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AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN TEACHER GRIT, TECHNOLOGY SELF-EFFICACY, AND TECHNOLOGY INTEGRATION

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AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN TEACHER GRIT, TECHNOLOGY SELF-EFFICACY, AND TECHNOLOGY INTEGRATION

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Education
at the University of Kentucky

By
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ABSTRACT

AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN TEACHER GRIT, TEACHER SELF-EFFICACY, AND TECHNOLOGY INTEGRATION

The use of educational technology applications has grown tremendously in the last decade. Instructors are now equipped with hardware and software applications previously unavailable, such as mobile and interactive technologies. These tools can have tremendous impact on students' learning and teacher practices. Teachers can improve their assessment capabilities through technology integration, provide better learning opportunities for students with learning disabilities, and promote deeper learning practices. Due to these benefits, budgets at the federal, state, and local levels of the United States now have specific allocations regarding technology-related purchases. Nevertheless, barriers remain regarding the effective integration of technologies in public schools.

Student and teacher access to technology can be limited when at school versus at home. Internet access or slow speeds can drastically impact educational access in rural communities. Such differences in access can limit teachers' and students' experiences with technologies, restricting instructor technology background and student learning outcomes. School district policies regarding testing requirements can constrain teachers' use of technology for instruction. Additionally, professional development opportunities for technology training can focus solely on introducing new technologies and not on effective integration strategies. While some of these variables can be addressed by increasing access to technology and shifting technology policies to increase teachers' daily use, non-cognitive factors, such as teacher levels of technology self-efficacy and grit, may play a role in helping teachers use technology more effectively. This study addressed non-cognitive factors of self-efficacy and grit and their role in teacher levels of technology integration.

A rural school district was chosen to evaluate high school teachers' level of technology integration, technology self-efficacy, and grit. Exploratory Factor analysis, Correlation analysis, and hierarchical linear regression modeling were used to determine the correlations of grit and self-efficacy with technology integration. While self-efficacy correlates with technology integration for providing students with content, grit is correlated with how teachers use technology for tasks relating to higher-order thinking processes such as student publication. This study offers a foray into understanding the relationship between grit and technology integration across multiple high school locations in a rural district. The application of non-cognitive psychometrics on technology integration may support educators in advancing student use of technology to become deep-conceptual, metacognitive learners.

KEYWORDS: Grit, Self-efficacy, Technology Integration, Leadership, Education, Teachers.

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11/01/2022

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Dedication

This dissertation is dedicated to my family: Christy, Micah, Canaan, Evangeline, Rex, Wesley, Georgia, and Hosanna. Your time and sacrifice made this possible. I hope you dream and never doubt your ability to do anything that you set your mind to. There is nothing in this world too difficult for you to accomplish.

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CHAPTER 1

INTRODUCTION

Using technological resources in public P-12 schools provides opportunities for students to increase their achievement (Cai et al., 2019; Chen & Howard, 2010; Shin et al., 2012). Educational technology promotes collaborative work and peer-to-peer feedback (Humble-Thaden, 2011). Utilizing technologies in educational settings supports new and innovative ways for students to learn complex or challenging principles, such as mathematics (Cai et al., 2019) and science (Chen & Howard, 2010). Technology also provides solutions during times of crisis, especially when students could not attend in-person classes during the COVID-19 pandemic.

Technology integration in schools has grown exponentially since the global COVID-19 pandemic (Hu et al., 2021). The COVID-19 pandemic forced most schools in the U.S. to transition to online learning and alter how typical instruction was conducted (Rahmadi, 2021). As U.S. schools return to in-person meetings, a significant issue facing public schools is how best to continue to effectively integrate technology for students' learning (Ata et al., 2021). Some issues relating to technology integration can be addressed with increased federal and state funding (Barnum, 2022; McCandless, 2015; Friday Institute, 2015), which supports the purchase of hardware and software. However, the effective day-to-day use of that hardware and software falls on schools and school personnel. Many investigations have sought to dig deeper into teachers' role in the classroom to determine issues impacting technology use in schools, such as teachers' experiences with technology and how it impacts their technology use in the classroom (Abbitt, 2011; Hutchison & Woodward, 2018; Khalif, 2018; Li, 2007).

Addressing how teachers use and integrate technology is vital (Delgado et al., 2015; McLeod & Richardson, 2015; Sawyer, 2017). Teachers are the main drivers of technology integration in their classrooms (Claro et al., 2017). Teachers decide which tools are best suited for their students based on their curriculum (Belson et al., 2013; Dalby & Swann, 2019; Kennedy et al., 2015; Ok & Bryant, 2017; Shin & Bryant, 2017: Townsend, 2017), testing needs (Dalby & Swann, 2019; Townsend, 2017), and the needs of their students (Bartow, 2014; Hoyt & Sorensen, 2001; Marion & Beecher, 2010). Despite a school district having similar technology expectations across schools, integrating technology in classrooms heavily depends on teachers' practices (Chen, 2010; Kent & Giles, 2018) and several cognitive (Amor, 2020; Collins et al., 2016) and non-cognitive factors (Joo et al., 2018; Kent & Giles, 2018).

Many investigations have sought to understand teacher's approaches to technology integration relating to cognitive factors, such as access (Amore, 2020; Collins et al., 2016; Glasmeier, 2021; Grant et al., 2015; Hampton et al., 2020; Harris et al., 2021; Hutchison & Reinking, 2011; Kaden, 2020; Khlaif, 2018; Kurt & Cliftci, 2012; McElrath, 2020; Romano, 2020; Sangani, 2013), experience (Abbitt, 2011; Hutchison & Woodward, 2018; Khlaif, 2018; Li, 2007), testing protocols (Cifuentes, Maxwell, & Bulu, 2011; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Wang, Hsu, Campbell, Coster, & Longhurst, 2014), and professional development (Ertmer et al., 2012; Grant et al., 2015; Hutchison & Woodward, 2018). More recent investigations into teacher non-cognitive factors, such as teachers' levels of technology self-efficacy (Joo et al., 2018; Kent & Giles, 2018), have sought to dig deeper into variables impacting teachers' approaches to technology integration. This study explores the relationship between teachers' perceived levels of technology integration, technology self-efficacy, and teacher grit. This investigation adds to the literature on psychometric studies and applies grit as an investigative tool for understanding technology integration.

Background

Funding for technology in education has provided unprecedented access to technology in public P-12 schools (ISTE, N.D.; US DOE, 2018). These tools have provided benefits to students regarding engagement and learning (Chou et al., 2012; Shin et al., 2012). With these benefits in mind, teacher preparatory programs include effective use of technology in their curriculum, but in varying degrees (Koch et al., 2012). These different approaches to teacher training, plus school testing requirements (Wang et al., 2014), professional development (Ertmer et al., 2012), and psychological factors (Joo et al., 2018) can impact how teachers integrate technology into their classrooms. The following sections will establish the background of technology integration in schools and the need to further understand and research variables relating to teacher use of technology for instructional practice.

Technology and Broadband Funding for Schools

Before 1996, only 14% of schools nationwide had access to broadband internet (FCC, 2015). As of 2014, thanks to federal funding, all P-12 schools and libraries have access to broadband internet (FCC, 2015). The Every Student Succeeds Act (ESSA), signed by President Barack Obama in 2015, addresses college and career readiness goals for public P-12 institutions (USDOE, n.d). ESSA, contained under the Student Support and Academic Enrichment Grants (SSAEG) and within Title IV Part A of The Every Student Succeeds Act (ESSA), provides funding for school technology (ISTE, n.d.). Approximately 60% of SSAEG funds are for technology purchases, with the remaining 40% allotted to safe, healthy, and well-round school activities (ISTE, n.d.). Since 2015, funding opportunities have been created for schools to fund technology. Under Title I, Title II, and Title III of ESSA and the Individuals with Disabilities in Education Act (IDEA) (USDOE, 2018):

- Title I: Funds allocated for schools with at least 40% of students designated as low-income.
- Title II: Funds allocated for teacher and administrator quality improvements.
- Title III: Funds allocated for schools with limited English-speaking student populations.
- IDEA: Funds allocated to support educational opportunities for students with disabilities (USDOE, 2018).

