there is potential for receiving higher ratings from their stakeholders, and an increased ability to set a unique vision from school leaders who have a healthy amount of self-efficacy.

Uncertainties of administering a building seemingly arise as new federal mandates and educational theories are fielded. No Child Left Behind (NCLB) admonished educators to use scientific, research-based strategies to ensure that all students learn. Likewise, Race to the Top required educators to use "research-based" school improvement models (DuFour & Mattos, 2013). Unless principals “believe they can make a difference through their actions, there is little incentive to act” (Hoy, 1998, p. 4). Unfortunately, the core strategies of both NCLB and Race to the Top largely ignore this call for practices grounded in research. Stakeholders expect the principal to improve student learning by implementing mandated reforms that have been proven ineffective in raising student achievement (DuFour & Mattos, 2013).

Beliefs About Instructional Techniques and UDL

Throughout their experiences of studies in educational methods, teachers learn that students bring to the classroom a great diversity of learning styles. Grasha (1996) argued that “the problem is not that faculty and student mismatches sometimes occur, but

rather it is the failure to acknowledge and work out the potential conflicts and misunderstandings that undermine student learning" (Montgomery & Groat, 1998, p. 6). Randall et al, (1995) claimed that "Indeed, acknowledgment can be empowering for students if they can be made aware of their preferred learning style(s) and assisted in stretching their capabilities to accommodate greater variety" (p. 7). Montgomery and Groat offered a few suggestions that faculty could do to discover how to make these adjustments for their learners.

First, faculty could begin by being self-reflective about their pedagogical goals and strengths in teaching. As Grasha (1996) suggested, "any attempt to modify one's teaching style needs to be framed within this broader conceptual context" (p. 7). Second, it is important for instructors to remember that neither learning nor teaching styles are immutable; they can be modified over time and for different purposes in different classroom contexts (Montgomery & Groat, 1998). Moreover, "matching teaching style to learning style is not a panacea that solves all classroom conflicts" (p. 7). Other factors such as classroom climate, previous background, motivation, gender, and multicultural issues will of course greatly influence the amount of quality of learning that takes place, as McKeachie (1995) reminded us. By faculty members being self-reflective and explicit about the role learning styles play in educating others can make teaching more rewarding and enhance student learning at the same time (Montgomery & Groat, 1998).

The UDL framework has increasingly drawn the attention of researchers and educators as an effective solution for addressing differences in student abilities and individual pupil needs (Al-Azawei, Serenelli & Lundqvist, 2016). Learners naturally have different characteristics, preferences, needs, and skills, and such particular

features may affect their academic performance and learning experience. According to Burgstahler (2011), learner diversity also comprises physical, visual, hearing, sensory, attention, and communication impairments.

Two popular perspectives were developed to tackle this issue. The first one was called Learning Styles Theory (LST), which suggested individualizing learning content or providing a pathway determined by learner preferences (Learning Styles, 2016). This theory has attracted considerable attention from educational psychologists and instructional designers (Akbulut & Cardak, 2012; Al-Azawei & Lundqvist, 2015; Özyurt & Özyurt, 2015; Truong, 2015).

Pashler, McDaniel, Rohrer, & Bjork (2009) used the term "style-matching hypotheses" to demonstrate that the fundamental concept of LST was matching teaching and learning styles to promote a meaningful learning experience. Hence, LST has been widely integrated into adaptive educational hypermedia systems (AEHSs) to respond to individual learning styles (Akbulut & Cardak, 2012; Özyurt & Özyurt, 2015; Truong, 2015). However, the pedagogical implications of this educational psychology framework on instructional practice are far from being universally accepted (Akbulut & Cardak, 2012; Al-Azawei, Al-bermani, & Lundqvist, 2016; Al-Azawei & Lundqvist, 2015; Coffield, Moseley, Hall, & Ecclestone, 2004; Mayer, 2011; Pashler et al., 2009). The LST model will help some students, while others have argued that UDL is a better philosophy to follow.

UDL, the second perspective, provides a far more comprehensive point of view of assisting a broader range of students. According to Rose, Harbour, Johnston, Daley, & Abarbanell (2006), UDL attempts to tackle the limitations of a learning environment

rather than addressing learner limitations. This approach has progressively gained consensus, particularly in the United States (Rose & Meyer, 2002). UDL researchers suggested that designing content and delivering it in an accessible learning environment could improve the learning experience regardless of individual needs.

Although UDL assumes that learning is a unique process, it focuses on curricula design techniques to minimize the implications of learner differences (Courey, Tappe, Siker, & LePage, 2012). Accordingly, UDL can be significant in different learning settings as empirical research has delivered promising results from UDL adoption regarding academic performance and learner perceptions (Burgstahler, 2011; Rao, Ok, & Bryant, 2014). On the other hand, prior meta-analysis has shown that the UDL framework has not gained real momentum yet, compared to other global attempts of implementation and its adoption in the United States (Mangiatordi & Serenelli, 2013).

According to supporters of the Christian Blind Mission (CBM),

> Similar to inclusive education, UDL is often viewed as an approach only for the inclusion of learners with disabilities. However, it is a practice aimed at the inclusion of all learners, irrespective of the kind of barriers to learning that they face. UDL recognizes that everyone learns differently and is an instructional strategy that can address systemic inequality and discrimination, which may arise from an intersectionality of multiple forms of disadvantage, such as racial inequality, gender discrimination, poverty, and disability stigma. (McKenzie, Karisa, & Tesni, 2021, p. 6)

Early on in their profession, school practitioners gain knowledge and experience in learning the importance of inclusion for all learners. Similarly, they can find educating

their youth more difficult at times when outside interests or groups place emphasis on a certain collection of learners, like those that may arguably be at a disadvantage.

As UDL gains momentum and acknowledging the growing importance of UDL as a framework for implementing inclusive education, there are some educational researchers that believe there is minimal evidence and guidance on how it might be effectively implemented in Low- and Middle-Income Countries (LMICs) (McKenzie, Karisa, & Tesni, 2021, p. 6). Given the apparent gap in research and knowledge of how and where inclusive education is implemented the extent to which UDL forms part of any implementation remains a contention among education professionals, specifically in the P.D. realm. The variation lies in the effects of the implementation of UDL, most notably context-relevant and capacity-building needs for teacher professional development (p. 6).

Ultimately, LST and UDL have aimed to reduce learning barriers, albeit from different angles (Learning Styles, 2016). While LST suggests overcoming learner deficits by serving a student's individual preferences and focusing on the design of instructional content; the UDL aims to move from a teacher-centered to a learner-centered approach by providing multiple means of content representation, knowledge expression, and learner engagement (Al-Azawei et al., 2016). Moreover, UDL is more inclined to tackle accessibility issues, promote learner inclusion, and keep students together without segregation based on their diverse abilities. In other words, UDL seeks to address learning limitations from a broader perspective, whereas the empirical application of LST considers the content design only.

Social Class and Cultural Changes That Impact Classroom Instruction

During the 1948 Inglis Lecture at Harvard University, psychologist Davis shared views of social class and how it influences learning. His main point was that our social class system narrows a person's learning and training environment by defining the people with whom an individual may have intimate social relationships. A person's social instigations and goals, their symbolic world, and their evaluations are primarily selected from the narrow culture of that class with which they alone can associate freely (PsycNET, n.d.). Some have argued that Gay's theory is opposite to the efforts of UDL and inclusion, and would not support its vision of learning in a universal environment.

Gay contended that being culturally responsive was relevant in modern education regarding social and cultural changes in education. Gay remarked that "culturally responsive instructors need to fit the specific characteristics and needs of different settings, relative to societal dynamics, and student ethnic, cultural, racial, immigration/migration, economic, and linguistic demographics." Gay argued that, consequently, teaching offers both challenges and invitations for specific instructional practices (Gay, 2015, p. ix).

Concerning educational transformation and perceptions, Watson and Reigeluth (2013) asserted that "systemic organizational transformation with broad stakeholder involvement is needed in our educational systems" (p. 4). Communities are at their best when its stakeholders know how the schools are performing and when school leaders advocate for and collaboratively support improved outcomes (Engaging Stakeholders. Including Parents and the Community to Sustain Improved Reading Outcomes, 2009). Watson and Reigeluth believed that it was crucial to involve all stakeholders in building

grass-roots community support and garner input to achieve fundamental transformation in schools. Unfortunately, their findings indicated that community members were the least represented stakeholder group in most change efforts (Watson & Reigeluth, 2013).

Another study in 2013 on societal class and culture explored stakeholders' perceptions of "barriers and facilitators" related to the successful adoption and implementation of a comprehensive school improvement model. In particular, this study explored perceived barriers and facilitators related to these efforts and whether there were any preliminary differences in perceptions based on stakeholder role (Mendenhall, Iachini, & Anderson-Butcher, 2013). Lack of buy-in and understanding of the improvement efforts, student home life, and limited time were identified as the top barriers to school improvement efforts. Professional development, leadership, and on-site consultation were identified as important facilitators for success (p. 1). Suggested solutions to these findings included a variance in the reported barriers and facilitators by stakeholder role suggesting a need for targeted professional development and consultation opportunities to address the unique needs of various stakeholder groups (p. 1). Finally, these findings from 2013 suggested that social class and cultural change could benefit if school social workers, who are educated around systems change, collaboration, and resource allocation, could play an important role in supporting and leading these types of efforts (Mendenhall, Iachini, & Anderson-Butcher, 2013).

Evaluative Research. Evaluative research in education is research that is conducted to investigate educational programs (e.g., federal and state initiatives, school-based professional development programs, new curricula, and new methods for teaching and discipline) (Check & Schutt, 2017). Concerning evaluative research in PjBL, some

researchers have focused on primary school pupils regarding their content knowledge and attitudes towards self-efficacy, task value, group work, teaching methods applied, and peers from diverse ethnic backgrounds. Kaldi (2010) found that students submerged in a PjBL environment could obtain content knowledge and group work skills, and then become less favorable to traditional teaching versus experiential learning.

Conversely, at post-secondary levels, PjBL evaluative research has lauded differing outcomes. Preparing to be career-ready, college students especially in the areas of science, technology, engineering, and math (STEM) experience less benefits of receiving PjBL instructional techniques since most instruction is delivered in traditional methods. For example, according to Mills and Treagust (2003), modern engineering professionals constantly deal with uncertainty, the predominant model of engineering education remains like that practiced in the 1950s, with large classes and single-discipline, lecture-based delivery being the norm. Developments in student-centered learning such as PjBL have led to relatively little impact on mainstream engineering education. Mills and Treagust (2003) found that the role of PjBL in attaining consistently successful problem-solving outcomes could not be readily determined because the programs studied involved multifaceted skill development efforts (Mills & Treagust, 2003).

Universal Design for Learning (UDL)

In public schools, UDL mandated into the ESSA, was a possible answer to learning more about how public education progressed in providing educational offerings that personalize a learner's pace. This initiative was an approach designed to allow all learners the opportunity to increase their access to learning, their participation in the

classroom, and their progression of learning (D'Apice, 2015). UDL could be practiced by planning and developing the class curriculum to allow for such improvements.

A disadvantage of UDL was that it challenged the status quo. Faculty, curriculum developers, and administrators could face difficult conversations as they integrate UDL into the learning environment. Gronneberg and Johnston (2015, April 6) observed,

> Unlike programs that target specific disabilities or learning needs, which tend to separate such students from the rest of the class, UDL provides an approach with many paths to learning that benefits all students without forcing them to self-identify as needing unique support. (p. 2)

Teaching styles have changed significantly over the years. The traditional way that education was delivered was through recitation and memorization techniques, whereas the modern way (21st century) of doing things involves interactive methods (Pearse, 2017). Some educational practitioners believed that because traditional techniques used repetition and memorization of information to educate students, it meant that they were not developing their critical thinking, problem solving and decision-making skills necessary for UDL to be effectively implemented. According to the Pearse Foundation (2017), modern learning encourages students to collaborate and therefore can be more productive. Saying that, traditional and modern teaching methods such as UDL, are both effective and useful in today's education (Pearse, 2017). Sarah Wright, an educational blogger, explains, "As with most things, it's all about balance. We need to understand when a traditional method works best and when it's right to try new and innovative approaches (Pearse, 2017)."

Current / Past UDL Pedagogy

A review of the literature on UDL resulted in most sources being scholarly reviews or expert opinions about how UDL can be implemented in K-12 classrooms (Howard, 2004; Hunt & Anderson, 2011) or in university courses (Burgstahler & Cory, 2008; Handle, 2004; Ofiesh, Rojas, & Ward, 2006; Rose, Harbour, Johnston, Daley, & Abarbanell, 2006). However, limited empirical studies exist that examine the impact of UDL on student engagement or achievement. Researchers have only reported on learning materials and technological applications that have been designed with UDL principles in mind (Okolo et al., 2011; Proctor, Dalton, & Grisham, 2007). Educational professionals could look at this as an undue dilemma, especially when federal mandates such as the ESSA (2015) mandate such implementation.

The training of teachers and university instructors in planning lessons that incorporate the principles of UDL (Schelly et al., 2011; Spooner, Baker, Harris, Ahlgrim-Delzell, & Browder, 2007) has also been observed. However, only a few studies have examined the impact of the commonly accepted principles of UDL when implemented as a comprehensive framework in K-12 classrooms (Browder, Mims, Spooner, Ahlgrim-Delzell, & Lee, 2008; Dymond et al., 2006; Friesen, 2008). Since the research on UDL has seemingly resulted in more researchers exploring the framework, some have argued that more needs to be done to identify UDL as a research-based practice. As ongoing UDL research occurs, educators will need to continue adjusting their lesson planning and be cognizant of current federal and state mandates, and specifically in their own district.

By way of explanation, the vanguard of literature in UDL could be characterized as rhetorical advocacy. UDL literature is in the early stages of introducing and

promoting UDL pedagogy. Still, there is currently not a strong base of research to establish UDL as a scientifically validated intervention (Edyburn, 2010). Furthermore, Canter et al. (2017), argued that UDL might sound like a good idea, but until the research base shifts from advocating, assessing, and measuring UDL outcomes, the promise of this approach will not be realized (Canter et al., 2017).

To realize the promise of UDL more should be done to make education more inclusive. Blackboard.com, an EdTech company serving K-12, and higher education believed that creating an inclusive environment makes a difference for all learners (Blackboard.com. About Us, 2022). In addition to inclusion, some have made the claim that by providing appropriate support the realization of UDL and its benefits can be further discovered. Dr. Ritschel-Trifilo, Director of Online Learning for Wayland Baptist University, an advocate for providing this specific support stated,

> The fact is that people learn in lots of different ways, and depending on the subject, you may choose a different method to learn along the way. To reduce barriers in learning, it is important to provide appropriate support, making information equally accessible to all learners by presenting the same content in varying materials. (Ritschel-Trifilo, 2022)

Professional Development, Evaluation, and UDL

Although the framework of UDL has arguably been effective in designing tools and lessons, implementation of the framework to design entire learning environments possesses its own limitations in research. Guskey (2002) found a meaningful relationship between P.D. and UDL. Four states (California, Kentucky, New York, and Ohio) selected the pilot-study approach, introduced by Guskey and Yoon when they considered

implementing UDL initiatives (Muller & Tschantz, 2003). Their P.D. efforts ranged from disseminating information on UDL to educators via listserv to sending administrators, teachers, and technology specialists to the Center for Applied Special Technology (CAST) headquarters for no more than a three-day training institute. Kentucky began the UDL implementation gradually by training selected teachers across the state to produce and use digital curricula. New York's program emphasized developing technical assistance providers, and California's program stressed the conversion of curricular materials into digital formats. Finally, Ohio's program focused on building organizational capacity and introducing UDL concepts in P.D. (Muller & Tschantz, 2003).

All four states used intensive two- or three-day institute training at CAST to train an initial cohort of educators. They devoted most of their P.D. efforts and resources to training teachers in the use of digital materials or technology. According to their findings, small-scale actions such as these cost much less than implementing UDL on a full-scale state level. However, they concluded this process of P.D. may result in teachers misunderstanding the concept of UDL, perpetuating misconceptions about UDL (Edyburn, 2009). School leaders should remember that limitations come into play whenever they attempt to implement a framework, not just UDL, when it involves entire learning environments. Limitations such as small-scale actions, or more cost-effective means of P.D. may not fully reach as many educators as might be intended compared to if leadership fully explored the benefits of larger scale P.D. to meet a broader group and more variations for their constituents.

Upon graduating from university programs, teachers continue learning about their trade from various sources, including experiences in the classroom and within the school system. Some examples this sort of P.D. includes collaboration with colleagues and a variety of other educational P.D. opportunities. Borko (2004) envisioned these types of learning experiences as situational. In these instances, there was an implication that as participants in the various activities of their profession, such as instructing, collegial collaboration, and attendance at meetings or conferences, teachers become more and more competent and knowledgeable in their subject area and general pedagogy. Borko (2004) further stated that the activities in which a teacher engages should be orchestrated to promote teacher learning and growth. As educators continue receiving a variety of professional development (P.D.), it is important for them to find the most effective strategies to reach all students.

According to Darling-Hammond, Hyler & Gardner (2017), well-designed and implemented P.D. should be considered an essential component of a comprehensive system of teaching and learning that supports students to develop the knowledge, skills, and competencies they need to thrive in the 21st-century. Maryland was one of the first states to incorporate UDL principles into state educational regulations (DeCoste, Kaplan & Spinnato, 2015). Maryland's path to statewide UDL implementation provided specific examples for states and other nations that desired to explore the feasibility of incorporating UDL in education (DeCoste, Kaplan & Spinnato, 2015). In regard to this study, P.D. for Missouri teachers required teachers in most core areas and librarians to complete 30 hours of P.D. in the first four years of teaching. In Missouri, one college credit hour equaled 15 P.D. Contact Hours (Staff, 2021).

Pertaining to PjBL, districts across the country should attempt to employ a variety of methods to incorporate project-based lessons and other UDL practices. Since every person learns at a different pace and better at different methods, practitioners should be cautious and remember that being fully immersed solely in PjBL, may not necessarily produce or guarantee an increase in student achievement for all students. In the end, theories, and methods such as PjBL will continue to be practiced, yet it is arguably most important that the P.D. be effective and measurable.

Although P.D. in education can be criticized often, improvements in education are unlikely to happen without doing professional development (Guskey, 2000). Guskey and Sparks (2002) proposed a theoretical model that described the relationship between P.D. and positive student outcomes. The first part of their model included content characteristics (e.g., research-based interventions, new knowledge, and skills), and process variables (e.g., type and form including how activities are planned, organized, and implemented). The second part of their model included context characteristics (e.g., aspects of the school culture, students, and educators), and how to work together to determine the quality of P.D. Guskey and Sparks' main point was that it is the effect of P.D. on teachers and administrators that impacts student outcomes. Conversely, the occurrence of P.D. alone does not improve student learning; educators' application of the new knowledge and skills makes the difference in student outcomes (Borko, 2004).

Successful implementation of any program stems from an effective P.D. program. Guskey (2000) defined P.D. as "those processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might, in turn, improve the learning of students" (p. 16). Unfortunately, P.D. programs provided by

states and school districts arguably, were considered irrelevant or insufficient (Richardson, 2003), faddish, and lacking empirical support (Guskey, 2000).

At times, teachers thought of professional development only as something done to meet the specified criteria for continued certification (Torff & Sessions, 2008), yet they placed no value in it relative to their personal growth (Guskey, 2000; Joyce & Calhoun, 2010). In some studies, for example, teachers generally felt that effective P.D. experiences were provided on topics chosen by, and facilitated by, teachers. The successful experiences in these instances gave teachers the opportunity to apply what they had learned and allowed time to meet with facilitators once again to debrief and discuss which strategies had been effective and which had not been effective (Casale, 2010).

Across the United States there are teachers that benefit from districts that provide professional development, and those that wish they could work in their classrooms more. Regardless of the required amount of P.D., it needs to be continually embedded, practiced, and result in higher student achievement to be effective. Finally, school administrators need to consider how the possibility of other factors come into play, such as extra-curricular assignments, like athletic or club sponsorship, and fine arts coaching, and how they impact a building or district's vision take part into an offering of P.D. that they want to implement across their school professional community.

According to Casale (2010), results of a variety of P.D. studies suggested an increased awareness of how teachers perceive P.D. effectiveness and whether teachers were aware of the availability of models different from the traditional models of P.D. This awareness may assist educators in an exploration of models that fit their learning

styles thereby increasing teacher effectiveness. The results may also assist districts, policy makers, and designers of P.D. in the quest for more personalized professional learning.

Educators have often considered how to change to meet the demands of effectively educating an increasingly diverse student population with the skills, knowledge, and abilities they need to be productive citizens in the 21st-century. Canter et al. (2017) suggested creating classrooms, teachers, and schools that embrace the progressive and inclusive practices espoused by UDL. In addition to being rooted in UDL pedagogy, Canter et al. observed that classrooms designed to meet the challenge of 21st-century education need to be substantially integrated into existing advancements in technology.

Theories Supporting Trends in American Public Education

Throughout the history of public education in the U.S., public schools have filled multiple roles. These roles are an outgrowth of why public schools came into being and how they have evolved (Kober, 2020). Currently in modern-public education, Rickards, Hattie, and Reid (2020) asserted that a revolution is happening in education, with leaders and teachers asked to focus on learning, to develop collaborative teams to impact on students, to use and raise professional standards, and to identify and esteem expertise in the profession of education. They claimed that with new demands relating to technological advances, changing demographics, internationalism, and the inclusion of 21st-century skills, pressure existed on schools to deliver more significant and resounding success with more students (Rickards, Hattie & Reid, 2020). Linda Darling-Hammond and her research team (Darling-Hammond et al., 2017) researched high-performing

school systems worldwide. They discovered that a characteristic unique to those systems that set them apart from the United States was how they treated their teachers. In high-performing systems such as those in Australia, Canada, Finland, Shanghai, and Singapore, teachers were intentionally recruited, developed in a high-quality manner that relied on collaboration, provided leadership and career advancement opportunities within their respective schools, and given a significant voice in decisions that affected student learning. Teachers in those systems were revered and honored as essential leaders in their culture (Schul, 2020).

Some educational researchers have argued that the three principles of UDL were well suited for a project-based learning environment ("PBL UDL," 2014). Almost as many, if not more educators have rethought education through innovative designs for knowledge, researched and reviewed guidelines, and have made suggestions to make learning more accessible to all students. In any case, multiple methods continue to be pursued and rooted into modern theories such as project-based learning. Some of these educators or researchers have professed that by using PjBL, new strategies and time put into universal understanding are often minimized. Educators that advocate for UDL argue that PjBL increases universal understanding sooner compared to traditional means since the means of instruction are focused on the instructor more than the learner. Further, these educational supporters of PjBL claim that, "students will always struggle regardless of teaching style, but PjBL is more open-ended. It allows greater student flexibility than a traditional direct instruction method" (PBL UDL, 2014).

Competency Based Education (CBE).

Several developments in K-12 education set the stage for CBE implementation, specifically for postsecondary education. In the United States and elsewhere, CBE has been linked to long-standing efforts to identify and achieve student outcomes for teaching and learning (Ford, 2014; Malan, 2000). Outcomes-based models focus on the successful demonstration of learning through student actions and performances that embody and reflect competence in using information, content, ideas, and tools (Malan, 2000; Spady, 1994). Efforts to focus on learning outcomes in the United States can be distinguished from traditional approaches that emphasize teaching processes and instructional delivery systems. For example, outcomes-based models seek to design and modify instructional practices based on demonstration of student skills, abilities, and knowledge, rather than providing standardized education processes based on fixed schedules and routines (Nodine, 2016).

CBE programs have spread quickly in higher education institutions over the past several years and recent reviews suggest that the recent traction of CBE models in U.S. higher education can be traced both to supply and demand dynamics, and their trajectory continues to rise (Nodine, 2016). School implementation of CBE can be visualized along a spectrum. At one end, the purest form of CBE is one in which students move to the next learning level only after demonstrating mastery of concepts; in this type of system, schools have no traditional grade levels. At the other end of the spectrum, schools retain some traditional school organization, including grade levels, but may adapt how they assess student learning by having courses with defined core competencies (Potts, 2016).

There are many types of CBE programs, and there is currently no federal definition for these educational methods. In general, CBE is a program of instruction that organizes content according to what a student knows and can do, often referred to as a "competency" (*Competency-Based Education Guide*, 2015). CBE programs also generally have obvious claims for student learning, stress what students can do with the knowledge and skills they acquire and have assessments that provide measurable evidence of competency. Student progress is determined by mastery of each competency. Because CBE focuses on whether students have mastered these competencies, there is a focus on learning outcomes rather than time spent in a classroom (*Competency-Based Education Guide*, 2015).

According to Nodine (2016), supporters of mastery learning have suggested that most students can attain mastery of learning tasks (Bloom, 1968; Carroll, 1963). The key variables, rather, are the amount of time required to master the task and the methods and materials used to support the learning process. For mastery learning, therefore, the main priorities are to provide sufficient time for each student to master the material and to provide "the methods and materials which will enable the largest proportion of our students to attain such mastery" (Bloom, 1968, p. 1). Bloom contrasted this approach with the outcomes prioritized by standardized instructional processes and timeframes, which tend to replicate a distribution of student performance, through grade levels, with about one-third of students failing or just getting by in each class.

Others in education contend that a few obstacles stand in the way of CBE movement and its progression. Jenna Tomasello, a policy associate for the American Youth Policy Forum, shared five challenges that a variety of panel's made up of

educational practitioners and policymakers deliberated at a 2016, Regional Educational Laboratory at EDC Symposium (Stevens, 2018), these Five Challenges are (See [Figure 3]):

1. Language. Semantics and a lack of consensus around terms and definitions are a persistent challenge in the CBE space.

2. Quality. There is as much variation of CBE practices between schools as within schools, meaning there is a lack of consistent implementation across both schools and classrooms.

3. Systems Alignment. States and districts might be hesitant to fully adopt CBE if student assessment and academic reporting changes and no longer aligns with what colleges and universities are looking for.

4. Equity. A challenge of CBE moving forward might be an inability on the part of schools to provide the supports and resources necessary to guarantee high-quality access to all students.

5. Skepticism. CBE is sometimes dismissed as just another new “fad” in American education.

Project-Based Learning (PjBL)

Defined by the Educators of America organization, “Project-Based Learning is more than just a teaching method. It’s a revitalization of education for students so that they can develop intellectually and emotionally” ("What is Project-Based Learning? Discover Here | Educators of America, 2019). Using real-world scenarios, challenges, and problems, PjBL gives students practical knowledge and skills that increase during their designated project periods. The goals of using complex questions or issues are to

develop and enhance student learning by encouraging critical thinking, problem-solving, teamwork, and self-management. The project's proposed question drives students to make their own decisions, perform their research, and review their own and fellow students' methods and outcomes (What is Project-Based Learning? Discover Here | Educators of America, 2019).

As far back as the early 1900s, John Dewey supported the "learning by doing" approach to education, which was the essential element of PjBL. In more recent times, PjBL has been viewed as a model for a classroom activity that shifts away from teacher-centered instruction and emphasizes student-centered projects (Research Spotlight on Project-Based Learning, n.d.). PjBL, a teaching methodology that utilizes student-centered projects to facilitate student learning (Mergendoller, 2006), was touted as superior to traditional teaching methods in improving problem-solving and thinking skills and engaging students in their education (Berends, Boersma & Weggemann, 2003; Scarborough, Bresnen, Edelmann, Laurent, Newell & Swann, 2004; Tsang, 1997).

Popular in pre-professional training in medicine, science, technology, engineering, and mathematics since the 1970s, momentum has developed more recently to extend these practices to elementary and secondary classrooms (Buck Institute, 2005; Knoll, 1997). According to the Buck Institute for Education (BIE), "All students - no matter where they live or what their background - should have access to quality PjBL to deepen their learning and achieve success in college, career, and life" (Project-Based Learning | BIE, n.d.). BIE aims to improve student learning outcomes by making PjBL accessible for teachers in grades K-12 and all subject areas. By the end of 2018, 1200 schools had implemented PjBL with BIE support (Project-Based Learning | BIE, n.d.).

In his review of research on PjBL, Dr. John W. Thomas shared an examination of research related to PjBL as a teaching and learning model. Thomas concluded with eight tentative conclusions of PjBL as a teaching and learning method (See figure 4.0) ("A Review of Research on Project-Based Learning | Project-Based Learning | BIE," 2000). Dr. Thomas performed this evaluation of PjBL at the turn of the 21st-century. At that time, PjBL was very new. His suggestions for the future of PjBL included continuing to expose teachers to the PjBL model and making PjBL information more readily available to educators and administrators. Additionally, he suggested being patient and allowing more widely accepted PjBL frameworks to be developed. His final recommendation was to make the research performed on PjBL relevant to the concerns of classroom teachers (A Review of Research on Project-Based Learning | Project-Based Learning | BIE, 2000).

The Challenge and Success of Incorporating PjBL Practices Into UDL

In a 2013 study, Cho and Brown argued that PjBL held the outstanding potential to be an innovative approach to teaching, learning and teacher professional development. These two researchers indicated that the major strengths of using PjBL came from integrating workforce needs of local businesses and the broader educational needs of students. Furthermore, Cho & Brown mentioned that the active involvement of community partners to make a project authentic was an essential element of a given class's PjBL environment that distinguishes it from simply offering PjBL as a stand-alone teaching method (Cho & Brown, 2013).

One study in higher education shared that involving community partners, as PjBL embeds in much of its methodology, was challenging and successful (Lee, Blackwell, Drake & Moran, 2014). One example provided in this study that was challenging

involved seeking multiple partners, not just the same repetitive community businesses, since it became more cumbersome to the instructors as they worked to sustain relations for future lessons. In sharing their success, select faculty stated, "We're giving opportunities for students to be able to get to know somebody so that they can build on that for an internship and then hopefully for employment down the road" (p. 24). As business partners consider partnering with secondary schools a goal should be to prepare graduating seniors for the workplace (Author, G., 2017).

Summary

First, the literature review provided a brief history of education and project methods. Then, research was offered to mention student achievement progress in three academic subjects of English Language Arts, Math, and Science and how all three subjects were studied in recent years. Finally, theories of UDL and CBE were shared while including different methods, pedagogies, and methodologies such as PjBL practices. The review continued with a look at teacher professional development and how it supported UDL and PjBL.

Chapter 3 provides the research design, measurement, data collection procedures, analysis and synthesis of the data, limitations, and summary.

Chapter Three

Methods

The purpose of this study was to examine if there was a difference in annual MAP assessment scores between students from two different Missouri elementary schools receiving separate styles of instructional methods. Specifically, this study was performed to examine if there was a difference in students' ELA, Math, and Science MAP assessment scores between the two different learning environments of Project-Based Learning (PjBL) and Competency-Based Education (CBE).

Research Design

This study applied a quasi-experimental quantitative research design. Like a true experiment, a quasi-experimental design aims to establish a cause-and-effect relationship between an independent and dependent variable. However, unlike a true experiment, a quasi-experimental does not rely only on random assignment. Instead, subjects are assigned to groups based on non-random criteria (Thomas, 2021).