The federal funding for grants for these programs in 2019 was more than six billion dollars. Additional grant funds were available for additional school programs, such as Career and Technical Education (CTE). CTE grants for 2019 provided 1.7 billion dollars to educational programs. The COVID-19 pandemic increased the amount of federal support for schools to over 190 billion dollars (Barnum, 2022). These significant investments address improving students' educational opportunities through technology.

Benefits of Technology Use

Technology provides many potential improvements for students in public P-12 schools to improve their technology self-efficacy (Cai et al., 2019), attitudes toward sciences (Chen & Howard, 2010), active engagement (Chou et al., 2012), and learning (Shin et al., 2012). Even more, these improvements can help address learning gaps (Hampton et al., 2020), deeper learning (Martinez & McGrath, 2014), digital citizenship (Chow & Jesness, 2012; Gleason & Gillern, 2018; Nelson, 2012), and students with learning disabilities (Belson et al., 2013; Kennedy et al., 2015; Ok & Bryant, 2016; Shin & Bryant, 2017). Many variables impact technology integrations in schools relating to infrastructure (Lamb & Weiner, 2021), information technology support staff (Claro et al., 2017; Hutchison & Reinking, 2011; Khlaif, 2018), district policies (Berrett et al., 2012) and instructional faculty (Carver, 2016; Grant et al., 2015;

Hutchison & Reinking, 2011; Vannatta & Bannister, 2009). While additional funding can address some of these variables, additional research is needed to address teachers' technology integration in classrooms.

While technology provides many opportunities to students, it provides additional opportunities to teachers as they strive to lead students to content mastery (Belson et al., 2013; Dalby & Swann, 2019; Kennedy et al., 2015; Ok & Bryant, 2017; Shin & Bryant, 2017: Townsend 2017). Teachers have found ways to leverage technologies by enhancing formative assessments (Dalby & Swann, 2019; Townsend, 2017) and providing supplemental resources to students (Hwange et al., 2011; Marino & Beecher, 2010; O'Malley et al., 2013). Unfortunately, while these tools benefit teachers and students, teachers have reported many obstacles to integrating technologies, such as access, experience, and testing requirements.

Despite its benefits, teachers or students may not have sufficient access to certain technologies (Kurt & Ciftci, 2012). For example, teachers may have limited access to technology at home compared to resources available at school (Purcell et al., 2013). Additionally, students may have limited access to broadband internet at home, limiting their ability to complete online assignments or collaborate with their peers (Hampton et al., 2020). Students may also not have resources at home, such as mobile devices or computers (Collins et al., 2016; Kaden, 2020). Another barrier to technology integration is teachers' prior preparation and experience with these tools.

Teacher Technology Use Preparation

There are many teacher preparation programs in the U.S. (Berliner & Laczko-Kerr, 2002; Darling-Hammond et al., 2005), but not all programs address teachers' prior technology use and effective technology integration (Koch et al., 2012). Teachers from all backgrounds and educational institutions likely have very different experiences with instructional technologies (Hutchison & Woodward, 2018). These experiences can impact teachers' integration of technology due to their limited experiences (Koch et al., 2012). While technology experience is variable, one consistent area across all areas of instruction is the demands of testing on public school teachers (Ryan et al., 2017; Wang et al., 2014).

Testing Demands on Technology Use

Testing can impact technology integration by limiting access to instructional technology during online testing requirements (Wang et al., 2014). These examinations can also stress instructional faculty (Ryan et al., 2017). These stresses may limit teachers' implementation of different pedagogical approaches or new technologies, impacting their students' overall testing success (Davies & West, 2014). One-way districts and administrators have sought to help teachers balance instruction demands and technology integration is through advancing professional development.

Technology Professional Development

Professional development can effectively present teachers with new and innovative technologies and applications (Ertmer et al., 2012; Hutchison & Woodward, 2018). However, often these initiatives do not meet the demands instructors have for technology integration (Grant et al., 2015). While professional development can provide many great resources, professional development may not assist teachers in integrating and using technology for instruction (Hutchison & Reinking, 2011). Schools may also lack the staff necessary to implement specific technologies or the individuals to support teachers' efforts (Ertmer et al., 2012). Another factor that plays a role in technology integration relates to psychological factors.

Psychological Factors of Technology Integration

The measurement of a teacher's skills, knowledge, thinking, and intelligence is sought to learn more about a teacher's cognitive abilities (Shavelson & Huang, 2003). Cognitive theory is grounded in the principle of sensemaking and how individuals process and apply new information (Choo, 2006; Dervin & Clark, 1987; Esen-Aygun, 2018; Weick, 1995). Sensemaking investigations deal with an individual's identity construction, prior experiences, environments, plausibility, and knowledge gaps (Weick, 1995). An extension of the cognitive framework (Spillane, 2000) is the attempt to understand how a teacher's non-cognitive processes impact their day-to-day practice.

The study of non-cognitive factors, the evaluation of thinking and attitudes, has been applied to many studies relating to instruction (Cheng & Zamarro, 2018; Garcia, 2016; Humphries & Kosse, 2017; Klassen et al., 2018; Valley et al., 2018). Research on non-cognitive variables includes teachers' emotional stability, extraversion, openness to experience, agreeableness, and conscientiousness. Known as the Big Five Personality Traits or The Big Five (Chamorro-Premuzic & Furnham, 2009; Cherry, 2021; Payn et al., 2007; Zhang, 2003), research on these traits among teachers has led to new applications of non-cognitive studies into technology integration relating to a teachers' technology self-efficacy.

Self-efficacy is grounded in the notion of beliefs (Abbitt, 2011; Banoglu et al., 2015). Teacher technology self-efficacy, by extension, is the notion that a teacher believes they can use technology for instruction (Chen, 2010; Fabelico & Afalla, 2020; Kent & Giles, 2018). Levels of technology integration are highly dependent upon a teacher's technology self-efficacy (Joo et al., 2018). Other methods add even more information about non-cognitive decision-making processes relating to passion and perseverance.

Grit is an investigative method that quantifies an individual's levels of perseverance and passion for long-term goals (Duckworth et al., 2009). The application of grit relates to teacher effectiveness regarding retention (Robertson-Kraft & Duckworth, 2014) and student success (Duckworth et al., 2009; Kim & Shin, 2018; Yates et al., 2015), and teacher performance (Alhadabi & Karpinski, 2020). However, the research literature is scarce regarding teacher grit and technology integration compared to technology self-efficacy. Therefore, this study aimed to determine the relationships between teachers' technology integration, technology self-efficacy, and grit. Specifically, does accounting for grit aid in determining teacher levels of technology integration compared to previous methods of evaluating teachers' technology self-efficacy?

Problem Statement

The amount of money spent on public education is in the hundreds of billions of dollars, and school districts are struggling to determine the best use of these funds. One of the most expensive items relates to integrating educational technologies. Research into teacher integration of technology shows a great deal of variability regarding how teachers integrate similar tools across states, districts, and individual schools. Teacher technology self-efficacy may be a predictor of teacher technology integration. Given the impact of teacher technology integration on their students, a question arises as to what additional parameters could impact teacher pedagogical practice. This study investigates the literature regarding technology integration into the curriculum and investigative approaches to understanding barriers to technology integration in P-12 schools. Results presented later in this study illustrate the relationship between grit and teacher levels of technology integration and the relationship between teachers' technology self-efficacy and grit. The findings of this study will add to the literature regarding the application of psychometric investigations into technology integration and the application of grit theory into the field of instructional practice.

Research Questions

The following research questions guided this investigation to address collecting quantitative data and analytical processes:

1. Is there a relationship between teacher grit and the type of technology integration applied by instructors for student work?

2. Is there a relationship between teacher grit and the following characteristics:

   a) subject area

   b) years of instruction

   c) age

   d) gender

   e) level of education

3. What is the effect of self-efficacy on levels of technology integration, after controlling for grit?

4. What is the effect of grit on levels of technology integration, after controlling for self-efficacy?

5. What is the effect of grit on overall technology integration, after controlling for self-efficacy?

Significance to the Field

The findings of this investigation will help determine the viability of grit as a factor in teacher integration of educational technology. Previous studies have found that other non-cognitive measures have already been shown to be predictors of teacher levels of technology integration, such as self-efficacy (Abbitt, 2011). This study will add to the literature on diverse ways to determine potential hurdles to overcome when evaluating technology integration barriers in public P-12 schools. Additionally, the findings of this investigation will provide data to provide additional support to instructors by districts and individual schools.