The dependent variables in this study were the ELA, Math, and Science scores of the MAP Assessment for students. The categorical independent variable included the two separate styles of instructional methods, PjBL and CBE. Approximately 50 students immersed in a PjBL environment throughout the study, during their third, fourth, and fifth grade elementary school years at VE. Their ELA, Math, and Science scores were compared with the scores of approximately 50 randomly picked third, fourth, and fifth grade students that received CBE instruction. These 50 randomly selected students remained the same throughout the study, while attending third, fourth, and fifth grades at GWE.

Selection of Participants

The population of this study included elementary school students with experience of either Project-Based Learning (PjBL) or Competency-Based Education (CBE) in the midwestern part of the United States. Two sample groups of participants were selected in this study using different sampling procedures.

A purposive sampling procedure was employed to select students from Voyage Elementary (VE), a fully immersed PjBL school. Lunenburg and Irby (2008) described purposive sampling as "selecting a sample based on the researcher's experience or knowledge of the group to be sampled" (p. 175). The first group included approximately 50 students from VE, who were enrolled in third through fifth grades during the 2014-15, 2015-16, and 2016-17 academic years.

A simple random sampling procedure was employed to select students from George Washington Elementary (GWE) receiving CBE instruction. Lunenburg and Irby (2008) described simple random sampling as "the process of selecting a sample in such a way that all individuals in the defined population have an equal chance of being selected for the sample" (p. 170). The second group included approximately 50 randomly picked students, who were enrolled in third through fifth grades at GWE during the 2014-15, 2015-16, and 2016-17 academic years.

Measurement

Creswell (2014) recommended that measurement information be included with an explicit description of the instrument used in data collection for descriptive research. According to McMillan (2008), sound measurement is also an essential element in

effective quantitative studies. Therefore, specific details about instrumentation were essential to be included in this study.

Missouri Assessment Program (MAP). The ELA, Math, and Science performance were all measured by Missouri MAP assessments. During all three academic years that were assessed in this research (2015-2017), Missouri MAP Assessments were used, which was developed and published under contract with Missouri Department of Elementary and Secondary Education (DESE) by Data Recognition Corporation (DRC). According to the DRC, the Missouri MAP Assessment was categorized as a formative assessment and deemed useful in providing student data for instructional planning (Missouri Assessment Program, 2020).

The Missouri MAP is designed to measure how well students acquire the skills and knowledge described in the Missouri Learning Standards (MLS) ("Missouri Assessment Program", 2020). The assessments yield information on academic achievement at the student, class, school, district, and state levels. This information is used to diagnose individual student strengths and weaknesses in relation to the instruction of the Missouri Learning Standards (MLS), and to gauge the overall quality of education throughout Missouri. Grade-Level assessments in ELA and Math are given at grades 3-8 and Science in grades 5 and 8 (MAP, 2020). The Missouri MAP requires between three to five hours of administration. Students respond to a variety of assessment items. These include selected-response items, constructed-response items, and performance events. The selected-response items require students to determine the correct answer for up to five response options, while the constructed-items ask students to write a response by

showing their work and how they arrive at their answers (Data Recognition Corporation, 2017).

Student scores were described according to four performance levels as evaluated on the Missouri MAP assessment. These performance levels were titled advanced, proficient, basic, and below basic. For analysis, all four levels were assigned a number: (4) for advanced, (3) for proficient, (2) for basic, and (1) for below basic.

The analyses of the internal structure of the Missouri MAP test can indicate the degree to which the relationship among test items and test components conform to the test construct which in turn provide a basis for test score interpretation. The reliability of raw scores by Missouri MAP test form was evaluated using Cronbach's coefficient alpha, which is a lower-bound estimate of test reliability. The Missouri MAP tests produce scores that would be relatively stable if the test were administered repeatedly under similar conditions.

ELA. The ELA Missouri MAP Assessment in third through fifth grades were administered online and contained various item types including multiple-choice (MC), technology-enhanced (TE), evidence-based selected response (ESR), short answer (SA), and writing prompt items (MAP Grade-Level Tech Report, 2016, ELA and Math, 2016). The ELA test forms were developed by Data Recognition Corporation (DRC) using DRC's college- and career-ready item bank. Scoring of TE, SA, ESR, and writing prompt items followed a predefined scoring criteria. The TE, SH, and ESR were auto-scored, while the writing prompts were scored by human readers. The inter-rater reliability statistics demonstrated that the writing prompt items were scored reliably

(MAP Grade-Level Tech Report, 2016, ELA and Math, 2016). Table 3 displays a sample of reliability statistics for grades third through fifth in the subject of ELA in 2016.

Table 3

2016 MAP, Reliability in English Language Arts

Grade	Form	Number Of Items	Number of Score Points	Cronbach's Alpha	SEM	N-Count
3	1	52	52	0.90	3.09	69,190
4	1	52	52	0.91	3.01	67,673
5	F3*	51	58	0.91	3.19	25,557

Note. SEM=Standard of Error Measurement. N-Count=Number. (*) Seven forms were offered on the 2016 MAP. As an example, Form 3 is represented in this table. Adapted from "Missouri Assessment Program Grade-Level Assessments, English Language Arts and Mathematics, Technical Report Manual, 2016, Final," by Data Recognition Corporation, 2016, *College and Career Readiness, Assessment, Technical Support Materials,* p. 167. Copyright © 2016 by Missouri Department of Elementary and Secondary Education.

Math. The Mathematics Missouri MAP Assessment in third through fifth grades intends to create a "personalized assessment experience by adapting to each student's learning level" (Missouri Assessment Program, 2020). Like the ELA testing mechanics, the Missouri Math MAP Assessment offered a variety of questions containing MC, TE, ESR, SA, and writing prompt items. The assessment has three intentions: (a) To provide information on what a student already knows, (b) To provide information about what a student still needs to learn, and (c) To provide information about how much a student has learned throughout the year (NWEA, 2016b). Missouri mathematics MAP Assessment data are used to make decisions about how to enrich or provide extra support for students in mathematics.

The test scaling was conducted using item response theory (IRT) methodology. The IRT models used for Mathematics test scaling were appropriate for the test data

supporting the operational data analysis and ensuring that the test items, as well as the overall tests, were functioning properly (MAP Grade-Level Tech Report, 2016, ELA and Math, 2016). The cut scores used in this Tech Report portrayed the classification of students into different performance levels and associated achievement level descriptors were maintained. Additionally, the standard of a collaborative and participatory process was sustained further supporting the validity and interpretation of the Missouri MAP scores. Table 4 displays a sample of reliability statistics for grades third through fifth in the subject of Missouri Mathematics in 2016.

Table 4

2016 MAP, Reliability in Mathematics

Grade	Form	Number Of Items	Number of Score Points	Cronbach's Alpha	SEM	N-Count
3	1	42	42	0.91	2.66	69,314
4	1	42	42	0.91	2.73	67,869
5	1	42	42	0.89	2.71	66,846

Note. SEM=Standard of Error Measurement. N-Count=Number. Adapted from "Missouri Assessment Program Grade-Level Assessments, English Language Arts and Mathematics, Technical Report Manual, 2016, Final," by Data Recognition Corporation, 2016, *College and Career Readiness, Assessment, Technical Support Materials,* p. 167. Copyright © 2016 by Missouri Department of Elementary and Secondary Education.

Science. The Missouri Science MAP Assessment for fifth grade is a summative, grade-span, assessment administered in Grades 5 and 8. Like the ELA and Mathematics assessments, these tests are designed to measure students' knowledge of Science and they are aligned with Missouri Learning Standards. Missouri Science assessments were developed in alignment with Missouri Learning Standards and Grade-Level Expectations.

They were built using the Missouri Science item pool and the Iowa Test of Basic Skills item pool developed by the University of Iowa.

Science assessments were administered online in a standardized manner further supporting validity of the intended interpretation of test scores. Scoring of constructed-response items followed predefined scoring criteria. The items were scored by human readers. The inter-rater reliability statistics demonstrated that the items were scored reliably. The test scaling and linking was conducted using IRT methodology.

The divergent evidence of the validity of the intended interpretation of Science test scores was evaluated through the correlations computed between the Science scale scores and the ELA and Mathematics scores. The student scores were found to be highly, but not perfectly, related to each other. This suggested that while different constructs are being measured, the three assessments may also be tapping into a similar knowledge base or general underlying ability. Table 5 displays a sample of reliability statistics for fifth grade in the subject of science in 2016.

Table 5

2016 MAP, Reliability in Science

Grade	Form	Number Of Items	Number of Score Points	Cronbach's Alpha	SEM	N-Count
5	CA2	41	60	0.88	3.59	43,467
5	CA3	41	60	0.85	3.51	23,370

Note. SEM=Standard of Error Measurement. N-Count=Number. CA=Principal Component Analysis of Science, proceeded by the form number. Adapted from "Missouri Assessment Program Grade-Level Assessments, English Language Arts and Mathematics, Technical Report Manual, 2016, Final," by Data Recognition Corporation, 2016, *College and Career Readiness, Assessment, Technical Support Materials*, p. 89. Copyright © 2016 by Missouri Department of Elementary and Secondary Education.

Data Collection Procedures

Prior to this study beginning, a research proposal was drafted and submitted to the Directors of Assessment for both JPS and TSD (see Appendices B and C). JPS granted permission in (March, 2022) (see Appendix C) and TSD provided their permission in (July, 2019) (see Appendix B). Next, the researcher sought permission from the Baker University's Institutional Review Board (IRB) committee (see Appendix A). In (February, 2022), the Baker IRB committee approved the study in (April, 2022) (see Appendix D).

After being approved by both JPS and TSD's Directors of School Assessment each school district's assessment department gathered the ELA, Math, and Science scores from the 2015, 2016, and 2017 school years and who attended third, fourth, and fifth grades. Specifically, Missouri MAP Assessment scores were gathered for the approximately 50 students who attended VE from third through fifth grade from the JPS's assessment department. Likewise, TSD provided MAP Assessment scores for their approximately 50 randomly picked students during the same timeframe.

The process of random selection of students from GWE were determined by TSD. Shared by the TSD Director of Assessment, the process of selecting students randomly began by determining the total number of students who attended GWE from grades three through five, during the academic years of 2014-15, 2015-16, and 2016-17. TSD then collected students' identification numbers from Missouri's Department of Elementary and Secondary Education (MO-DESE) website. By selecting the Core Data and Missouri Student Information System (MOSIS), TSD's assessment team randomly selected a query option of the same, approximate 50 students who attended GWE during the 2014-15, 2015-16, and 2016-17 academic years.

Each Department of School Assessment protected student identity by randomly assigning a number to each student. After all data were given to the researcher, the information was organized into a Microsoft Excel spreadsheet. To complete a statistical analysis of the data, it was imported into the IBM→ SPSS→ Statistics Faculty Pack 28 for Windows.

Data Analysis and Hypothesis Testing

RQ1. Is there a difference in the English Language Arts (ELA) MAP assessment scores between Voyage Elementary (VE) students receiving a PjBL-focused means of instruction and George Washington Elementary (GWE) students receiving a CBE means of instruction?

***H*1**. There is a significant difference in the ELA MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction.

An independent-samples *t* test was conducted to test H1. The mean of VE students' ELA MAP scores was compared to the mean of GW students' ELA MAP scores. An independent-samples *t* test was chosen for the hypothesis testing since it examines the mean difference between two mutually exclusive independent groups, and both means of two groups are continuous variables. The levels of significance was set at $\alpha = .05$. When appropriate, an effect size is reported.

RQ2. Is there a difference in the Mathematics MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction?

***H*2**. There is a significant difference in the Mathematics MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction.

An independent-samples *t* test was conducted to test H2. The mean of VE students' Mathematics MAP scores was compared to the mean of GW students' Mathematics MAP scores. An independent-samples *t* test was chosen for the hypothesis testing since it examines the mean difference between two mutually exclusive independent groups, and both means of two groups are continuous variables. The levels of significance was set at $\alpha = .05$. When appropriate, an effect size is reported.

RQ3. Is there a difference in the Science MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction?

***H*3**. There is a significant difference in the Science MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction.

An independent-samples *t* test was conducted to test H3. The mean of VE students' Science MAP scores was compared to the mean of GW students' Science MAP scores. An independent-samples *t* test was chosen for the hypothesis testing since it examines the mean difference between two mutually exclusive independent groups, and both means of two groups are continuous variables. The levels of significance was set at $\alpha = .05$. When appropriate, an effect size is reported.

Limitations

According to Lunenburg and Irby (2008), limitations are "factors that may affect the interpretation of the findings" (p. 133) that fall outside of the control of the researcher. Since the researcher cannot control limitations; it is important to identify and report the limitations to communicate clearly avoiding false interpretation (Lunenburg and Irby, 2008). Limitations of this study included:

1. The administration and testing environment of the MAP assessment may have varied from school to school, and within their school district. Specifically, instruction between MAP Assessment testing periods may have been different according to the instructional methods and teaching of instructors in third, fourth, and fifth-grade classroom environments throughout the two school districts.
2. Select students may have benefitted from previous personal experiences or learning opportunities, which assisted them in responding to MAP Assessment questions.

3. Samples were utilized in this study from two different school districts. Discretion should be exercised in generalizing findings to other populations.

Summary

A quasi-experimental quantitative research design was employed in this study to analyze Missouri Assessment Program (MAP) Assessment scores. First, chapter 3 contained the research design and selection of participants. Second, the measurement was explained including the validity and reliability information. Third, procedures for data collection and data analysis and hypothesis testing were described. Finally, the limitations of the study were provided. The results of this study are presented in chapter 4.

Chapter Four

Results

The main purpose of this study was to explore possible differences in scores on the Missouri Assessment Program (MAP) Assessment between students that received PjBL instruction and students that received CBE, or more commonly termed as traditional instruction. More precisely, the MAP scores in ELA, Math, and Science of students totally immersed in a PjBL environment were compared to the same scores of randomly selected students receiving a CBE instruction.

Descriptive Statistics

RQ1. Is there a difference in the English Language Arts (ELA) MAP assessment scores between Voyage Elementary (VE) students receiving a PjBL-focused means of instruction and George Washington Elementary (GWE) students receiving a CBE means of instruction?

H1. There is a significant difference in the ELA MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction.

The results of the independent samples *t* test indicated no difference between the means, $t(274.04) = -1.11$, $p = .269$. The ELA MAP mean scores for GWE students ($M = 3.28$, $SD = 0.91$, $n = 144$) was the same as the ELA MAP mean scores for VE students ($M = 3.39$, $SD = 0.73$, $n = 148$). The research hypothesis was not supported. So, there is no significant difference in the ELA MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction.

RQ2. Is there a difference in the Mathematics MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction?

H2. There is a significant difference in the Mathematics MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction.

The results of the independent samples *t* test indicated a statistically significant difference between the two means, $t(258.49) = -3.09$, $p = .002$, $d = -.36$. The Math MAP mean scores for GWE students ($M = 3.08$, $SD = 1.03$, $n = 144$) was significantly lower than the Math MAP mean scores for VE students ($M = 3.40$, $SD = 0.74$, $n = 147$). The research hypothesis was supported. Math MAP scores of VE students were higher than Math MAP scores of GWE students. The effect size indicated a small effect.

RQ3. Is there a difference in the Science MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction?

H3. There is a significant difference in the Science MAP assessment scores between VE students receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction.

The results of the independent samples *t* test indicated no difference between the means, $t(99) = -1.49$, $p = .138$. The Science MAP mean scores for GWE students ($M = 2.64$, $SD = 0.78$, $n = 50$) was the same as the Science MAP mean scores for VE students ($M = 2.86$, $SD = 0.72$, $n = 51$). The research hypothesis was not supported. So, there is no significant difference in the Science MAP assessment scores between VE students

receiving a PjBL-focused means of instruction and GWE students receiving a CBE means of instruction.