Studies have shown that grit may not be a permanent non-cognitive trait, and character-building and interventions can address grit (Alan et al., 2019). By determining how grit correlates with technology integration, schools may be able to provide additional support to address grit characteristics. This study adds to the literature in a way that can help administrations better prepare their faculty and improve upon technology investments in their schools.

Research on grit as a variable in education has primarily focused on improving student performance and is limited regarding teacher effectiveness, especially technology integration (Aparicio et al., 2017). Some researchers have scrutinized grit as a domain-based metric and suggested that grit applications within educational settings are limited and unreliable (Credé, et al., 2017). This investigation uses an established predictor variable for technology integration, technology self-efficacy, to determine if grit is a comparable or improved predictor of technology integration.

Methods Overview

There was limited research on grit and technology integration in public P-12 schools; therefore, this study was exploratory. Variables for this study were levels of teacher technology integration, teacher technology self-efficacy, and teacher grit. Additional variables investigated related to other areas of correlation between teacher demographic information and grit, such as subject area, years of instruction, age, gender, and level of education. A quantitative approach was applied to investigate the relationship between variables. A hierarchical linear regression model (HLRM) provided analytical parameters.

Sampling Framework

There are 115 school districts in the state of North Carolina. From all these districts, one rural school district was chosen. Approval was acquired from the district's superintendent to administer surveys across three traditional high schools in the school district. Other schools in the district listed as non-traditional public schools did not meet the requirements for this investigation. This district was representative of a rural school district in North Carolina. Each school that participated in the study had consistent technology policies and access to technology available from the district. There were 200 teachers surveyed for this study.

Grit was considered a predictor variable for technology integration using HLRM. Additional variables, including technology self-efficacy, were added to determine their possible relationship with grit and technology integration. Statistical correlation analyses determined the correlations between other variables and technology integration. Additional analyses determined differences between variables.

Participants

Teachers from 3 high schools in a rural school district in North Carolina during the 2021 - 2022 academic year participated in this study. All teachers are full-time instructional faculty. Teachers who were not considered full-time faculty did not participate, such as substitute teachers or part-time instructional faculty. Teachers responded to an email inviting them to participate in the study.

Data Collection

Data collection occurred in multiple steps. Survey data was collected from each teacher in three high schools in a rural school district in North Carolina. The survey collected gender, age, years of instruction, courses taught, perceived levels of technology integration, technology self-efficacy, and grit data. Data were then analyzed using Exploratory Factor analysis (EFA), Pearson correlation analysis, and the HLRM approach.

Data Analysis

I conducted statistical analysis on the quantitative data gathered from full-time instructors at the district's three traditional high schools. I used SPSS statistical software to analyze the data. To analyze correlations, I used several steps. Correlations were investigated between variables to determine any statistically significant relationships. These relationships were determined based on statistical analysis protocols relating to correlation coefficients and R-squared analysis. Any variable which did not exhibit significant correlations was not significant. I also considered relationships between independent variables to improve any shifts in variability resulting from significant correlation.

In the second step of the analysis, I used HLRM by predicting the level of teacher-perceived technology integration by grit, technology self-efficacy, and additional demographic information. Again, significant changes in R-squared values indicated variables that were correlated with the dependent variable of technology integration. These analyses determined how technology integration may be correlated with self-efficacy, grit, and other variables.

Delimitations

I selected sites for this study based on a sample that would be characteristic of other rural school districts throughout North Carolina. Rural school districts make up most school districts in North Carolina, with 87 of the 115 school districts classified as rural (North Carolina Rural Center, n.d.). Therefore, while this study may inform administrators and school policymakers of the benefits of psychometrics for investigating educational technology implementation, significant consideration should be made before making broad generalizations regarding the findings of this investigation.

This study utilized secondary schools for this investigation to limit any additional variable relating to vastly different ages of students. Considering the differences in pedagogical decisions because of the spectrum of P-12 courses would have added a broader component to this investigation that went beyond the scope of the research questions. Additionally, other non-traditional high schools in the district would have added a level 2 variable to this investigation and required additional factors to the HLRM. Therefore, administrators and policymakers should consider all variables before applying the results of this study to any non-traditional, P-12 public institution.

Lastly, I used HLRM for this investigation to determine how adding grit and self-efficacy to different statical models improved the predictability of each variable on technology integration. Further investigations into the reasons for teachers' differences in technology self-efficacy relating to prior experiences, teacher preparation programs, or technology perspectives would invoke the use of qualitative research protocols. While the research literature could benefit from this qualitative investigation, an established understanding of the relationship between grit, self-efficacy, and technology integration variables must be established. This exploratory investigation was necessary due to the limited applications of grit in technology integration studies in educational settings.

Key Terms

- Cognitive Measures - measurement of an individual's cognitive abilities such as domain-specific knowledge, verbal skills, thinking, or intelligence (Shavelson & Huang, 2003)
- Cognitive framework - sensemaking relating to policy mandates by the interpretation of policy signals, situations, and an individual's prior knowledge and beliefs (Spillane, 2002)
- Grit - A quantitative measurement of perseverance and passion for long-term goals (Duckworth et al., 2007).
- Instructional Technology - Educational use of hardware, software, networks, and online tools (Wells, 2010).
- Non-cognitive measures measure an individual's motivation, personality, attitudes, or beliefs (ACT, 2014; Bandura, 2014).
- Organizational Sensemaking - The methods leaders use when making decisions based upon gaps in their existing cognitive structure (Weick, 1995).
- Psychometrics - the practice of quantifiably determining processes relating to cognitive abilities, personality traits, and social attitudes (Mitchell, 2008)
- Rural - areas that do not lie within an urbanized area (>50,000 people) or urbanized cluster population (>2,500 people) (National Center for Education Statistics (NCES), n.d.)
- Technology Self-efficacy - Teachers' beliefs about the potential to use technology in their instructional practice (Abbitt, 2011; Bandura, 2006).

Summary

Significant investments are being made in public education institutions annually, especially related to educational technologies. These technologies benefit teachers and students, yet many barriers exist to effectively integrating these tools for educators. While there are many investigative tools to mitigate technology integration by instructional staff, these techniques may not be effective because of teachers' non-cognitive traits relating to self-efficacy and grit. Teacher grit impacts teacher job performance and retention, but there is limited information in previous studies regarding the application of grit to technology integration. In the following chapters, I will present a thorough investigation of the research literature, a detailed description of the research methods and results, and a discussion relating to the conclusions of this study and its implications.

CHAPTER 2

LITERATURE REVIEW

Educational researchers have concluded that technology is vital for teaching and learning in P-12 education environments (Chishom et al., 2002; Hutchison & Reinking, 2011, Kent & Giles, 2017). However, students report not feeling satisfied with how their instructors use technology in class and concomitantly express a desire to use more technology in their coursework (Chishom et al., 2002; Kahveci, 2010). Similarly, teachers report not feeling prepared with the skills required to teach students with technology (Dalby & Swan, 2019; Hutchison & Reinking, 2011). The absence of technology use is due in part to the lack of teacher professional development opportunities (Claro et al., 2017; Hutchison & Reinking, 2011), scarcity of access to technology (Delgado et al., 2015; Hutchison & Reinking, 2011; Reinhart & Banister, 2009), shortage of administrative support (Claro et al., 2017; Hutchison & Reinking, 2011; Khlaif, 2018), and low teacher technology self-efficacy (Banoglu et al., 2015; Hutchison & Reinking, 2011; Kent & Giles, 2017; Reinhart & Banister, 2009). To better understand the issues behind these reasons and provide a foundation upon which to frame this study, this chapter summarizes literature relating to teacher use of technology in P-12 schools and frameworks that allow researchers to understand issues relating to technology integration.

This chapter will also review research within the cognitive and non-cognitive research paradigms, examining their tenets and presenting them as an approach to address the teacher integration of technology. Finally, because this study takes place during the COVID-19 pandemic of 2020-2022, I review literature on the impact of history as an internal validity threat to technology integration in educational settings.

Literature Review Methodology

I selected literature for review using Machi and McEvoy's (2016) literature review process protocol. First, I conducted electronic literature searches using EBSCO, JSTOR, Google Scholar, and the University of Kentucky library catalog. Second, full-text articles were accessed based on reviewing abstracts. Third, I surveyed each article and critiqued the methods for each investigation (i.e., participants, instruments, frameworks), their findings, and implications. The top-level search terms were educational technology integration, grit, self-efficacy, and phenomenological events in P-12 education. Additional search terms were cognitive and non-cognitive factors, organizational leadership, technology use, grit, teacher grit, teacher mindset, and technology perceptions. Finally, after reviewing the abstracts of candidate pieces, I selected full-text articles and subjected them to critique their methods, findings, and implications. All selections were stored in the referencing software Mendeley and cataloged by keywords, methods, findings, and population in a spreadsheet using the online spreadsheet application Google Sheets by applicable keywords, methods, findings, and populations.

Chapter Structure

I separated this chapter into the following sections: technology in public P-12 schools (technology impacts on student learning, technology impacts on teacher practice, enhancement of formative assessment, supporting students with learning disabilities, remediation, deeper learning, and digital citizenship), barriers to technology integration (access, experience, policies, professional development, and self-efficacy), noncognitive and cognitive measurement techniques (Weick's theoretical framework, the cognitive frame), and non-cognitive measures (big five personality traits and grit), phenomenological investigations of technology integration, and gaps in the literature. This chapter structure aims to establish the role of technology in instructional practice, the barriers teachers face regarding integrating new technologies, and how researchers investigate new methods and gain insights to improve the techniques used for technology integration in schools.

Technology in Public P-12 Schools

Student and teacher use of educational technology applications and devices has grown immensely in the last fifty years, from calculators in the 1970s and desktop computers in the 1980s (Bigum, 2012) to the personal cell phones and tablets seen in the 21st century (Bigum, 2012; Khlaif, 2018). With the deployment of more computers in society in the late 20th century came the necessity for more computers in P-12 classrooms (Bigum, 2012). As of 2017, the United States invested billions of dollars in educational technologies (Morrison et al., 2019). As a result, over 40% of school districts have reported having one device per student (i.e., 1-to-1 program) (Cavanagh, 2018). In addition, innovative P-12 institutions have greater availability of devices (Bigum, 2012; Khlaif, 2018), which has led to increased financial support for these technologies (Morrison et al., 2019) and new requirements for teachers regarding their use of technology in the classroom.

Wearable technologies (i.e., smartwatches, glasses, and headphones), interactive whiteboards, tablets (Bernstein, 2019), mobile devices (Khlaif, 2018), and advanced web applications (Sadaf et al., 2013) are becoming a requirement for teachers to learn. Within these resources exist many computer applications for teachers to use and learn; keeping up with the use and integration of such tools can be overwhelming (Morrison et al., 2019). Some school systems require teachers to use technology in instruction and assess teachers' performance on their use of technology as a part of their annual performance reviews (Khlaif, 2018). Institutional support for using technologies influences teachers' attitudes (Khlaif, 2018). Many teachers do not have a voice regarding purchasing and allocating new devices in their schools because they are not involved in the decision-making process for new technologies or in leadership positions (Morrison et al., 2019). New technologies purchased by school leadership are based heavily on the potential these devices hold for student learning (Cai et al., 2019; Chou et al., 2012; Rau et al., 2008; Skillen, 2015). In the following section, I explain the impacts of technology on student learning, teacher practice, assessments, individuals with learning disabilities, digital citizenship, and deeper learning.

Technology Impacts on Student Learning

Technology has the potential to improve student engagement, digital literacy, digital citizenship (Chou et al., 2012), collaboration, cognitive processes (Skillen, 2015), achievement (Cai et al., 2019; Chen & Howard, 2010; Shin et al., 2012), and external motivation (Rau et al., 2008). Students have reported an increase in efficiency of learning, diverse opportunities for understanding course content material, preparation for their future, and higher motivation levels when using technology (Li, 2007). In addition, increased cell phone usage by 166 high school graduates in their courses improved collaboration, peer tutoring, assignment submission, educational activities, teacher feedback, and general learning tool application use (Humble-Thaden, 2011). The use of technologies in schools has also resulted in increased quantitative measurements of student learning, such as augmented reality to improve learning mathematics (Cai et al., 2019), gaming to improve students' elementary mathematics skills (Shin et al., 2012) and simulations to improve scientific content knowledge (Chen & Howard, 2010). Based on the research on student learning with technology, instructors have sought to implement technology in their classrooms, resulting in positive impacts on their teaching practices. Improvements in teaching have led to many investigations into how technology has impacted the role of instructional faculty in P-12 institutions.

Technology Impacts on Teacher Practice

Teachers report that technology benefits instruction (Carver, 2016; Grant et al., 2015; Hutchison & Reinking, 2011; Vannatta & Bannister, 2009). In a survey of 1,037 teachers who participated in a technology empowerment program, technology provided teachers with increased student engagement, student excitement, student accelerated learning, and student computer proficiency (Mundy et al., 2012). In a study of nationwide literacy instructors, 1,441 teachers reported technology as beneficial for instruction and a supplemental resource for instructional practice (Hutchison & Reinking, 2011). Instructors report that learning new technologies is essential (Vannatta & Banister, 2009), and instructors have found many different uses for new technologies. Teachers have reported using technology to display documents, present material, perform research, replace in-class materials, tutor students, read, administer tests, write, and enhance their instructional environment (Hutchison & Reinking, 2011). One of the most crucial jobs of an educator when using technology is making sure students are learning content presented in the classroom and can show content mastery using formative assessments (Belson et al., 2013; Dalby & Swann, 2019, Kennedy et al., 2015; Ok & Bryant, 2017; Shin & Bryant, 2017: Townsend 2017).

Enhancement of Formative Assessments

Technology has improved the way educators evaluate student work (Dalby & Swann, 2019; Townsend, 2017). One example of such assessment is the application of tablet hardware, wherein iPads for mathematics instruction allowed for increased assessment and feedback (Dalby & Swann, 2019). In this case, software was adaptive to students' responses, thereby increasing the teachers' instructional capacity to assist diverse student populations (Dalby & Swann, 2019). Online software has also provided teachers and students with mechanisms that allow real-time feedback and increased opportunities for peer-to-peer collaboration (Townsend, 2017). The International Society of Technology in Education (2020) now recommends using technology to make more informed, data-driven decisions. Once teachers better understand student performance, they can begin to address specific student needs, such as students with learning disabilities.

Supporting Students with Learning Disabilities

Technology can address specific instructional practices to remediate students or address learning goals for students with specific learning disabilities (Belson et al., 2013; Kennedy et al., 2015; Ok & Bryant, 2016; Shin & Bryant, 2017). The technologies used to address student-specific learning disabilities include iPads (Ok & Bryant, 2016), interactive computer applications (Shin & Bryant, 2017), podcasts (Kennedy et al., 2015), and digital notetaking technology (Belson et al., 2013). Technology implementation assists in the learning processes for students with mathematics learning disabilities (Ok & Bryant, 2016; Shin & Bryant, 2017), reading disabilities (Kennedy et al., 2015), and writing disabilities (Belson et al., 2013). Examples of gains by students with learning disabilities using technology include gains in vocabulary performance (Kennedy et al., 2015), improved quality of the content (Belson, Hartmann, & Sherman, 2013), improvements in Common Core State Standards for Mathematics (Shin & Bryant, 2017), and the ability to improve recall mathematical operations (Ok & Bryant, 2016). Technology not only provides new instructional options for students with learning disabilities but also for addressing students who require additional instruction in the form of remediation. Remediation is a technique used to address specific areas in students' learning outcomes when they are not meeting necessary course standards (Marino & Beecher, 2010). Technology has provided teachers with a resource to help students deficient in specific subject areas or lack understanding of foundational concepts required to advance their education (Bartow, 2014; Hoyt & Sorensen, 2001; Marion & Beecher, 2010).