Summary

Chapter 4 contained the independent samples *t* test results for each of the research questions posed in this study. The results of this study showed no significant difference existed on the ELA or Science portions of the MAP Assessment between GWE and VE students.

However, the Math MAP portion showed that a statistically significant difference existed. Specifically, the means of the Math MAP scores of third, fourth, and fifth grade students in this study were significantly higher from receiving PjBL instruction, compared to receiving CBE instruction. In chapter 5, implications for action and recommendations for the future are explained, followed by the concluding remarks.

Chapter Five

Interpretation and Recommendations

Since 1993, the MAP Assessment has been utilized by school districts throughout the state of Missouri as a formative tool for educators to use when planning for instruction to better meet student learning needs (Missouri Assessment Program, 2020). Across the United States, school districts are exploring methods of instruction in an attempt to increase student performance and prepare them for their future in an increasingly competitive work environment. The purpose of this study was to inspect the efficacy of the MAP Assessment as an assistive tool when comparing two different instructional methods.

Specifically, this study was conducted to analyze possible differences in the ELA, Math, and Science MAP Assessment scores of approximately 50 elementary students totally immersed in a PjBL environment, compared to approximately 50 randomly picked CBE students for whom took the same state assessment during their third, fourth, and fifth grade academic years. Included in this chapter is a summary of the study in which the problem, purpose, research questions, methodology, and major findings are provided. The findings related to the literature and the conclusions are discussed, as well as implications for future recommendations of research regarding methods of instruction.

Study Summary

This study was performed to inspect for possible differences in ELA, Math, and Science MAP scores of students attending elementary school while in their third, fourth, and fifth grade years, and in two different learning environments. In this section, a summary of the current study is provided. An overview of the problem, the purpose and

research questions, review of methodology, and the major findings of the study are shared.

Overview of the problem. America's public-school stakeholders continue to inquire about how current students are performing today. This is a fundamental component of any contemporary education policy discussion. Rapidly, public education continues to be reformed. During these reforms, elementary students across the United States keep struggling to learn.

Ninety-three million adults in the U.S., or 63 percent of the U.S. population, read at or below the basic level needed to contribute successfully to society. Unfortunately, 65 percent of fourth graders read at or below the primary level ("Literacy-Facts-Stats," 2017). As curriculum advances, these children will fall behind ("Literacy-Facts-Stats," 2017). According to the ESSA 2015, the U.S. Congress stated schools should adhere to principles of UDL as they develop student assessments.

When reviewing the endorsement of UDL and connecting this to assist struggling elementary students, essential questions for schools in Missouri arise. Missouri administrators and educators continue to explore how students can increase academic achievement on the annual Missouri Assessment Program (MAP) assessment. Pointedly, these professionals place emphasis on how students can increase their academic performance in the subjects of English Language Arts (ELA), Math, and Science.

Purpose statement and research questions. This study was conducted to examine if there was a difference in annual Missouri Assessment Program (MAP) assessment scores between students from two different Missouri elementary schools receiving separate styles of instructional methods. Specifically, the purpose of this study

was to examine if there was a difference in students' ELA, Math, and Science MAP assessment scores between VE students attending school in a PjBL-focused environment, and GWE students attending school in a Competency-Based Education (CBE) focused, or more traditional, environment. Three research questions were developed to address the purpose of the study.

Review of the methodology. Using a quasi-experimental quantitative research design, archival MAP data were collected from both JPS and TSD. An independent samples *t* test was utilized to compare the data. The dependent variables in this study were the ELA, Math, and Science scores of the MAP Assessment for students. The categorical independent variable included the two separate styles of instructional methods, PjBL and CBE. Approximately 50 students immersed in a PjBL environment throughout the study, during their third, fourth, and fifth grade elementary school years at VE served as the PjBL student subjects. Their ELA, Math, and Science scores were compared with the scores of approximately 50 randomly picked third, fourth, and fifth grade students that received CBE instruction. These approximately 50 randomly selected students remained the same throughout the study, while attending third, fourth, and fifth grades at GWE.

Major findings. The findings of the study related to the three research questions are presented. All three hypothesis tests were performed to examine the extent to which scores were different on the ELA, Math, and Science portions of the MAP Assessment. An analysis of the data showed that there was no significant difference that existed on the ELA or Science portions of the MAP Assessment between GWE and VE students.

Conversely, the Math MAP portion showed that a statistically significant difference existed.

After comparing any extent of difference of the ELA scores, the mean scores for GWE students were the same as for VE students. The research hypothesis was not supported. There was no significant difference in the ELA MAP assessment scores between VE students receiving PjBL instruction and GWE students receiving CBE instruction. There was no significant difference in the Science MAP scores. The outcome for the Science mean scores was the same, and the hypothesis was not supported.

The means of the Math MAP scores of third, fourth, and fifth grade students in this study resulted in a significantly higher outcome. VE students who received PjBL instructional methods scored significantly higher, contrasted with GWE students receiving CBE instructional methods. The means effect size was not statistically significant.

Findings Related to the Literature

This section examines the current study's findings as they relate to the literature regarding the impact of PjBL, an intervention method of UDL, on student achievement and to what extent there was a difference in teaching methodologies on the Missouri Assessment Program (MAP) Assessment. The results of the studies included in the literature review found that school administrators and teachers continue to face the unique challenge of communicating effectively and offering appropriate instruction for today's students. By communicating effectively and offering multiple methods of instruction, public schools will be better prepared to increase student success as they

prepare youth for the future and face continued, and higher expectations from their stakeholders.

According to Reardon, Valentino & Shores (2012), only a modest increase in literacy and English skills has occurred over the past forty years of nine-year-olds, while the skills of thirteen- and seventeen-year-olds have remained relatively flat. The current study results support these findings for GWE and VE students who continued learning from CBE or traditional teaching methods and those that learned from PjBL, a newer instructional methodology. The findings in this study showed there was not a significant difference in ELA offered from the two types of teaching methodologies of PjBL and CBE. The challenge remains for Missouri educators to work on communicating effectively and to explore a variety of appropriate instructional techniques to increase ELA student achievement on the Missouri MAP assessment.

The results of other studies claimed that PjBL is an effective method of improving K-8 students' science academic achievement, including conceptual development and knowledge retention (Merritt, Lee, Rillero & Kinach, 2017). The findings in this study contrasted with these study findings indicating that there was not a significant difference in science offered through PjBL or CBE. Although Merritt et al. found inconsistencies in the definition of PBL, i.e., problem or project, science instructors in Missouri should continue monitoring attainment of knowledge ("Achievement Level 4 Report - Public - Historical", 2021).

The findings from the current study matched that of Speziale's (2021) findings, lauding that PjBL positively impacted how students learn and achieve in math. Speziale's study compared elementary classes piloting PjBL with groups continuing to

use a district's traditional math curriculum, like the current study. In both studies, the students who received math instruction by PjBL methods of instruction outperformed students who continued to use their district's traditional math curriculum.

Conclusions

Amidst ongoing pressure to meet established standards, U.S. schools have embraced traditional forms of instruction that too often lack the personalization students need to learn and grow. In an increasingly complex world and workforce, today's students must master essential problem-solving and critical thinking skills to be successful in the future despite likely national economic disruption ("Creativity in Learning", 2019). Future jobs, many of which have not even been imagined yet, will require individuals who can develop new, creative ways to address problems. This creation process will not be the result of rote memorization or repetition, which is today's dominant teaching method, but instead is fostered through creativity in learning.

Implications for action. In conducting research on effective implementation of initiatives, implications are provided for schools considering implementing or even piloting PjBL. Greaves, Wilson, & Gielniak (2017) found that the relationship between the school building leader, and the effect of their initiatives was imperative because, "When a principal used change management strategies to lead the school, students showed a statistically significant and educationally meaningful positive relationship in proficiency levels" (p. 4). The results from this study suggest that students receiving Math in a totally immersed PjBL environment score higher on the Missouri Assessment Program (MAP) assessment, whereas this study suggests there is no significant difference

of achievement in the subjects of ELA and Science as it relates to same-age peers receiving CBE or commonly referred to as traditional methods of instruction.

Recommendations for future research. The purpose of this study was to examine if there was a difference in annual Missouri Assessment Program (MAP) assessment scores between students from two different schools that received separate styles of instructional methods. This study investigated potential differences in ELA, Math, and Science MAP scores from students receiving instruction via PjBL means, and students who received Competency-Based Education (CBE) methods. By analyzing the scores from the MAP assessment, recommendations are offered and presented to researchers, school district administrators, and educators.

1. It is recommended that further research of PjBL attempted at the middle and high school levels be completed and how its assessment results compare to traditional instruction such as CBE. By expanding the study, researchers may be able to generalize further about the results across different grade levels and school districts that utilize the MAP.
2. It is recommended that programs, departments, or even school districts considering incorporating PjBL devote most of their professional development efforts and resources to training administrators and teachers in the use of digital materials or technology. By limiting professional development efforts to these small-scale actions, cost-savings should result compared to implementing an across-the-board effort to PjBL, including a larger scale UDL approach.
3. It is recommended that future research includes more than one year of Science data, compared to three years of both ELA and Math data. Only one year worth

of science data was able to be collected from the two participating school systems. Perhaps, it would benefit future studies should they include three or more years of science data to make this study more rigorous.

4. It is recommended that before a school or district attempts PjBL or another component of UDL, sufficient and evidence-based data should be collected and examined to show significant student achievement exists to various instructional strategies. Effective instructional strategies should meet all learning styles and the developmental needs of all learners. According to Meador (2019), "Teachers are best served when they utilize a variety of instructional strategies as opposed to one or two."
5. It is recommended that effective and sound professional development, focused in PjBL and UDL, is instituted for instructors and school administrators. Improved teacher understanding should result, and it will provide opportunities for teachers to learn new skills and strategies to enable them to be more effective at reaching all students. Included in this professional development, training teachers in the appropriate administration and interpretation of the data collected from a given test instrument is needed in realizing the full benefits of the given assessment. Regardless of the instrument chosen to gather data, educational teams should continue to analyze all available data when making instructional decisions for potentially incorporating a new or newer method of delivering instruction.
6. It is recommended that the principles of UDL should continue to be incorporated into university programs to examine the impact of those that are commonly accepted. As mentioned in chapter two, limited empirical studies exist that

examine the impact of UDL on student engagement or achievement. Researchers have only reported on learning materials and technological applications that have been designed with UDL principles in mind (Okolo et al., 2011; Proctor, Dalton, & Grisham, 2007).

7. It is recommended that another three years of comparison between PjBL and a more traditional means of instruction take place. To determine if there is any relationship to this study, a level of control that should be considered is to use approximately 50 different students from VE and approximately 50 randomly picked students from another comparable elementary school like GWE. The analysis should include three years of MAP scores on the ELA, Math, and Science Assessments. This sort of study should help glean differences, improvements, or similarities to how Missouri students are progressing on the annual Missouri Assessment Program (MAP) assessment, and how they are progressing in the Missouri Learning Standards (MLS).
8. It is recommended that a similar study be conducted using another normed assessment tool. Regardless of the assessment, for example the iReady assessment, examiners, instructors, and school administrators could use the results to determine if there are any linkages of student achievement to a given teaching methodology. Furthermore, by using a separate normed assessment, different than the Missouri MAP, other states could benefit by viewing the potential for student achievement and integrating a variety of teaching methodologies to reach more students.

Concluding remarks. No matter the educational topic, there is always need for more research. In the case of Project-Based Learning, the lack of an overarching theory or model of PjBL, the paucity of research devoted to PjBL methods, and assumed gaps in public educational knowledge about the relative effectiveness of teacher-initiated projects creates an unusual and vulnerable situation for PjBL practitioners. The Project-Based Learning movement is growing rapidly and has many strong supporters. Yet the movement is taking place at a time when a much larger and more vocal contingent is pressing, quite successfully, for more emphasis on standardized testing, statewide standards, and increased accountability on the part of teachers and schools, all emphases that tend to move schools in the direction of traditional, teacher-directed instruction. Thus, there is a timely need for expansion of some of the PjBL research reported above, coupled with a systematic effort to build a knowledge base that will be accessible and useful to people in the field ("A Review of Research on Project-Based Learning | Project-Based Learning | BIE," 2000).

References

A Review of Research on Project-Based Learning | Project-Based Learning | BIE. (2000). Bie.org. Retrieved 22 April 2018, from http://www.bie.org/object/document/a_review_of_research_on_project_based_learning

Abedi, J. (2004). The No Child Left Behind Act and English language learners: Assessment and accountability issues. *Educational Researcher*, 33(1), p. 4-14.

About. (2019). Retrieved from http://composeourworld.org/blog/about/

About IDEA. (2022). Retrieved 5 January 2022, from https://sites.ed.gov/idea/about-idea/

About Universal Design for Learning. (2015). *Center for Applied Special Technology*. Retrieved 26 June 2016, from http://www.cast.org/our-work/about-udl.html

Akbulut, Y., & Cardak, C. S. (2012). Adaptive educational hypermedia accommodating learning styles: A content analysis of publications from 2000 to 2011. *Computers & Education*, 58(2), 835– 842. doi:10.1016/j.compedu.2011.10.008

Al-Azawei, A., Al-bermani, A., & Lundqvist, K. (2016). Evaluating the Effect of Arabic Engineering Students' Learning Styles in Blended Programming Courses. *Journal of Information Technology Education: Research*, 15, 109–130.

Al-Azawei, A., & Lundqvist, K. (2015). Learner Differences in Perceived Satisfaction of an Online Learning: an Extension to the Technology Acceptance Model in an Arabic Sample. *Electronic Journal of E-Learning*, 13(5), 408–426.

Al-Azawei, A., Serenelli, F., & Lundqvist, K. (2016). Universal Design for Learning (UDL): A Content Analysis of Peer Reviewed Journals from 2012 to 2015. *Journal Of The Scholarship Of Teaching And Learning*, 16(3), 39-56. doi:

10.14434/josotl.v16i3.19295

Allinder, R. M. (1995). *The relationship between efficacy and the instructional practices of special education teachers and consultants*. Teacher Education and Special Education, 17, 86–95.

Ambrosetti, D.D., & Cho, G. (2005). *Do Parents Value Education? Teachers' Perceptions of Minority Parents. Reaching out to Families: Parental Participation, Simon, J.B.* (2006). Perceptions of the IEP Requirement. Teacher Education and Special Education, 29(4), 225-235.

American Psychological Association, A. (2022). Socioeconomic status. Retrieved June 21, 2022, from https://www.apa.org/topics/socioeconomic-status

Author, G. (2017, November 29). Business partnerships in PBL: What does that really mean - getting smart. Retrieved July 8, 2022, from https://www.gettingsmart.com/2016/11/29/business-partnerships-in-pbl/

Azodi, D.S. (2006). *Principal leadership, trust, and teacher efficacy.* Unpublished Doctoral dissertation, Sam Houston State University, Huntsville, Texas.

Batt, L., Kim, J., & Sunderman, G. (2005). Limited English Proficient Students: Increased Accountability Under NCLB. Retrieved 8 December 2021, from https://civilrightsproject.ucla.edu/research/k-12-education/nclb-title-i/limited-english-proficient-students-increased-accountability-under-nclb/batt-kim-sunderman-limited-english-proficient-2005.pdf

Bennett, W. (1998). *American education: Making it work*. (p. 2). Washington D.C.: U.S. Government Printing Office, Superintendent of Documents.