Remediation

Many educational topics require teachers to reteach concepts to students, especially in content areas that are strong predictors of college success (Hoyt & Sorensen, 2001). For example, colleges evaluate students' math and English scores (i.e., reading and writing) to determine how successful students may be in college courses and whether students will need remedial courses upon entering college (Hoyt & Sorensen, 2001). Technology has been beneficial in addressing specific student remedial needs and reteaching core concepts (Marino & Beecher, 2010). For example, researchers investigated five teachers in a secondary education setting to determine how social media impacted their teaching practices to engage their students (Bartow, 2014). Teachers who used social media reported that technology helped students push their knowledge beyond the information presented in the classroom (Bartow, 2014). Other potential technologies used for remediation, such as mobile devices (Hwang, Wu, & Ke, 2011), video games (Marino & Beecher, 2010), tablets (O'Malley, Lewis & Donehower, 2013), and wearable technologies have provided unique opportunities to assist teachers in achieving specific learning outcomes for their students. While technologies help address specific learning outcomes, these tools also have the potential to push student learning beyond the typical classroom curriculum.

Deeper Learning

Deeper learning refers to teachers' extension of classroom content to contribute to students' higher levels of creativity and understanding (Alexander et al., 2016). Technology provides many opportunities for deeper learning (Mcleod & Graber, 2018). For example, teachers who apply more profound learning concepts with technology integration can produce students who are collaborative problem-solvers, self-motivated (Martinez & McGrath, 2014), and have a deeper understanding and responsibility for their learning (Turvey, 2006). For example, in an investigation of eight schools, researchers found that teachers who promoted deeper learning with technology collaborated more often, conducted more self-directed work, had more relevant course curricula, and extended learning beyond the school walls (Martinez & McGrath, 2014). While many examples exist of teachers applying deeper-learning principles (Alexander et al., 2016; Martinez & McGrath, 2014), most schools fail to use technologies to transform learning for students and inspire deeper-learning processes (Mcleod & Graber, 2019).

New protocols for deeper learning using technologies in classrooms call for teachers and administrators to investigate authentic student work and agency and personalization and the infusion of technology in classrooms (Mcleod & Graber, 2019). When investigating innovative schools’ use of technology for deeper learning, researchers found technology as a resource instead of a distraction (Martinez & McGrath, 2014). Additionally, teachers and students used various innovative software and hardware programs to collaborate and connect to better track students' development (Martinez & McGrath, 2014). Finally, teachers were active on social media, and there was a healthy understanding of the potential pitfalls of technology and how students could use it effectively for deeper learning (Martinez & McGrath, 2014). Not only can technology inspire deeper learning, but it can also address students' identities when interacting with others online.

Digital Citizenship

There are many different perspectives on adequately teaching students how to conduct themselves online or using digital tools (Jones & Mitchell, 2016). Digital citizens "recognize the rights, responsibilities, and opportunities of living, learning, and working in an interconnected digital world, and they act and model in ways that are safe, legal, and ethical" (International Society of Technology in Education (ISTE), 2016, p.1). Researchers have proposed developing students as strong digital citizens by utilizing social media (Gleason & Gillern, 2018), one-to-one iPad integration (Chou & Jesness, 2012), and bringing your device programs (Nelson, 2012). However, the integration of digital citizenship practices has many barriers due to a lack of access, time, support, knowledge, ability, and motivation (Hutchison & Reinking, 2011; Vannatta & Banister, 2009). In the following discussion, I will present how researchers have investigated these barriers to technology integration.

Barriers to Technology Integration for Instructors

When educators adhere to widely accepted standards for technology integration in P-12 schools, they can encourage students to design, collaborate, and use technology for higher-order thinking processes (ISTE, 2017). However, this type of integration is not pervasive (Delgado et al., 2015; Sawyer, 2017). More typically, teachers use technology for simple applications such as checking email, peer-to-peer communication, display of presentation slides, or assessment of student work (Hutchison & Reinking, 2011). The following sections focus on factors limiting technology use by P-12 instructors, such as access, experience, professional development, and technology self-efficacy.

Access

Technology access has grown tremendously for teachers in P-12 schools (Hutchison & Reinking, 2011) due to additional funding and resources. However, many teachers report not having access to technology tools for instruction, such as laptops and digital projectors for students and teachers (Hutchison & Reinking, 2011). With the lack of access to student devices, some teachers have relied on students' devices to access programs and applications (Sangani, 2013). However, school district protocols may limit the use of personal devices for students while on school grounds (Grant et al., 2015). School internet use protocols also limit many opportunities for teachers to take advantage of specific programs due to concerns about students' inappropriate use (Hutchison & Reinking, 2011). Even if students have access to their devices and programs, many teachers may not feel trained to use these devices or have the experience to use them effectively (Khlaif, 2018). Teacher experience brings about another specific variable requiring special consideration regarding where and how teachers and their students access specific technologies in varying locations.

At-School vs. At-Home vs. Parking Lot. As a result of the 2020 COVID-19 global Coronavirus pandemic, over 93% of children's school instruction was via distance learning in 2020 (McElrath, 2020). In the Fall of 2020, over half of U.S. elementary and high school students continued to attend school virtually (Harris, Ziedan, & Hassig, 2021). Of the 52 million households with children in the United States, 4.4 million households lack consistent computer access, and 3.7 million lack internet access (U.S. Census Bureau, 2020). In a study of 3,258 students from 15 Michigan school districts, researchers found that students who did not have internet access were less likely to express the intention of completing a college or university degree (Hampton et al., 2020). These students also reported a lower range of digital skills, completion of homework assignments, and grade point average (Hampton et al., 2020). Students with cell phones had even more significant gaps in performance than students with internet access due to small screens, access to different features, and reliance on data caps (Fernandez et al., 2020; Hampton et al., 2020). Many large technology companies like Google and Amazon have enacted new laptop loaner programs and mobile wireless hotspots on school buses for students to access the internet in rural communities (Amore, 2020; Romano & Childress; 2020; Johnson, 2020). With a change in students' access to technology and learning environments also comes a shift in how teachers should approach their instructional practice. Researchers have found that providing access to online instruction is insufficient to address equitable educational opportunities for students from all socioeconomic backgrounds (Kaden, 2020). Instructors must continue to be aware of how to diversify their online instructional practice to address barriers regarding students' access to technology and socioeconomic factors.

Socio-economic. A barrier to technology access is its associated costs (Collins et al., 2016; Kurt & Ciftci, 2012). Students from lower socioeconomic levels have less access to technology weekly (Collins et al., 2016). Additionally, children with parents of a higher socioeconomic status utilized the internet differently from students from lower socioeconomic status by accessing fewer social-networking sites and fewer online activities (Collins et al., 2016). Considering that students' socioeconomic status is just one issue affecting technology use in P-12 schools, teachers' socioeconomic status affects integration as well (Kurt & Ciftci, 2012). In an investigation of 60 elementary school teachers and their perspectives on technology integration, teachers reported not having enough money to purchase additional technologies (Kurt & Cliftci, 2012). According to the NC DPI, incoming certified school teachers can expect a starting salary of $35,000 per /year as a starting teacher in a P-12 school in 2020-2021 (North

Carolina Department of Public Instruction, 2021). For a single adult living in North Carolina with no children, the living wage is approximately $30,617 a year (Glasmeier, 2021). Based on this data, investigating the literature regarding teacher and student experience with technology is necessary to better establish a baseline for barriers relating to technology integration.

Teacher Experience

Teacher background and applications of technology for instruction can vary between instructors (Hutchison & Woodward, 2018) based on: teacher preparation programs (Abbitt, 2011), teachers' prior use of technology (Khlaif, 2018), and teachers' personal use of technology (Li, 2007). Enhancing preservice teachers' knowledge level of technology was determined to positively impact teachers' feelings towards integrating new technologies into their courses (Abbitt, 2011). In addition, teachers' previous experiences with tablets impact whether teachers integrated available tablet technologies into their courses (Khlaif, 2018). Lastly, teachers who use technology in their personal lives tend to have positive views on using technology for instruction (Li, 2007). While teachers may have positive views on using technology for instruction, in the next section I discuss how demands to comply with standardized testing policies can limit their ability to integrate new technologies effectively.