Berends, H., Boersma, K. and Weggeman, M. (2003). *The structuration of organizational*

learning. Human Relations, 56:9 1035-1056.

Best States for Education - Education Rankings. (2018). Retrieved 12 November 2019, from https://www.usnews.com/news/best-states/rankings/education

Birman, B., Desimone, L., Porter, A., & Garet, M. (2000). Designing professional development that works. *Educational Leadership* (May), 28-33.

Blackboard.com. About Us. (n.d.). Retrieved June 25, 2022, from https://www.blackboard.com/aboutus?utm_medium=cpc&utm_source=google&utm_campaign=NA_-_Higher_Ed_-_Accessibility_-_LeadGen_-_BOF_ _Search&utm_term=universal+design+principles+for+learning

Bloom, B.S. (1968, May). Learning for mastery. Evaluation comment 1(2). Center for the Study of Evaluation of Instructional Programs. UCLA.

BoardDocs® Pro, 01/20/2014 Regular Board of Education Meeting, 7:00 p.m. (2014). Boarddocs.com. Retrieved 19 April 2018, from https://www.boarddocs.com/mo/lpsdmo/Board.nsf/vpublic?open#

Bolman, L. G. & Deal, T. E. (2008). *Reframing organizations: Artistry, choice, and leadership* (4th ed.). San Francisco, CA: Jossey-Bass.

Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher, 33*(8), 3-15. Doi: 10.3102/0013189X033008003

Browder, D., Mims, P., Spooner, F., Ahlgrim-Delzell, L., & Lee, A. (2008). Teaching elementary students with multiple disabilities to participate in shared stories. *Research & Practice for Persons with Severe Disabilities, 33*(1-2), 3-12.

Buckendahl, C., & Hunt, R. (2005). *Whose rules? The relation between the rules and*

laws of testing. In R. P. Phelps (Ed.), Defending standardized testing (pp. 147–158). Mahwah, NJ: Erlbaum.

Burgstahler, S. (2011). Universal Design: Implications for Computing Education. *ACM Transactions on Computing Education*, 11(3), 1–17. doi:10.1145/2037276.2037283

Burgstahler, S., & Cory, R. (2008). *Universal design in higher education: From principles to practice*. Cambridge, MA: Harvard Education Press.

Butler, M. (2014). The Effects of Embedding Formative Assessment Measures in a Problem - - Based Learning Mathematics Curriculum for Middle School Students. Retrieved 13 December 2021, from https://uknowledge.uky.edu/cgi/viewcontent.cgi?article=1010&context=edsrc_etds

CAST: About Universal Design for Learning. (2019). Retrieved from http://www.cast.org/our-work/about-udl.html#.XJPgbhNKjBI

Canter, L., King, L., Williams, J., Metcalf, D., & Potts, K. (2017). *Evaluating Pedagogy and Practice of Universal Design for Learning in Public Schools*. Retrieved 28 September 2019, from https://ir.lib.uwo.ca/eei/vol27/iss1/1/

Carroll, J. (1963). A model of school learning. *Teachers College Record*, 64, 723– 733.

Carter, E. & Wilson, C. (2011). ERIC ED540489: *An Attitudinal Study: Perceptions of Teachers, Parents and Public School Stakeholders Concerning the IEP Process and Development: ERIC: Free Download & Streaming: Internet Archive*. Retrieved 13 May 2016, from https://archive.org/details/ERIC_ED540489

Casale, M. (2010, November 30). Teachers' perceptions of professional development: An

exploration of delivery models. Retrieved June 11, 2022, from https://eric.ed.gov/?id=ED528051

Cavanagh, S. (2014). *What Is 'Personalized Learning'? Educators Seek Clarity*. *Education Week*. Retrieved 26 June 2016, from http://www.edweek.org/ew/articles/2014/10/22/09pl-overview.h34.html

Center for Applied Special Technology. http://www.cast.org

Chase, C., & Klahr, D. (2017). Invention Versus Direct Instruction: For Some Content, It's a Tie. *Journal Of Science Education And Technology*, 26(6), 582-596. doi: 10.1007/s10956-017-9700-6

Check, J., & Schutt, R. K. (2017, December 17). *Evaluation Research*. Retrieved June 25, 2022, from https://methods.sagepub.com/book/research-methods-in-education/i705.xml

Cho, Y., & Brown, C. (2013). Project-based learning in education: integrating business needs and student learning. *European Journal Of Training And Development*, 37(8), 744-765. doi: 10.1108/ejtd-01-2013-0006

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). Learning styles and pedagogy in post16 learning: A systematic and critical review.

Common Core State Standards - Articles, Books, Resources. (2019). Retrieved from http://www.ascd.org/research-a-topic/common-core-state-standards-resources.aspx

Competency-Based Education Guide. (2015) (1st ed., p. 9). Retrieved from https://experimentalsites.ed.gov/exp/pdf/CompetencyBasedEducationGuide.pdf

Competency-Based Education and Project-Based Learning in Johnston County Public

Schools. (2021). Retrieved 2 November 2021, from https://www.rti.org/impact/competency-based-education-and-project-based-learning-johnston-county-public-schools

Condliffe, B., Quint, J., Visher, M., Bangser, M., Drohojowska, S., Saco, L., & Nelson, E. (2017). Project-Based Learning A Literature Review [Ebook]. New York: MDRC.org. Retrieved from https://files.eric.ed.gov/fulltext/ED578933.pdf

Contact Information. (2019). Retrieved 26 March 2019, from https://www.jps53.org/Page/1547

Cook, B. (2002). *Inclusive attitudes, strengths and weaknesses of pre-service general educators enrolled in a curriculum infusion teacher preparation program*. Teacher Education and Special Education, 25(3), 262–277.

Education for All Handicapped Children Act of 1975, Pub. L. No. 94-142. § 612, 89 Stat. 781 (1975).

Core Data & MOSIS: Missouri Department of Elementary and Secondary Education. (2022). Retrieved February 26, 2022, from https://dese.mo.gov/

Courey, S. J., Tappe, P., Siker, J., & LePage, P. (2012). Improved Lesson Planning with Universal Design for Learning (UDL). *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*. doi:10.1177/0888406412446178

Craig, T., & Marshall, J. (2019). Effect of project-based learning on high school students' state-mandated, standardized math and science exam performance. *Journal Of Research In Science Teaching*, 56(10), 1461-1488. doi: 10.1002/tea.21582

Creativity in Learning. (2019). Retrieved 23 February 2020, from

https://www.bigthought.org/wp-content/uploads/2019/11/Creativity-in-Learning-1.pdf

Creativity Will Drive the U.S. Economy. (2012). Retrieved 21 April 2018, from https://www.usnews.com/opinion/articles/2012/08/09/creativity-will-drive-the-us-economy

Creswell, J. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage Publications.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297–334.

Culture of 21st Century Education. (2019). Retrieved 29 September 2019, from https://www.dancker.com/blog/culture-21st-century-education/

D'Apice, M. (2015). *What are the benefits of Universal Design for Learning and h.* Retrieved 21 March 2019, from https://prezi.com/eed1auogkg-z/what-are-the-benefits-of-universal-design-for-learning-and-h/

Dalton, E. M., & Brand, S. (2011, November 30). The assessment of young children through the lens of Universal Design for Learning (UDL). Retrieved June 30, 2022, from https://eric.ed.gov/?id=EJ979436

Darling-Hammond, L., & Hyler Madelyn Gardner, M. (2017). Effective Teacher Professional Development. Retrieved 7 July 2019, from https://learningpolicyinstitute.org/product/effective-teacher-professional-development-report

Data Recognition Corporation. (2017). Missouri assessment program grade-level

assessments: Grades 3-8 english language arts and mathematics grades 5 and 8 science technical report. MN: Maple Grove

DeCoste, D., Kaplan, M., & Spinnato, S. (2015). UDL: A Maryland State of Mind. Retrieved 13 November 2021, from https://www.learningdesigned.org/sites/default/files/DeCoste_Kaplan_Spinnato_2015.pdf

DeSilver, D. (2020, August 21). *U.S. students' academic achievement still lags that of their peers in many other countries*. Retrieved June 25, 2022, from https://www.pewresearch.org/fact-tank/2017/02/15/u-s-students-internationally-math-science/

DuFour, R., & Mattos, M. (2013). How Do Principals Really Improve Schools? - Educational Leadership. Retrieved from http://www.ascd.org/publications/educational-leadership/apr13/vol70/num07/How-Do-Principals-Really-Improve-Schools%C2%A2.aspx

Dymond, S., Renzaglia, A., Rosenstein, A., Chun, E., Banks, R., Niswander, V., & Gilson, C. (2006). Using a Participatory Action Research Approach to Create a Universally Designed Inclusive High School Science Course: A Case Study. *Research And Practice For Persons With Severe Disabilities, 31*(4), 293-308. doi: 10.1177/154079690603100403

Edmonds, B. (2016). Political Action in Public Education. Retrieved from https://scholarworks.umb.edu/cgi/viewcontent.cgi?article=1016&context=honors_theses

Education Week. "Missouri Earns a C-Minus on State Report Card, Ranks 32nd in the Nation." Available at: https://www.edweek.org/ew/collections/ quality-counts-2018-state-grades/highlightreports/ 2018/01/17/missouri.html. Accessed January 22, 2018.

Edyburn, D. (2009). RTI and UDL interventions. *Journal of Special Education Technology, 24*(2), 46-47.

Edyburn, D. (2010). *Would You Recognize Universal Design for Learning if You Saw it*? Ten Propositions for New Directions for the Second Decade of UDL - Dave L. Edyburn, 2010. Retrieved 28 September 2019, from https://journals.sagepub.com/doi/10.1177/073194871003300103

Engaging Stakeholders. Including Parents and the Community to Sustain Improved Reading Outcomes. (2009). *Sustaining Reading First*, 6, 14. Retrieved from https://www2.ed.gov/programs/readingfirst/support/stakeholderlores.pdf

Explore Trinity School District. (2019). Retrieved 2 September 2019, from https://www.niche.com/k12/d/trinity-school-district-mo/

Evans, C., Williams, J. B., King, L., & Metcalf, D. (2010). *Modeling, guided instruction, and application of UDL in a rural special education teacher preparation program*. Rural Special Education Quarterly, 29(4), 41-48.

Federal Role in Education. (2019). Retrieved 26 March 2019, from https://www2.ed.gov/about/overview/fed/role.html

Fish, W. W. (2008). *The IEP meeting: Perceptions of parents of students who receive special education services*. Preventing School Failure, 53(1), 8–14.

Ford, K. (2014). *Competency-based education: History, opportunities, and challenges.*

Center for Innovation in Learning and Student Success. Univ. of Maryland University College. Available from: http://files.eric.ed.gov/fulltext/ED114384.pdf [last accessed 26 June 2022].

Framework for 21st Century Learning - P21. (2007). P21.org. Retrieved 22 April 2018, from http://www.p21.org/our-work/p21-framework

Friesen, S. (2008). Raising the floor and lifting the ceiling: Math for all. *Education Canada, 48*(5), 50-54.

Friesen S. (2016) Assessment for Learning in a Math Classroom. In: Scott S., Scott D., Webber C. (eds) Leadership of Assessment, Inclusion, and Learning. *The Enabling Power of Assessment*, vol 3. Springer, Cham. https://doi.org/10.1007/978-3-319-23347-5_6

From Floating Buildings to 'Trail Rails,' These Schools Are Designed with Learning in Mind. (2016). TakePart. Retrieved 21 April 2018, from http://www.takepart.com/feature/2016/10/31/innovative-school-design-gallery

Gay, G. (2015). *The what, why, and how of culturally responsive teaching: international mandates, challenges, and opportunities*. Retrieved 13 November 2021, from https://www.tandfonline.com/doi/abs/10.1080/2005615X.2015.1072079

Grasha, A. F. (1996). *Teaching with style: A practical guide to enhancing learning by understanding teaching and learning styles*. Pittsburgh, PA: Alliance.

Greaves, T., Wilson, L., & Gielniak, M. (2017). *Leadership Brief*. Retrieved from http://one-to-oneinstitute.org/images/remository/Leadership_Brief.pdf

Greer v. Rome City, 967 F. Supp. 470 (11th Cir. 1992). *Individualized Classroom*

Accountability Network (n.d.). Retrieved from ICAN Project: https://ican.doe.state.in.us/beta/istart7.htm. doi: 10.1080/13603110010035843

Gronneberg, J., & Johnston, S. (2015, April 6). 7 things you should know about universal design for learning [Brief]. *Educause Learning Initiative*. Retrieved from http://www.educause.edu/library/resources/7-things-you-should-know-about-universal-design-learning

Guskey, T. (2000). *Evaluating professional development*. Thousand Oaks, CA: Corwin Press, Inc.

Guskey, T., & Sparks, D. (2002). *Linking professional development to improvement in student learning*. New Orleans, LA: American Educational Research Association

Guskey, T., & Yoon, K.S. (2009). What works in professional development? *Phi Delta Kappan*(March).

Hall, T.E., Cohen, N., Vue, G. & Ganley, P. (2015). Addressing learning disabilities with UDL and technology: Strategic Reader. *Learning Disability Quarterly 38(2): 72-83.* doi: 10.1177/0731948714544375

Handle, V. (2004). Universal instructional design and world languages. *Equity & Excellence in Education, 37,* 161-166. doi: 10.1080/10665680490454039

Heath, A., & Clifford, P. (1990). Class Inequalities in Education in the Twentieth Century. *Journal Of The Royal Statistical Society. Series A (Statistics In Society), 153*(1), 1-16.

Hehir, T. (2009). Policy foundations of universal design for learning. In D. T. Gordon, J. W. Gravel & L. A. Schifter (Eds.), *A policy reader in universal design for learning* (pp. 35-45). Cambridge, MA: Harvard Education Press.

Heppner, P.P., & Heppner, M.J. (2004). *Writing and publishing your thesis, dissertation, and research*. Belmont, CA: Thomson/Brooks Cole.

Heppner, P.P., Kivlighan, D.M., & Wampold, B.E. (1999). *Research design in counseling* (2nd ed.). Belmont, CA: Wadsworth.

Individualized Education Program (IEP) Facilitation. *A Guide for Parents of Children & Youth (Ages 3-21).* (2014). Center for Appropriate Dispute Resolution in Special Education (CADRE). Retrieved from http://eric.ed.gov/?id=ED555858

Israel, M., Ribuffo, C., & Smith, S. (2014). Universal Design for Learning: *Recommendations for teacher preparation and professional development* (Document No. IC-7). Retrieved from University of Florida, Collaboration for Effective Educator, Development, Accountability, and Reform Center website: http://ceedar.education.ufl.edu/tools/innovation-configurations/

Item response theory. (n.d.). Retrieved February 25, 2022, from https://www.publichealth.columbia.edu/research/population-health-methods/item-response-theory, Public-Health, Columbia.edu

Jordan, A., & Stanovich, P. (2001). *Patterns of teacher-student interaction in inclusive elementary classrooms and correlates with student self-concept*. International Journal of Disability, Development and Education, 48(1), 33–52.

Jordan Anstead, M. (2016). *Teacher's perceptions of barriers to universal design for learning* (Ed. S). Walden University.

Johnson-Harris, K. (2014). *The effects of universal design for learning on the academic engagement of middle school students (M.S.).* Southern Illinois University Carbondale

Joyce, B., & Calhoun, E. (2010). *Models of professional development: A celebration of educators* Thousand Oaks, CA: Corwin

JPS Academic Services. (2018). Lps53.org. Retrieved 19 April 2018, from https://www.jps53.org/domain/1069

Knecht-Sabres, L. J. (2013). Experiential learning in occupational therapy. *Journal of Experiential Education*, 36(1), 22-36. doi:10.1177/1053825913481584

Knoll, M. (1997). *The Project Method: It's Vocational Education Origin and International Development*. Journal of Industrial Teacher Education, 34(3), 59-80.