Testing Policies

Teachers have reported having limited access to technological tools in their institutions due to the demands of standardized online testing protocols (Wang et al., 2014). Using school technologies for standardized testing takes away from the ability of teachers and students to use them (Ertmer et al., 2012). Additionally, the time required to implement new technologies takes away from teachers' ability to prepare their students for testing (Cifuentes et al., 2011). According to proficient teachers in technology use, standardized testing is a significant barrier to technology integration (Ertmer et al., 2012). One method used to address the perceived barriers to technology associated with integrating technology in the classroom is advancing professional development opportunities for teachers (Ertmer et al., 2012). The following section will discuss professional development to establish how researchers have shown its impacts on technology integration.

Teacher Professional Development

One of the many strategies used to improve technology integration by teachers is by providing them professional development on the use of technology (Ertmer et al., 2012; Hutchison & Woodward, 2018). Hutchison and Woodward (2018) evaluated professional development techniques in their research on how teachers felt about integrating Chromebooks into their classrooms. Hutchison and Woodward (2018) utilized a mixed-method study approach to determine thirty-three teachers' changes in perceptions based on professional development initiatives in their school district. Sustained professional development initiatives improve teachers' confidence when using technology (Hutchison & Woodward, 2018). Researchers also found that one of the most significant reasons for the lack of technology implementation is a lack of professional development (Ertmer et al., 2012). Teachers recognized as quality technology integration instructors credit a large part of their development to quality training and professional development (Ertmer et al., 2012). While professional development has many potential benefits as an effective method to improve integration efforts, opportunities are not always available to teachers.

Grant et al. (2015) investigated how nine teachers used mobile devices for instruction and determined themes relating to professional development regarding teachers' integration. Professional development is rare regarding mobile device integration, and many teachers investigate learning opportunities independently (Grant et at., 2015). Some professional development is insufficient at meeting teachers' technology needs (Grant et al., 2015).

Hutchison and Reinking (2011) surveyed 1,441 literacy teachers across the United States. Teachers reported professional development opportunities as insufficient and not appropriately focused on their integration of technology. Teachers further reported professional development as limited to technology tools only and lacking pedagogical applications (Hutchison & Reinking, 2011). Based on these research findings, there are many benefits to professional development for teachers' technology integration. However, some professional development may not be as effective as other training opportunities, and teachers may have to rely on their background in technology. Therefore, one additional consideration relating to teachers' technology integration is teachers' background with technology and whether they feel confident using technology for instruction.

Teacher Self-efficacy

Technology self-efficacy is one's belief in their perceived potential to use technology (Banoglu et al., 2015). Teacher technology self-efficacy is a teacher's belief in their potential to use technology in their instructional practice (Abbitt, 2011). An investigation of 45 teachers found that knowledge of pedagogical approaches using technology improved teachers' technology self-efficacy (Abbitt, 2011). In the following sections, I will discuss how technology self-efficacy impacts technology integration and how to further evaluate factors that impact technology integration.

Teachers' technology self-efficacy is essential for technology integration (Chen, 2010; Kent & Giles, 2018). Technology self-efficacy impacts teachers' intention to use technology (Joo et al., 2018) and teachers' technology implementation (Kent & Giles, 2018). In a study of 64 preservice teachers, 91% of respondents felt capable of using technology and incorporating technology into their instruction (Kent & Giles, 2018). Researchers have stressed the need for further research into factors impacting technology self-efficacy and integration (Kent & Giles, 2018). One investigative technique to further understand teachers' self-efficacy is grit (Robertson-Kraft & Duckworth, 2014) which can be applied as a predictor of success (Duckworth & Quinn, 2009). Grit provides opportunities for educational researchers to explore non-cognitive measurement techniques and their applications and extensibility in other research fields. Understanding the background surrounding cognitive and non-cognitive techniques within the literature allows for the further development of grit as a measurement technique.

Non-cognitive vs. Cognitive Measurement Techniques

Cognitive skills are those associated with specific conscious abilities, such as thinking, processing, and memorizing information (ACT, 2014). On the other hand, non-cognitive skills require little to no conscious effort, such as motivation, personality, and attitude (ACT, 2014, Bandura, 2012). The applications of cognitive measures to the education literature will be discussed in the following sections, followed by a discussion of non-cognitive measures and the extension of these methods into the notion of grit.

Cognitive Measures

The broad principle of cognitive measures is the measurement of an individual's cognitive abilities, such as domain-specific knowledge, verbal skills, thinking, or intelligence (Shavelson & Huang, 2003). Teachers' cognitive skills impact student performance (Hanushek et al., 2014). For example, researchers found that variations in teachers' cognitive skills directly impacted student performance in 31 countries (Hanushek et al., 2014). Other investigations of teachers' cognitive skills by cognitive measures have investigated the impacts of teachers' incoming grade point average (GPA) on student achievement (Gronqvist & Vlachos, 2016), the ability of teachers to find alternative strategies for individual students' needs (cognitive flexibility) (Esen-Aygun, 2018), and non-verbal reasoning skills (cognitive ability) (Baier et al., 2019). The following section aims to outline the development of cognitive theory and the overall processes governing sensemaking strategies (Weick, 1995). The following section will present several key ideas to discuss cognitive measures. In the first section, I will discuss the framework of organizational sensemaking and its tenets (Weick, 1995). Next, I will use this theory to introduce the application of sensemaking within policy implementation, known as the cognitive framework (Spillane et al., 2002). Finally, I will compare sensemaking and the cognitive framework and their differences. From this comparison, I will highlight the need for investigating technology implementation using a non-cognitive measures approach.

Weick's Theoretical Framework of Organizational Sensemaking. Weick (1995) established a framework for organizational sensemaking. According to organizational sensemaking theory, leaders make sense of new situations based on a gap in their existing cognitive structure (Choo, 2006; Dervin & Clark, 1987; Weick, 1995). Therefore, it is crucial to identify how organizational members and leaders make sense of new information as it could affect organizational structure, goals, and future endeavors (Choo, 2006). Furthermore, Weick (1995) postulated that sensemaking results from the interchanging of belief-driven and action-driven processes. Therefore, it is essential to identify how beliefs and actions develop to obtain collective action (Weick, 1995). There are seven fundamental principles relating to organizational sensemaking: Identity construction, retrospective, enactive of sensible environments, social, ongoing, extracted by cues, driven by plausibility, and gaps in knowledge

(Weick, 1995). These principles result from constant processes of social interactions, bounded by life experiences and moments of meaning (Choo, 2006).

Identity construction. Individuals base their notions of self, based on how others see them (Weick, 1995). When evaluating individual sensemaking in organizations, researchers investigate the balance of a myriad of selves. "The sensemaker is himself or herself an ongoing puzzle undergoing continual redefinition, coincident with presenting some self to others and trying to decide which self is appropriate" (Weik, 1995, p. 20). The impact of self-identification on sensemaking develops based on how individuals interpret situations and how those interpretations impact their sense of self-worth.

Retrospective**.** Sensemaking occurs only after a situation or decision has been presented (Weick, 1995). Individuals make sense by reflecting on their prior experiences and applying them to new situations (Weick, 1995). When making decisions in organizations, individuals work to reflectively determine how new approaches fit within the history and structure of the organization (Weick, 1995). The retrospective process occurs until a feeling of satisfaction is achieved based on prior experiences (Weick, 1995).

Enactive of Sensible Environments, Social, and Ongoing**.** When individuals decide or make decisions, they place constraints on themselves by enactment (Weick, 1995). Through enactment, individuals establish the environments they will face and work in (Weick, 1995). The decision to act is not independent of social constructs (Weick, 1995). Sensemaking is contingent upon the conduct of others (Weick, 1995). The action process within social constructs never begins but is always in the process of continual flow between new information and reflection on the past (Weick, 1995).