Kober, N. (2020). *History and evolution of public education in the US - eric*. Retrieved June 25, 2022, from https://files.eric.ed.gov/fulltext/ED606970.pdf

Kosko, K. & Wilkins, J. (2009). *General Educators' In-Service Training and Their Self-Perceived Ability to Adapt Instruction for Students with IEPs*. Professional Educator, 33(2). Retrieved from http://eric.ed.gov/?id=EJ988196

Kurzweil. (2019). Three Principles of UDL. Retrieved July 5, 2022, from https://www.kurzweiledu.com/udl-three-principles-p4.html

La Salle, T., Roach, A., & McGrath, D. (2013). *The Relationship of IEP Quality to Curricular Access and Academic Achievement for Students with Disabilities*. International Journal of Special Education, 28(1), 135-144. Retrieved from http://eric.ed.gov/?id=EJ1013681

Language arts overview - Oklahoma. (n.d.). Retrieved February 26, 2022, from https://sde.ok.gov/sites/ok.gov.sde/files/C3langartsPASS.pdf

Learning Styles. (2016). Retrieved 2 November 2021, from https://www.pearson.com/content/dam/one-dot-com/one-dot-com/ped-blogs/wp-

content/pdfs/INSTR6230_LearningStyles_WP-2.pdf

Lee, J., Blackwell, S., Drake, J., & Moran, K. (2014). Taking a Leap of Faith: Redefining Teaching and Learning in Higher Education Through Project-Based Learning. *Interdisciplinary Journal Of Problem-Based Learning*, 8(2). doi: 10.7771/1541-5015.1426

Levin, S., & Bradley, K. (2019). Understanding and Addressing Principal Turnover: A Review of the Research. Retrieved 5 January 2022, from https://learningpolicyinstitute.org/product/nassp-understanding-addressing-principal-turnover-review-research-report

Lewis, J. (1983). *Long-range and short-range planning for educational administration*. (p. 68). Boston: Allyn & Bacon.

Literacy-Facts-Stats. (2017). Retrieved 27 October 2019, from https://www.rif.org/sites/default/files/Literacy-Facts-Stats.pdf

Lopez-Garrido, G. (2020). Self-Efficacy Theory | Simply Psychology. Retrieved 5 January 2022, from https://www.simplypsychology.org/self-efficacy.html

Lunenburg, F. (2012). Organizational structure: Mintzberg's framework. *International Journal of Scholarly, Academic, Intellectual Diversity. 14*(1).

Lunenburg, F., & Irby, B. (2008). *Writing a successful thesis or dissertation*. Thousand Oaks, Calif.: Corwin.

Lynch, M. (2018, September 02). Educators: What the 20th Century Progressive Education Movement did for you. Retrieved May 17, 2022, from https://www.theedadvocate.org/educators-20th-century-progressive-education-movement/#:~:text=The%20progressive%20education%20movement%20surface

d,and%20political%20benefits%20for%20all.

MAP Grade-Level Tech Report, 2016, ELA and Math. (2016). Retrieved February 25, 2022, from https://dese.mo.gov/ Data Recognition Corporation

McKeachie, W. J. (1995). Learning Can Become a Learning Strategy. *The National Teaching & Learning Forum*, 4(6), 1-3.

Malan, S.P.T. (2000). The "new paradigm" of outcomes-based education in perspective. *Journal of Family Ecology and Consumer Science*, 28, 22– 28.

Mangiatordi, A., & Serenelli, F. (2013). Universal design for learning: A meta-analytic review of 80 abstracts from peer reviewed journals. *Research on Education and Media*, 5(1), 109–118.

Mayer, R. E. (2011). Does styles research have useful implications for educational practice? *Learning and Individual Differences*, 21(3), 319–320. doi:10.1016/j.lindif.2010.11.016

McKenzie, J., Karisa, A., & Tesni, S. (2021). Review of UDL in low- and middle-income countries - CBM. Retrieved June 11, 2022, from https://www.cbm.org/fileadmin/user_upload/UDL_review_report_2021.pdf

Meador, D. (2019, July 23). *How effective instructional strategies can boost student learning*. Retrieved May 22, 2022, from https://www.thoughtco.com/building-an-arsenal-of-effective-instructional-strategies-3194257#:~:text=Teachers%20are%20best%20served%20when,their%20preferred%20individualized%20learning%20style.

Mendenhall, A. N., Iachini, A., & Anderson-Butcher, D. (2013). *Exploring Stakeholder Perceptions of Facilitators and Barriers to Implementation of an Expanded*

School Improvement Model, 35(4), 225-234. doi:10.1093/cs/cdt011

Mergendoller, J.R. (2006) Project Based Learning Handbook, 2nd edition. Novato, CA: Buck Institute for Education.

Merritt, J., Lee, M., Rillero, P., & Kinach, B. (2017). Problem-Based Learning in K–8 Mathematics and Science Education: A Literature Review. *Interdisciplinary Journal Of Problem-Based Learning*, 11(2). doi: 10.7771/1541-5015.1674

Mid-America Regional Council. (2017). Retrieved 02 July 2019 from https://www.marc.org/Data-Economy/Metrodataline/assets/Poverty-by-school-district.aspx

Militello, M., Schweid, J., & Sireci, S. G. (2010). Formative assessment systems: Evaluating the fit between school districts' needs and assessment systems' characteristics. *Educational Assessment*. doi: 10.1007 /sl 1092-010-9090-2

Mills, J., & Treagust, D. (2003). *ENGINEERING EDUCATION – IS PROBLEM-BASED OR PROJECT-BASED LEARNING THE ANSWER(*?). Retrieved 13 November 2021, from http://www.aaee.com.au/journal/2003/mills_treagust03.pdf

Miranda, A. H. (2002). *Best practices increasing cross-cultural competence*. In A. Thomas & 1. Grimes (Eds.), Best practices in school psychology IV (pp. 353-362). Bethesda, MD: NASP.

Missouri Assessment Program. (2020). Retrieved 21 January 2022, from https://dese.mo.gov/special-education/effective-practices/student-assessments/missouri-assessment-program

Missouri Comprehensive Data System - District and School Information. (2018).

Mcds.dese.mo.gov. Retrieved 27 April 2018, from https://mcds.dese.mo.gov/quickfacts/Pages/District-and-School-Information.aspx?RootFolder=%2Fquickfacts%2FSchool%20Finance%20Data%20and%20Reports%2FFree%20and%20Reduced%20Lunch%20Percentage%20by%20Building&FolderCTID=0x012000B3EF86959C3A824680BF44E0680ED1F4&View={0E813976-3BD6-4D9B-9112-5D0C54B515E8}

Montgomery, S. M., & Groat, L. N. (1998). *Student Learning Styles and their Implications for Teaching* (Vol. 10). Ann Arbor, Michigan: Centre for Research on Learning and Teaching, University of Michigan. doi:chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://web.uri.edu/teach/files/Student-Learning-Styles-and-Their-Implications-for-Teaching.pdf

Muller, E., & Tschantz, J. (2003). Universal design for learning: Four state initiatives. Washington, DC: National Association of State Directors of Special Education.

National Center for Education Statistics. (n.d.). *Number and percentages of youth ages 3- 21 served under the Individuals with Disabilities Education Act*. Retrieved June 16, 2016, from http://nces.ed.gov/programs/coe12007/section1/table.asp?tableID =670

National Center on Universal Design for Learning. http://www.udlcenter.org/aboutudl/whatisudl

NEA Education Policy and Practice Department. (2008). *Universal Design for Learning (UDL): Making learning accessible and engaging for all students* [Ebook] (pp. 1-4). Washington D.C. Retrieved 02 July 2019 from http://www.nea.org/assets/docs/PB23_UDL08.pdf

Nodine, T. (2016). How did we get here? A brief history of ... - Wiley Online Library. Retrieved June 26, 2022, from https://onlinelibrary.wiley.com/doi/full/10.1002/cbe2.1004

Northwest Evaluation Association (2016). *How research informs our products*. Retrieved from https://www.nwea.org/research/how-research-informs-our-products/

Ofiesh, N., Rojas, C., & Ward, R. (2006). Universal design and the assessment of student learning in higher education: Promoting thoughtful assessment. *Journal of Postsecondary Education and Disability, 19*(2), 173-181.

Okolo, C., Englert, C., Bouck, E., Heutsche, A., & Wang, H. (2011). The virtual history museum: Learning U.S. history in diverse eighth grade classrooms. *Remedial and Special Education, 32*(5), 417-428. doi: 10.1177/0741932510362241

Overview. (2019). Retrieved 26 March 2019, from https://dese.mo.gov/state-board-education/overview

Özyurt, Ö., & Özyurt, H. (2015). Learning style based individualized adaptive e-learning environments: Content analysis of the articles published from 2005 to 2014. *Computers in Human Behavior*, 52, 349–358. doi:10.1016/j.chb.2015.06.020

PBL UDL. (2014). Retrieved from http://www.learninginnovationlab.com/pbl-udl.html

Pascarella, E.T. & Terenzini, P.T. (2005). *How college affects students [Vol. 2]: a third decade of research.* 2nd ed. Jossey-Bass. San Francisco.

Pashler, H., Mcdaniel, M., Rohrer, D., & Bjork, R. (2009). Learning Styles Concepts and Evidence. *Psychological Science in the Public Interest*, 9(3), 105–119.

Pearse, S. (2017, July 31). Teaching methods: Traditional vs modern. Retrieved July 7, 2022, from

https://sixthform.stephenperse.com/blog/?pid=458&nid=45&storyid=4728#:~:text=Because%20traditional%20techniques%20used%20repetition,and%20therefore%20be%20more%20productive.

Pellegrino, J. W., and Hilton, M. L. (Eds.). (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century.* Washington, DC: National Academies Press.

Pendergrass, S. (2019). *We're on the Road to Nowhere . . .* Retrieved 26 November 2019, from https://showmeinstitute.org/blog/accountability/we%E2%80%99re-road-nowhere

Penikas, D. (2019). The Impact of Blended Instruction on Student Achievement and Teacher Perceptions – ProQuest. Retrieved 13 December 2021, from https://www.proquest.com/docview/2268338341

Peterson, B. W. (2012). Uncovering the progressive past: The origins of project based learning. *UnBoxed: A Journal of Adult Learning in Schools, 8*. Retrieved from http://gse.hightechhigh.org/unboxed/issue8/uncovering_the_progressive_past/. Accessed on September 22, 2021.

Phillippo, K. & Stone, S. (2006). *School-based collaborative teams: An exploratory study of tasks and activities*. Children & Schools, 28, 229-235.

Poponi, D. (2009). *The relationship between student outcomes and parental involvement in multidisciplinary IEP team meetings*. Philadelphia College of Osteopathic Medicine.

Potts, K. (2016). *Competency-based education in grades K-12*. Retrieved June 25, 2022, from https://comptroller.tn.gov/office-functions/research-and-education-

accountability/publications/prek-12/competency-based-education-in-grades-k-12.html#:~:text=Competency%2Dbased%20education%20(CBE),learning%20or%20proficiency%2Dbased%20learning.

Proctor, P., Dalton, B., & Grisham, D. (2007). Scaffolding English language learners and struggling readers in a universal literacy environment with embedded strategy instruction and vocabulary support. *Journal of Literacy Research 39*(1), 71-93.

Project Tomorrow. (2011). *The new 3E's of Education: Enabled, Engaged, Empowered. How today's' educators are advancing a new vision for teaching and learning*. Irvine, CA: Author. Retrieved from http://www.tomorrow.org/speakup/pdfs/SU10 3EofEducation Educators.pdf

PsycNET. Retrieved 28 September 2019, from https://psycnet.apa.org/record/1950-00136-000

Public Education Snapshot. (2018). Retrieved 12 November 2019, from https://dese.mo.gov/sites/default/files/2017-18-public-education-snapshot.pdf

Quasi-experimental design: Explanation, methods and faqs. (2021, October 05). Retrieved March 7, 2022, from https://www.voxco.com/blog/quasi-experimental-design-explanation-methods-and-faqs/#:~:text=The%20advantages%20include%3A,with%20other%20experimental%20methods%20too.

Randall, L. E., Buscher, C., & Swerkes, S. (1995). Learning Styles of Physical Education Majors: Implications for Teaching and Learning. *Excellence in College Teaching*, 6(2), 57-77.

Rao, K., Ok, M. W., & Bryant, B. R. (2014). A Review of Research on Universal Design

Educational Models. *Remedial and Special Education*, 35(3), 153–166. doi:10.1177/0741932513518980

Ravitch, D. (2000). *Left back: A century of failed school reforms*. New York, NY: Simon and Schuster.

Reardon, S., Valentino, R., & Shores, K. (2012). *Patterns of Literacy among U.S. Students*. The Future Of Children, 22(2), 17-37. doi: 10.1353/foc.2012.0015

Reiman, J., Beck, L., Coppola, T., & Engiles, A. (2010). *Parents' Experiences with the IEP Process: Considerations for Improving Practice*. Center for Appropriate Dispute Resolution in Special Education (CADRE). Retrieved from http://eric.ed.gov/?id=ED512611

Research Spotlight on Project-Based Learning. NEA. Retrieved 22 April 2018, from http://www.nea.org/tools/16963.htm

Richardson, V. (2003). The dilemmas of professional development. *Phi delta Kappan, 84*, 401-406.

Rickards, F., Hattie, J., & Reid, C. (2020). The turning point for the teaching profession (1st ed.). London: Routledge.

Ritschel-Trifilo, P. (2022). *Accessibility & Universal Design for Learning*. Retrieved June 25, 2022, from https://www.blackboard.com/teaching-learning/accessibility-universal-design?utm_source=google&utm_medium=cpc&utm_campaign=NA_-_Higher_Ed_-_Accessibility_-_LeadGen_-_BOF_-_Search&utm_term=universal+design+principles+for+learning&gclid=CjwKCAjw5NqVBhAjEiwAeCa97SZPTTWd2axgWzYv7VbmGtGrb8Qe4iRwvjoy6jVOA7aimrNxUaCNDBoCP-gQAvD_BwE

Rose, D. H., & Meyer, A. (2002). *Teaching Every Student in the Digital Age: Universal Design for Learning*. (V. A. Alexandria, Ed.).

Rose, D., Harbour, W., Johnston, C., Daley, S., & Abarbanell, L. (2006). Universal design for learning in post-secondary education: Reflections on principles and their application. *Journal of Postsecondary Education and Disability, 192*(2), 135-151.

Samuels, C. (2016). *Universal Design for Learning Makes its Way into ESSA Law*. Retrieved from https://www.govtech.com/education/k-12/Universal-Design-for-Learning-Makes-its-Way-into-ESSA-Law.html

Savery, J. (2006). Overview of Problem-based Learning: Definitions and Distinctions. *Interdisciplinary Journal Of Problem-Based Learning*, 1(1). doi: 10.7771/1541-5015.1002

Senior, Freshman, & Sophomore. (2021, January 08). *Explore jonesberry school district*. Retrieved June 24, 2022, from https://www.niche.com/k12/d/jonesberry-school-district-mo/

Scarbrough, H., Bresnen, M., Edelman, L., Laurent, S., Newell S. and Swan, J. A. *The processes of project-based learning: An exploratory study*. Management Learning, 35 (2004). 491-506.

Schelly, C., Davies, P., & Spooner, C. (2011). Student perceptions of faculty implementation of universal design for learning. *Journal of Postsecondary Education and Disability, 24*(1), 17-30.

Schneider, J. (2018). *How are America's public schools really doing*? Retrieved from https://www.washingtonpost.com/education/2018/10/15/how-are-americas-

public-schools-really-doing/?noredirect=on&utm_term=.89043259cc5a

Schul, J. (2020). Propelling Schools Forward: Five Initiatives to Improve American Public Education. Retrieved 18 December 2021, from https://openriver.winona.edu/eie/vol25/iss1/3/?utm_source=openriver.winona.edu%2Feie%2Fvol25%2Fiss1%2F3&utm_medium=PDF&utm_campaign=PDFCoverPages

Shaffer, D. W., Squire, K. R., Halverson, R., & Gee, J. P. (2005). *Video games and the future of learning*. Phi Delta Kappan, 87(2), 104-111.

Silverman, S. L., & Casazza, M. E. (2000). *Learning and development: Making connections to enhance learning.* San Francisco: Jossey-Bass.

Sloan, T. F. (2015, August 22). Data and learning that affords program improvement: A response to the U.S. accountability movement in Teacher Education - *Educational Research for Policy and Practice*. Retrieved June 30, 2022, from https://link.springer.com/article/10.1007/s10671-015-9179-y

Smith, F. (2008). *Perceptions of universal design for learning (UDL) in college classrooms* (Ed. S). The George Washington University.

Smith-Canter, L., King, L., Williams, J., Metcalf, D., & Rhys Myrick Potts, K. (2017). *Evaluating Pedagogy and Practice of Universal Design for Learning in Public Schools*. Exceptionality Education International, 27(1), 1-16.

Spady, W.G. (1994). Outcome-based education: Critical issues and answers. Arlington, VA: *American Association of School Administrators*. Available from: http://files.eric.ed.gov/fulltext/ED380910.pdf [last accessed 26 June 2022].

Speziale, K. (2021). Study Confirms Project Based Learning Has a Positive Impact on

How Students Learn Science and Math. Retrieved 13 December 2021, from https://blog.definedlearning.com/blog/project-based-learning-research

Spooner, F., Baker, J., Harris, A., Ahlgrim-Delzell, L., & Browder, D. (2007). Effects of training in universal design for learning on lesson plan development. *Remedial and Special Education, 28*(2), 108-116.

Staff, F. (2021). Professional Development for Missouri Teachers | Continuing Ed Courses. Retrieved 13 November 2021, from https://ce.fresno.edu/news/professional-development-for-missouri-teachers

Standards-Based Grading: What to Know for the 2021-2022 School Year. (2022). Retrieved 22 January 2022, from https://www.powerschool.com/resources/blog/standards-based-grading-what-to-know-for-the-2021-2022-school-year/

Sterba, J. (2004, February 20). *Limited-English school deadline may gain a year*. Retrieved May 15, 2004, from Arizona Daily Star Web site: http://www.dailystar.com/dailystar/relatedarticles/10740.php

Stevens, S. (2018, October 01). 5 challenges facing the CBE Movement. Retrieved June 26, 2022, from https://www.aypf.org/blog/5-challenges-facing-the-cbe-movement/

Support Services Directory. (2018). Jps53.org. Retrieved 19 April 2018, from https://www.jps53.org/lpsdepartments

Taldi, S. (2010). Project-based learning in primary schools: effects on pupils' learning and attitudes. Retrieved 13 November 2021, from https://www.tandfonline.com/doi/full/10.1080/03004270903179538?src=recsys

Tanjung, D. F., Syahputra, E., & Irvan, I. (2020). Problem based learning, discovery learning, and open-ended models: An experiment on mathematical problem-solving ability. *JTAM | Jurnal Teori Dan Aplikasi Matematika*, 4(1), 9. doi:10.31764/jtam.v4i1.1736

Title I Explained: What is title I and how is it used to fund our schools? (n.d.). Retrieved June 25, 2022, from https://www.edpost.com/explainer/explained-what-is-title-i-and-how-is-it-used-to-fund-our-schools

Title I - Improving The Academic Achievement Of The Disadvantaged. (1965). Retrieved from https://www2.ed.gov/policy/elsec/leg/esea02/pg1.html

Title IX and Sex Discrimination. (1972). Retrieved from https://www2.ed.gov/about/offices/list/ocr/docs/tix_dis.html

Thomas, J. W. (2000). *A review of research on project-based learning*. San Rafael, CA: The Autodesk Foundation.

Thomas, L. (2021, October 20). An introduction to quasi-experimental designs. Retrieved March 7, 2022, from https://www.scribbr.com/methodology/quasi-experimental-design/

Thousand, J., Villa, R., & Nevin, A. (2007). *Differentiating Instruction: Collaborative planning and teaching for universally designed learning*, Thousand Oaks, CA: Corwin Press.

Torff, B., & Sessions, D. (2008). *Factors associated with teachers' attitudes about professional development*. Teacher Education Quarterly, 35(2), 123-133.

Truong, H. M. (2015). Integrating learning styles and adaptive e-learning system: Current developments, problems, and opportunities. *Computers in Human Behavior*. doi:10.1016/j.chb.2015.02.014

Tsang, E. (2007). *Organizational learning and the learning organization: A dichotomy between descriptive and prescriptive research*. Human Relations, 50, 73-89.

Tyler, K.M., Boelter, C.M., & Boykin, A.W. (2000). *Linking Teachers' Perceptions of Educational Value Discontinuity to Low-Income Middle School Students' Academic Engagement and Self-Efficacy*. Educational Value Discontinuity, 3(4), 1-20.

UDL: Three Principles. (2019). Retrieved 21 March 2019, from https://www.kurzweiledu.com/udl-three-principles-p4.html

Universal Design for Learning (UDL): Reaching All, Teaching All. (2004). Retrieved 02 July 2019 from https://eric.ed.gov/?id=ED485470

U.S. Census Bureau QuickFacts: Jonesberry city, Missouri. (2019). Retrieved 17 September 2019, from https://www.census.gov/quickfacts/jonesberrycitymissouri

U.S. Census Bureau QuickFacts: Trinity, Missouri; United States. (2019). Retrieved 17 September 2019, from https://www.census.gov/quickfacts/fact/table/trinitymissouri,US/PST045218

Vander Ark, T. (2020). Tom Vander Ark on Personalized Learning | Getting Smart. Retrieved 20 February 2020, from https://www.gettingsmart.com/2017/07/tom-vander-ark-on-personalized-learning/

Vision, Mission & Goals. (2019). Retrieved 26 March 2019, from https://dese.mo.gov/commissioner/vision-mission-goals

Vitelli, E. (2013). *Universal design for learning and pre-service general education teacher preparation* (Ed. D). The George Washington University.

Voyage Vision Framework / Home. (2015). Jps53.org. Retrieved 21 April 2018, from https://www.jps53.org/domain/1541

Vygotsky, L. S. (2011). *The dynamics of the schoolchild's mental development in relation to teaching and learning*. Journal of Cognitive Education and Psychology, 10(2), 198-211. Retrieved from http://www.springerpub.com/journal-of-cognitive-education-and-psychology.html

Watson, S., & Reigeluth, C. (2013). Community members' perceptions on social, cultural changes and its implication for educational transformation in a small school district community. Retrieved 13 November 2021, from https://www.tandfonline.com/doi/abs/10.1386/jots.5.1.45_1

What is an Individualized Education Plan? | AccessComputing. (2006). Retrieved 5 January 2022, from https://www.washington.edu/accesscomputing/what-individualized-education-plan

What is the Every Student Succeeds Act? (2020). Retrieved 5 January 2022, from https://oese.ed.gov/families/essa/

Welcome to Jonesberry Public School District. Retrieved April 15, 2018, from https://www.jps53.org/domain/73

Welcome to Jonesberry Public School District. (2017). Jps53.org. Retrieved 21 April 2018, from https://www.jps53.org/domain/73

What is Project Based Learning? Discover Here | Educators of America. (2019).

Retrieved 21 March 2019, from https://educatorsusa.org/our-programs/professional-development/project-based learning/?gclid=EAIaIQobChMI4KDe8viT4QIVg_7jBx1R0wJWEAAYASAAEgJf1vD_BwE

Witt, J.C., Miller, C.D., McIntyre, R.M., & Smith, D. (September 1984). *Effects of Variables on Parental Perceptions of Staffing*. Exceptional Children, 51(1), 27-32.

Appendices

Appendix A: Baker IRB Proposal Application

BAKER UNIVERSITY

IRB Request

Date 2/08/2022

IRB Protocol Number _____
(IRB use only)

I. Research Investigator(s) (students must list faculty sponsor)

Department(s) GSOE (K12) Ed.D.

	Name	Signature	
1.	Jason Maeder	_____	Principal Investigator
2.	Dr. Jim Robins	_____	☐ Check if faculty sponsor
3.	Dr. Li Chen-Bouck	_____	☐ Check if faculty sponsor
4.			☐ Check if faculty sponsor

Principal investigator contact information

Phone 816-522-9709

Email jason.maeder@gmail.com

Address 1910 Buckingham Drive
Liberty, MO, 64068

Note: When submitting your finalized, signed form to the IRB, please ensure that you cc all investigators and faculty sponsors using their official Baker University (or respective organization's) email addresses.

Faculty sponsor contact information

Phone 816-604-8045

Email jrobins@bakeru.edu

Expected Category of Review: ☑ Exempt ☐ Expedited ☐ Full ☐ Renewal

II. Protocol Title

The Effectiveness of Project Based Learning and Exploring Theories Supporting 21st Century Learning Methods

III. Summary:

The following questions must be answered. Be specific about exactly what participants will experience and about the protections that have been included to safeguard participants from harm.

A. **In a sentence or two, please describe the background and purpose of the research.**

This study was conducted to examine if there was a difference in annual MAP assessment scores between students from two different Missouri elementary schools receiving separate styles of instructional methods. Specifically, the purpose of this study was to examine if there was a difference in students' ELA, Math, and Science MAP assessment scores between VE students attending school in a PjBL-focused environment, and GWE students attending school in a Competency-Based Education (CBE) focused, or more traditional environment.

B. **Briefly describe each condition, manipulation, or archival data set to be included within the study.**

There are no manipulative conditions involved in this study. The data set consists of Missouri Assessment Program (MAP).

IV. Protocol Details

A. **What measures or observations will be taken in the study? If any questionnaire or other instruments are used, provide a brief description, and attach a copy.**

No measures or observations are included in this study. Additionally, there are no questionnaire's involved in this study.

B. **Will the subjects encounter the risk of psychological, social, physical, or legal risk? If so, please describe the nature of the risk and any measures designed to mitigate that risk.**

There are no psychological, social, physical, or legal risks involved in this study.

C. **Will any stress to subjects be involved? If so, please describe.**

No stress is involved to any subjects in this study.

D. **Will the subjects be deceived or misled in any way? If so, include an outline or script of the debriefing.**

No subjects will be deceived or misled in any way, in this study.

E. **Will there be a request for information which subjects might consider to be personal or sensitive? If so, please include a description.**

No request for information of subjects will be considered personal or sensitive in this study.

F. **Will the subjects be presented with materials which might be considered to be offensive, threatening, or degrading? If so, please describe.**

The subjects of this study will not be presented with materials which might be considered to be offensive, threatening, or degrading from this study.

G. **Approximately how much time will be demanded of each subject?**

None.

H. **Who will be the subjects in this study? How will they be solicited or contacted? Provide an outline or script of the information which will be provided to subjects prior to their volunteering to participate. Include a copy of any written solicitation as well as an outline of any oral solicitation.**

Approximately 50 students from one elementary school immersed in a Project-Based Learning environment, and approximately 50 randomly selected students from a comparable elementary school, instructed under a Competency Based Education method of instruction. Both elementary schools are in the state of Missouri.

I. **What steps will be taken to ensure that each subject's participation is voluntary? What if any inducements will be offered to the subjects for their participation?**

There is no direct participation by the subjects of this study. No inducements will be offered to the subjects for their participation in this study.

J. **How will you ensure that the subjects give their consent prior to participating? Will a written consent form be used? If so, include the form. If not, explain why not.**

There is no need for a consent form since there is no direct participation.

K. **Will any aspect of the data be made a part of any permanent record that can be identified with the subject? If so, please explain the necessity.**

The data is coded by private student identification numbers to protect their anonymity.

L. **Will the fact that a subject did or did not participate in a specific experiment or study be made part of any permanent record available to a supervisor, teacher, or employer? If so, explain.**

No.

M. **What steps will be taken to insure the confidentiality of the data? Where will it be stored? How long will it be stored? What will be done with the data after the study is completed?**

The confidentiality of the data will be secured in the researcher's possession, saved on their work laptop, and not shared with anyone else besides the individuals who initially shared it with them. At the conclusion of the study, the data will either be destroyed, or it will be returned to the Dir. of Assessment from each school district that participated.

N. **If there are any risks involved in the study, are there any offsetting benefits that might accrue to either the subjects or society?**

There are no risks involved, nor are there any benefits that could be accrued from this study.

O. **Will any data from files or archival data be used? If so, please describe.**

Archival Missouri Assessment Program (MAP) data will be used from year's 2015, 2016, and 2017 of the MAP. Ch. 3 is the specific area where the archived data will be shared and utilized. Subjects include English, Math, and Science. Grade levels involved are third, fourth, and fifth.

Appendix B: Request and Permission to Conduct Research within [redacted]SD

Approval from [redacted] School District

Gmail Jason Maeder <jason.maeder@gmail.com>

Request to Conduct Research within WGSD

Jason Maeder <jason.maeder@gmail.com> Wed, Jul 24, 2019 at 11:43 AM
To: denbow.kristin@[redacted]

Dr. Denbow-

I request your consideration in offering me information on how to apply with [redacted] to conduct research on one or two of your elementary schools. One in particular is [redacted]

I am a doctoral student with Baker University. Full t me, I am a teacher/coach with the Liberty Public Schools (LPS). Liberty, MO, in the northland of Kansas City, MO. On a side note, I think we played your boys BKB team a couple years ago in the Final Four! You guys beat us!:(

My research involves Project-Based Learning (PBL) and I aim to compare its progress to that of a more traditional elementary learning environment. The school that I teach 1/2 time at is named [redacted] We've been a fully immersed PBL school for 5 years now. Working with our LPS Director of Assessment, Eva uation and Testing, Mr. Christopher Hand, he helped me learn of a few Missouri schools that matched the demographics of [redacted] Elementary ([redacted]) is one of these few schools!

I have applied to conduct research at a nearby district here in K.C., MO called Park Hill School District. Working with their Director of Assessment, Dr. Mike Kimbrel, I believe they may not have an elementary that has similar demographics. FYI, I have attached a "write up" that I'd sent to Dr. Kimbrel. My hope is that you'll glean more info. on my study and what I'm asking of you and WGSD.

In advance, thank you for your consideration and time.

Best Wishes to the start of a new school year!

Sincerely,

Jason Maeder
jason.maeder@[redacted]
jason.maeder@gmail.com
(816) 522-9709-Personal Ce l

App to Conduct Research in PHSD - 22Jul2019.docx
16K

Gmail

Jason Maeder <jason.maeder@gmail.com>

Request to Conduct Research within [redacted]

Jason Maeder <jason.maeder@gmail.com> Thu, Sep 19, 2019 at 2:41 PM
To: Kristin Denbow <Denbow.Kristin@[redacted]

Dr. Denbow-

Greetings from [redacted] I hope your school year is going well.

I wanted to check back with you to be sure you and [redacted] were still interested in helping me out with my research/dissertation. My advisor, Dr. Jim Robins (Baker University), had sent you an email on 8/14/19.