Extracted by Cues and Driven by Plausibility. To make sense of new information, individuals utilize their existing knowledge base. Connections involve using cues. Cues are "seeds from which people develop a larger sense of what may be occurring" (Weick, 1995, p. 50). Based on extracted cues, there must be a sense of plausibility when establishing how to proceed. Plausibility, rather than accuracy, drive people to action (Weick, 1995). Individuals need enough information to move forward, and while accuracy is ideal, it does not dictate sensemaking (Weick, 1995).

Gaps in knowledge. Three central questions illuminate the sensemaking process relating to how organizations overcome their knowledge gap, "What in your situation is stopping you? What confusion do you have? What kind of help do you hope to get" (Dervin & Clark, 1987, p. 25). Comparing the works of Dervin and Clark (1987) and Weick (1995) led to new insights into organizational sensemaking (Choo, 2006), as well as methods for evaluating how individuals in organizations make decisions, which will be discussed in the following section.

***Methodological Approaches to Organizational Sensemaking*.** Weick's (1995) work has applied to many research studies on sensemaking (Anuar, 2013; Barrera, 2013, Carraway & Young, 2015; Coburn, 2005; DeMatthews, 2012; Evans, 2007; Ikemoto, 2007; Ingle, et al., 2011; Janger, 2006; Schubart, 2021; Spillane, 1997; Spillane, 2000; Weick et al., 2005). Investigations of organizational sensemaking have uncovered how organizations establish collective sensemaking for meeting organizational goals. The methods of investigating organizational sensemaking include observations, interviews, and artifacts to indicate sensemaking (Janger, 2006; Weicks, 1995). These methodological approaches have been utilized in many instances to determine elements of organizational sensemaking within the organizational literature.

A study investigating the restructuring of the Danish toy company, Lego, addressed how middle managers make sense of new change initiatives (Lüscher & Lewis, 2008). The researchers used focus groups to ascertain perceptions of frustration within middle managers about change initiatives. More recent studies have utilized field interviews to understand the sensemaking of agencies responsible for producing offshore hydrocarbons (Busby & Collins, 2014). According to the findings of Busby and Collins (2014), individuals within organizations make inferences regarding risk assessment based on their prior experiences and knowledge. Within the decision-making process is the difference between collective and individual sensemaking.

Collective and Individual Sensemaking. When organizational leaders experience a gap in their understanding, they must attempt to make sense of new information and its fit within their current knowledge (Choo, 2006; Dervin & Clark, 1987; Weick, 1995). Members of an organization have different approaches for interpreting external stimuli, impacting how organizations function (Choo, 2006). Collective sensemaking results from individual and organizational members sharing their beliefs for collective action (Weick, 1995). In a similar approach, Spillane et al. (2002) describe individual sensemaking as "the active attempt to bring one's past organization of knowledge and beliefs to bear in the construction of meaning from present stimuli" (p. 394). The following section will highlight the application of sensemaking into the cognitive framework regarding policy implementation decisions (Spillane et al., 2002).

The Cognitive Frame. The Cognitive Frame is an investigative approach exploring how educational programs impact educator responses (Spillane, 2000). The cognitive framework establishes how to identify and understand how implementation agents shape their knowledge developed during the implementation process of new education policies (Spillane, 2002).

Spillane (2000) developed the cognitive framework by drawing upon empirical and theoretical works in sensemaking and cognition to establish an investigative protocol to research policy implementation. The following section will outline the background of this framework and how researchers have applied this framework in educational organizations.

Individual people make cognitive connections through the process of schemas (Spillane et al., 2002). Schemas allow individuals to use previous knowledge to make inferences about what is only partially understood and fill in gaps in existing knowledge (Spillane et al., 2002). The cognitive frame establishes stages or components of individual cognition, situated cognition, and the role of representatives (Spillane et al., 2002). Individual cognition relates to personal beliefs, experiences, emotions, and how individuals make sense of external data (Spillane et al., 2002). Situated cognition addresses the mindset that individual settings have more to do with the sensemaking process than providing context (Spillane et al., 2002). The role of representatives is to determine methods of promoting effective stimuli for enhancing the sensemaking process of individuals (Spillane et al., 2002). Regarding policy, representatives play a crucial role in crafting policies to promote the desired implementation approach by policy implementers (Spillane et al., 2002).

When considering new education reform efforts, a new approach was required to determine implementation problems and how implementation agents developed their knowledge during implementation (Spillane et al., 2002). As a result, Spillane et al. (2002) developed a theoretical framework that drew upon empirical and theoretical works in sensemaking and cognition to establish an investigative protocol to research policy implementation known as cognitive sensemaking.

Cognitive sensemaking. The cognitive sensemaking framework comprises three elements: an individual's prior knowledge and beliefs, situations requiring sensemaking, and signals that affect sensemaking relating to policy mandates (Spillane et al., 2002). An individual's prior knowledge and beliefs may cause them to fit incoming information into their framework, leading to individuals supplementing their existing knowledge instead of supplanting it (Spillane et al., 2002). Sensemaking resulting from situational factors has much more to do with the individuals within an organization and their impact on developing a collaborative understanding of new information (Spillane et al., 2002). When considering policy signals (i.e., interpretations of policy), individuals as implementers and policy designers for organizational policies must consider interpretations of policy within all levels of the organizational structure (Spillane et al., 2002). On an individual implementation basis, the more fundamental the changes required, the more individuals will have to alter their existing cognitive schema to understand new ideas (Spillane et al., 2002b).

The cognitive sensemaking framework approach applies to many policy implementation studies (Coburn, 2005; Evans, 2007; Honig & Coburn, 2007; Ingle et al., 2011; Janger, 2006; Rigby, 2015; Seashore Louis & Robinson, 2012; Schubart, 2021). For example, when investigating the cognitive sensemaking framework of mathematics reforms, researchers utilized interview data to uncover policy implementers' prior knowledge and beliefs, social interactions, and interpretations of policy signals (Spillane, 2000). Investigations into reading policy implementation also applied the cognitive framework to uncover principals' prior knowledge base and impacts on policy interpretation (Coburn, 2005). In addition, principals' social interactions with teachers played a significant role in how principals buffered policy messages for their faculty (Coburn, 2005). Finally, the cognitive sensemaking framework was applied to investigate school implementation of district policy for principals' leadership protocols and utilized a methodology of observations, documents, and interviews (Carraway & Young, 2015). The difference between Weick (1995) and (Spillane et al., 2002) is the collective sensemaking process and group-oriented practices.

Spillane et al. (20002) focuses more on individual beliefs and experiences as it impacts individual leaders' policy implementation, while Weick (1995) highlights the importance of collective agreement and explanations of organizational decision-making for organizational action. The difference between everyday sensemaking and organizational sensemaking is collective beliefs and knowledge. Organizational structure inhibits the availability of external stimuli, resulting in an organization being less capable of processing new information based on experiences with their external environment (Weick, 1995). To understand individual cognitive processes, we must understand situational social interactions (Spillane et al., 2002).

Sensemaking Resulting from Social Interactions. Situational cognitive sensemaking involves focusing on the situational social interactions between individuals (Spillane et al., 2002). Undoubtedly, social interactions occur within organizational sensemaking. Organizational leaders' management of these interactions creates uniformity and collective sensemaking (Weick, 1995). Organizations have sub-level interactions resulting in overlapping social interactions (Choo, 2006; Weick, 1995). For example, social interactions between different social subgroups of teachers impacted policy implementation (Cohen, Spillane, Jennings, & Grant, 1998). Maitlis (2005) conducted a longitudinal study that determined four distinct components of guided, fragmented, restricted, and minimal social interactions within organizational structures. Understanding the importance of social interactions within the cognitive sensemaking process is foundational for organizational success and policy implementation within educational institutions (Spillane et al., 2002). Organizational sensemaking attempts to identify ways to regulate and support effective social sensemaking processes. The cognitive framework isolates individual policy sensemaking (Spillane et al., 2002).

Sensemaking from Policy Signals. Policy signals have a great deal of impact on policy interpretation and implementation (Spillane et al., 2002). For example, individual implementing agents may often interpret or focus on specific policy messages while not considering others (Spillane et al., 2002). Additionally, implemented policies may only work within limited contexts. For example, implementing agents may assume notions of a policy that only require surface-level changes to satisfy the policies' mandates and be unaware of who is holding them accountable (Spillane et al., 2002). The comparative approach to policy signals within organizational sensemaking is the notion of cues.