Respectfully,

Jason Maeder
(816) 522-9709-Cell
[Quoted text hidden]

Gmail

Jason Maeder <jason.maeder@gmail.com>

Request to Conduct Research within [redacted]

Jason Maeder <jason.maeder@gmail.com> Mon, Dec 13, 2021 at 1:08 PM
To: Kristin Denbow <Denbow.Kristin@[redacted]

Dr. Denbow-

After taking a military furlough from my dissertation work under the Baker University's Ed.D program, I am now back to working on my research. My military furlough (leave) dealt with my attendance in the Army's War College (non-resident). I attempted to do both programs, yet quickly found that it would be too daunting for a person to complete Master's and Doctoral work at the same time. At the end of July 2021, I finally graduated with a second Master's degree, this one in Strategic Studies.

I remain in high hopes that [redacted] will continue participating in my research, i.e. comparing Project-Based Learning (PBL) to Competency-Based Education (CBE) instructional methods. Soon, I will complete my Review of Literature (Ch. 2), and will send you the official IRB.

Please let me know if you have any questions or concerns. Thank you very much.

Jason Maeder
[redacted]

Respectfully,
Jason
[Quoted text hidden]

Gmail

Jason Maeder <jason.maeder@gmail.com>

Request to Conduct Research within [redacted]

Kristin Denbow <Denbow.Kristin@[redacted]
To: Jason Maeder <jason.maeder@gmail.com>

Mon, Dec 13, 2021 at 1:37 PM

Hi Jason,

I retired from the [redacted] in June, 2020. Dr. Jason Adams is now the Assistant Superintendent for Learning and oversees these programs. His email is adams.jason@wgmail.org . Please reach out to him to fill him in on your research and progress.

Thanks,
Dr. Kristin Denbow
[Quoted text hidden]
--
Dr. Kristin Denbow
Special Projects
[redacted]

Gmail

Jason Maeder <jason.maeder@gmail.com>

Request to Conduct Research within [redacted]

Jason Maeder <jason.maeder@gmail.com> Mon, Dec 13, 2021 at 2:38 PM
To: adams.jason@[redacted]

Dr. Adams-

Checking to see if you, and more specifically, [redacted] are still interested in partnering with me as I complete my dissertation research under the direction of Baker University. As you can see, I'd emailed Dr. Kristin Denbow earlier today. Not knowing of her retirement, she suggested that I reach out to you.

Upfront, my Quantitative study compares Project-Based Learning (PBL) to more traditional means, i.e. Competency-Based Education (CBE).

Please consider maintaining this partnership with me. I look forward to hearing from you.

Thank you.

Jason Maeder

[redacted]

(816) 522-9709-Cell

[Quoted text hidden]

Gmail

Jason Maeder <jason.maeder@gmail.com>

Request to Conduct Research within [redacted]

Jason Adams <adams.jason@wgmail.org> Tue, Dec 14, 2021 at 3:09 PM
To: Jason Maeder <jason.maeder@gmail.com>

Hi Jason,

Thanks for reaching out. Due to everything going on this year, we have really limited what research experiences we participate in. Since this agreement was already developed prior to my time in the district, I'd be able to continue it. I'm happy to work with you and provide you what I can.

Thanks,
Jason Adams
[Quoted text hidden]

Appendix C: Request to Conduct Research within [redacted]

Letter from Liberty Public Schools

[redacted]

Research Checklist and Approval

Date: 3/3/2022

Submitted to: Christopher B. Hand - Director of Assessment, Evaluation, and Testing

Submitted by: Jason J. Maeder

Research Proposal Title: The Effectiveness of PBL and Exploring Teachers Supporting 21st Century Learning Methods

Principal Investigator(s): Jason J. Maeder

Checklist

- ☒ Completed "Application to Conduct Research in [redacted]"
- ☐ Copy of "Informed consent" letter to study population/parents
- ☒ Copies of measurement instruments
- ☐ Approval from university human subjects committee (IRB) if applicable
- ☒ Three (3) copies of your complete application package

Approval of this research is contingent on adherence to district procedures as outlined in the document entitled "Application to Conduct Research" and the information provided with the application. The district must be notified of any substantive changes to the information contained in the application. The district reserves the right to withdraw approval of research if the research is deemed to no longer be in the best interests of the [redacted] students, staff, or the district.

Research Application: ☒ Approved ☐ Denied Date: 3/30/22

Signatures

Christopher B. Hand
Director of Assessment, Evaluation, and Testing

Principal

Principal

[redacted]

[redacted]

Appendix D: Baker IRB Approval Letter

IRB

Baker University Institutional Review Board

April 12th, 2022

Dear Jason Maeder and Jim Robins,

The Baker University IRB has reviewed your project application and approved this project under Exempt Status Review. As described, the project complies with all the requirements and policies established by the University for protection of human subjects in research. Unless renewed, approval lapses one year after approval date.

Please be aware of the following:

1. Any significant change in the research protocol as described should be reviewed by this Committee prior to altering the project.
2. Notify the IRB about any new investigators not named in original application.
3. When signed consent documents are required, the primary investigator must retain the signed consent documents of the research activity.
4. If this is a funded project, keep a copy of this approval letter with your proposal/grant file.
5. If the results of the research are used to prepare papers for publication or oral presentation at professional conferences, manuscripts or abstracts are requested for IRB as part of the project record.
6. If this project is not completed within a year, you must renew IRB approval.

If you have any questions, please contact me at npoell@bakeru.edu or 785.594.4582.

Sincerely,

Nathan Poell, MLS
Chair, Baker University IRB

Baker University IRB Committee
Sara Crump, PhD
Nick Harris, MS
Christa Hughes, PhD
Susan Rogers, PhD

Figures

The Universal Design Guidelines

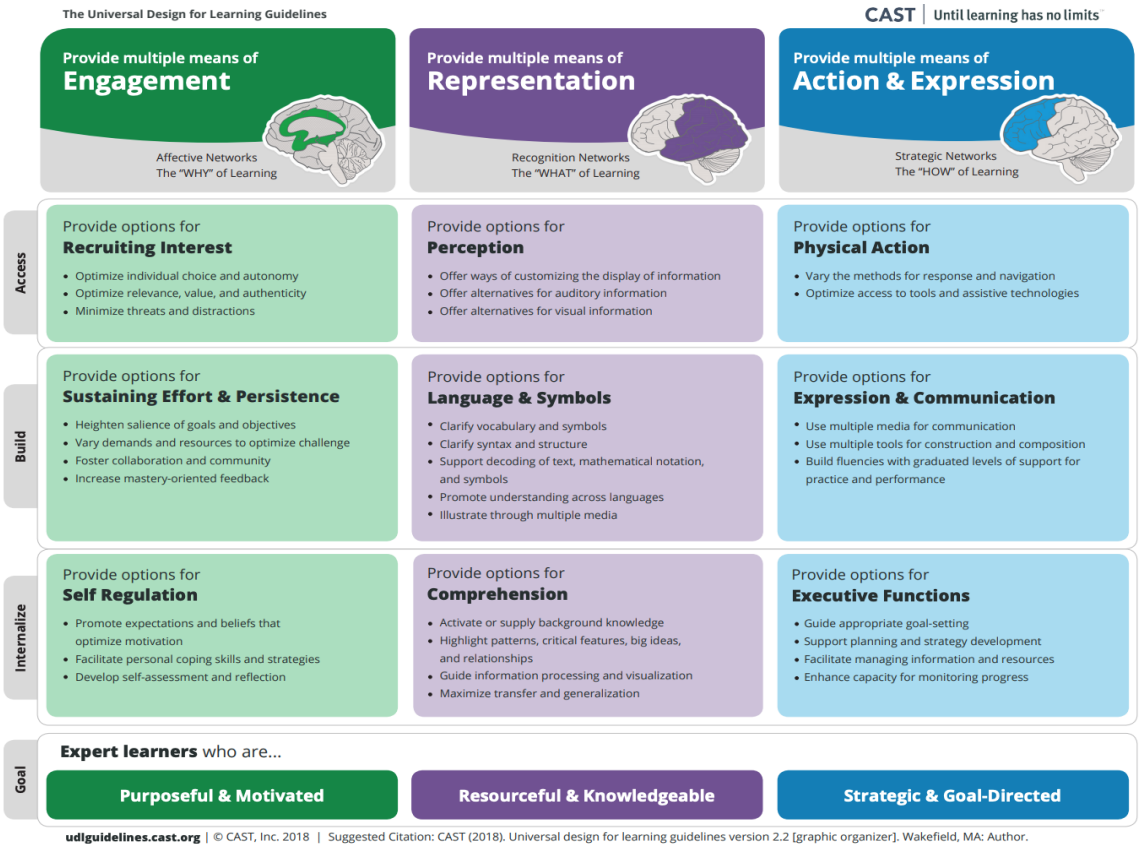

Figure 1. *The Universal Design for Learning Guidelines are a tool used in the implementation of UDL, a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn.*

P21 Framework for 21st Century Learning. ***21st Century Student Outcomes and Support Systems.***

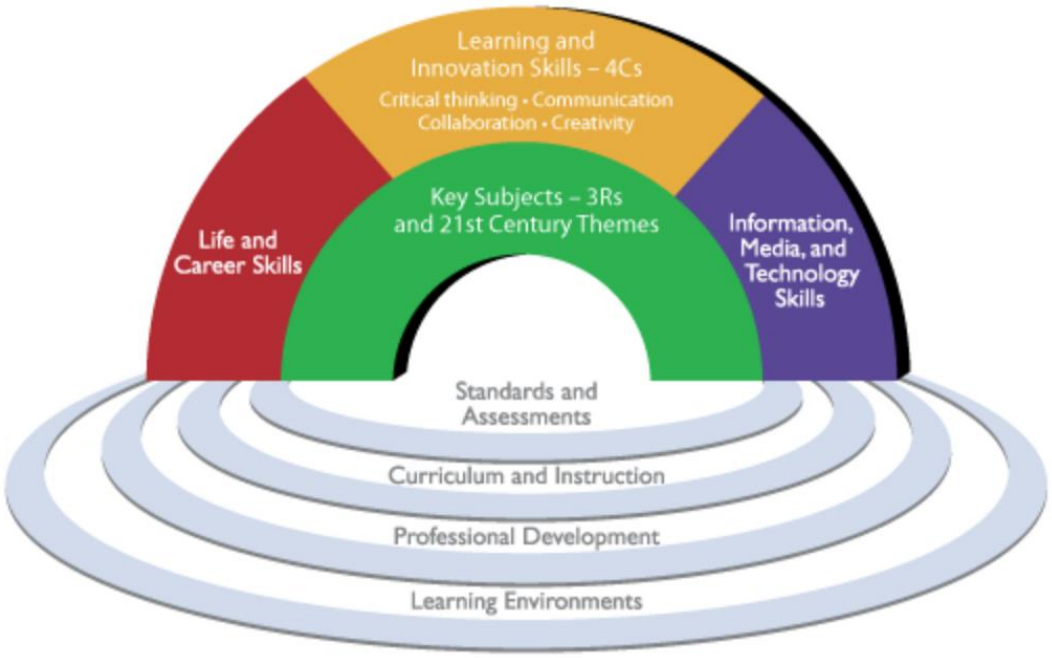

Figure 2. The *P21 Framework depicted above represents both 21st century student outcomes (as represented by the arches of the rainbow) and support systems (as represented by the pools at the bottom). While the graphic represents each element distinctly for descriptive purposes, P21 views all the components as fully interconnected in the process of 21st century teaching and learning*.

Five Challenges Facing the CBE Movement

1. Language. Semantics and a lack of consensus around terms and definitions are a persistent challenge in the CBE space. From a policymaker and practitioner perspective, states and districts are not willing to implement something if they're not sure it works, meaning research is needed to prove CBE is worth trying in schools. From a researcher perspective, the lack of consistent language of terms and definitions within the field of CBE, makes large-scale, rigorous research a challenge. A lack of consistent language of terms and definitions within the field of CBE makes large-scale, rigorous research a challenge.
2. Quality. There is as much variation of CBE practices between schools as within schools, meaning there is a lack of consistent implementation across both schools and classrooms. Many teachers in non-CBE schools reported implementing practices commonly associated with CBE. Moreover, students in CBE and non-CBE schools reported no meaningful differences in experience in most areas of teaching and learning.
3. Systems Alignment. Aligning K-12 levels with higher education is challenging. A competency-based diploma and the accrual of competency-based credits can look very different from the traditional model, i.e., credit transfer from one institution to another can be difficult. States and districts might be hesitant to fully adopt CBE if student assessment and academic reporting changes and no longer aligns with what colleges and universities are looking for. There is another alignment issue that goes in the opposite direction: college graduates are entering the teaching profession unprepared to practice in a CBE school system.
4. Equity. While a student-centered, self-paced, mastery-based system should create opportunities to advance equity by putting all students on the path to postsecondary success, including at-risk youth, CBE done poorly and without the appropriate resources and supports could exacerbate already existing achievement gaps and inequities. A challenge of CBE moving forward might be an inability on the part of schools to provide the supports and resources necessary to guarantee high-quality access to all students.
5. Skepticism. CBE is sometimes dismissed as just another new "fad" in American education. Sometimes the source of skepticism is simply a reluctance to change. Skepticism can come from all angles and an ongoing argument is that bringing a healthy amount to any issue is a good thing.

Figure 3. *This figure provides Five Challenges Facing the CBE Movement (Tomasello, 2016). Although these challenges were deliberated and discussed at a 2016, Regional Educational Laboratory at EDC Symposium, these challenges were published two years later by Shamika Stevens (2018), on the American for Youth Policy Forum's blog page (Stevens, 2018).*

Thomas' Eight Tentative Conclusions of Project-Based Learning

• Research on PBL implementation is largely limited to research on project-based science administered by teachers with limited prior experience with PBL. From this research, there is evidence that PBL is relatively challenging to plan and enact. Keeping the limitations of this research in mind, it is probably fair to say that most teachers will find aspects of PBL planning, management, or assessment fairly challenging and will benefit from a supportive context for PBL administration.
• There is some evidence that students have difficulties benefiting from self- directed situations, especially in complex projects. Chief among these difficulties are those associated with initiating inquiry, directing investigations, managing time, and using technology productively. The effectiveness of PBL as an instructional method may depend, to a greater extent than we recognize, on the incorporation of a range of supports to help students learn how to learn.
• There is direct and indirect evidence, both from students and teachers, that PBL is a more popular method of instruction than traditional methods. Additionally, students and teachers both believe that PBL is beneficial and effective as an instructional method.
• Some studies of PBL report unintended and seemingly beneficial consequences associated with PBL experiences. Among these consequences are enhanced professionalism and collaboration on the part of teachers and increased attendance, self- reliance, and improved attitudes towards learning on the part of students.
• PBL seems to be equivalent or slightly better than other models of instruction for producing gains in general academic achievement and for developing lower-level cognitive skills in traditional subject matter areas.
• More important, there is some evidence that PBL, in comparison to other instructional methods, has value for enhancing the quality of students' learning in subject matter areas, leading to the tentative claim that learning higher-level cognitive skills via PBL is associated with increased capability on the part of students for applying those learnings in novel, problem-solving contexts.
• There is ample evidence that PBL is an effective method for teaching student's complex processes and procedures such as planning, communicating, problem solving, and decision making, although the studies that demonstrate these findings do not include comparison groups taught by competing methods.
• Finally, there is some evidence, albeit indirect, that the effectiveness of PBL is enhanced when it is incorporated into whole-school change efforts.

Figure 4. *This figure provides Dr. Thomas' (2000) tentative conclusions for the future of PjBL. At the time of his study PjBL research then was sparse in each of the paradigms that have emerged whereby a common model for PjBL had been designed ("A Review of Research on Project-Based Learning | Project-Based Learning | BIE," 2000, p. 33).*