Extracted cues are developed based upon thoughts and ideas that previously existed; they are "simple, familiar structures that are seeds from which people develop a larger sense of what may be occurring" (Weick, 1995, p. 50). Like the notion of extracted cues is the concept of noticing. Starbuck and Milliken (1988) describe noticing is a process of determining meaning through existing structures. Noticing involves "people classifying stimuli by comparing them to other immediately available stimuli or standards for their experiences and expectations" (Starbuck & Milliken, 1988, p. 8). When evaluating the comparison of policy signals, cues, and the principle of noticing, the cognitive framework attempts to apply the notion of extracted cues into the policy arena. Organizational sensemaking and the cognitive framework regarding cues and policy signals differ in their application. The general principles of cues and policy signals relate to how individuals and organizations interpret external stimuli within their existing presumptions and filter information relevant to their current understanding. Understanding motivation, effort, and self-efficacy extend the work of sensemaking and the cognitive framework by attempting to understand existing non-cognitive abilities within individuals. Our journey to this point has been to outline the work of cognitive theory to establish the importance of understanding how individuals make sense of policies. To dig deeper into decision-making in education and educators' internal biases and passions, researchers must investigate non-cognitive measuring techniques. This section aims to determine the necessity of utilizing a non-cognitive measuring method to address technology integration gaps in P-12 schools.

Non-Cognitive Measures

Non-cognitive are skills related to creativity, thinking, persistence, social skills, and problem-solving (Garcia, 2016). Non-cognitive skills can have a significant impact on factors relating to cognitive development and learning (Humphries & Kosse, 2017), academic success (Valley, Camp, & Grawe, 2018), and practical instruction (Cheng & Zamarro, 2018; Klassen et al., 2018). Unfortunately, cognitive measurement techniques can often overshadow non-cognitive factors (Carneiro, Crawford, and Goodman, 2007). Non-cognitive skills have been investigated more in the educational research space due to works relating to the Big Five personality traits, self-efficacy, and grit. The following section will discuss the tools to investigate non-cognitive skills in educational research and the possible application of these investigative tools for technology integration.

Big Five Personality Traits. The Big Five personality traits are emotional stability, extraversion, openness to experience, agreeableness, and conscientiousness (Zhang, 2003). Emotional stability is having feelings of pessimism, guilt, and low values of self-esteem (Zhang, 2003). The characteristic of extraversion is being outgoing or an extrovert (Chamorro-Premuzic & Furnham, 2009). For example, individuals high in extraversion tend to be more assertive, expressive, and like to be sociable (Cherry, 2021; Payne, Youngcourt, & Beaubien, 2007). Openness is a trait associated with creativity, imagination, and a willingness to try alternative approaches (Zhang, 2003). Individuals with high attributes of agreeableness tend to be helpful and concerned with cultural empathy (Li et al., 2016). Those with low characteristics of conscientiousness lack self-discipline, achievement, order, and self-control (Costa Jr. & McCrae, 1998). The Big Five personality model applies to many research areas in educational research in technology integration.

The Big Five was used to investigate eighty-five pre-service music instructors and their motivation for computer-assisted instruction (CAI) (Perkmen & Cevik, 2021). They determined that openness and extroversion significantly contributed to teachers' motivation to use CAI (Perkmen & Cevik, 2010). When investigating the personality traits of four hundred twenty-five elementary, middle, and high school teachers and their willingness to use tablet computers, openness, and extraversion positively affected teachers' feelings about utilizing tablet computers (Camadan et al., 2018). An investigation of one hundred sixty-eight primary school teachers determined how big-five personality traits impacted teachers' self-efficacy (Djigić et al., 2014). The big-five personalities of conscientiousness and openness were predictors of teachers' self-efficacy (Djigic et al., 2014). Teacher self-efficacy has also been shown to have a relationship with technology integration (Chen, 2010).

Technology self-efficacy significantly impacts teacher technology integration (Chen, 2010; Kent & Giles, 2018). Furthermore, self-efficacy is closely related to teachers' feelings of their ability to persist when faced with complex tasks, or grit (Fabelico & Afalla, 2020). This relationship between self-efficacy and grit has generated a new potential area of research into technology integration in K-12 schools. The following section outlines the foundations of grit and its potential use as a research protocol for investigating technology integration.

Grit. Grit is the perseverance and drive an individual has to complete long-term tasks, even when faced with challenges and difficulties (Duckworth & Quinn, 2009). The measurement of individual grit involves self-identification of one's ability to persevere when faced with complex tasks (Duckworth & Quinn, 2009). Investigations on teacher effectiveness have used grit as an investigative technique (Duckworth et al., 2009; Kim & Shin, 20018; Robertson-Kraft & Duckworth, 2014; Yates et al., 2015). Investigators used grit to determine student academic success rates and teacher grit (Duckworth et al., 2009). In a longitudinal study of three hundred and ninety novice teachers, grit and life satisfaction were positive predictors of student academic success (Duckworth et al., 2009). Grit was also a factor in teacher retention (Robertson-Kraft & Duckworth, 2014). In an investigation of four hundred ninety-one novice teachers, teachers with lower grit scores were likelier to leave during the middle of the school year (Robertson-Kraft & Duckworth, 2014). In addition, teachers with more grit outperformed their less gritty colleagues (Robertson-Kraft & Duckworth, 2014). While grit applies to many investigations of teacher effectiveness, it has come under scrutiny regarding its predictability of success and appropriateness compared to other alternative measurements, such as self-efficacy.

While many studies have used grit to showcase its positive correlation with success (Alhadabi & Karpinski, 2020), many argue that these studies do not consider domain-specific parameters (Credé et al., 2017). Some have argued for a more robust evaluation of grit and not to overemphasize grit's value when determining educational policies and practices (Peterson, 2015). Variables such as unequal access to resources, socioeconomic status, and physical and emotional disabilities may cause individuals to be overlooked based on their grit scores (Kundu, 2014).

Self-efficacy has been determined as a more appropriate determinant of success when compared to grit regarding student success (Usher et al., 2013). In an investigation of two thousand three hundred-four elementary-aged students, grit was not the sole determinant of students' success. Other factors relating to student's perceived ability to complete the work were also necessary to predict success (i.e., self-efficacy) (Usher et al., 2013). Therefore, self-efficacy may be a better metric for determining future success (Usher et al., 2013). Self-efficacy and grit, together, contribute to university students' achievement (Alhadabi & Karpinski, 2020). Based upon the scrutiny of grit and its benefits as a metric of teacher success, the research results proposed here will help address whether grit is an effective technique for determining teachers' technology integration. Another potential variable impacting technology integration in P-12 schools is the effect of the COVID-19 pandemic. In the following section, I will present phenomenological studies of technology integration and how significant events such as the SARS pandemic and Hurricane Katrina impacted teacher use of technology.

Phenomenological Investigations of Technology Integration

The term *phenomenological* refers to studying a phenomenon or event, and its impact on participants lived experiences during the event (Cresswell, 2009; Fox, 2004; Hash, 2021; Ward et al., 2008). The COVID-19 pandemic provided unprecedented technology use in P-12 schools (Hash, 2021; Mailizar et al., 2020; Thomas et al., 2021). The rapid school closures left millions of students having to use online technological resources for learning and requiring teachers to utilize resources they previously may not have been familiar with (Almatnhari et al., 2020; Mailizar et al., 2020). The rapid use of e-learning tools was unobserved in the history of public education (Hash, 2021). Such rapid use left many instructors with little or no preparation for adjusting to this new atmosphere of online learning (Hash, 2021; Norgaard et al., 2021; Thomas et al., 2021). Understanding how specific phenomena impact technology integration in P-12 is necessary to establish a framework for how the COVD-19 pandemic could impact teacher practice. The following section will present teacher use of technology investigations, specifically during the 2003 severe acute respiratory syndrome (SARS) pandemic, the 2005 Hurricane Katrina event, and the current research on the 2020 COVID-19 pandemic.

The 2003 SARS pandemic resulted in the closure of 1302 schools in China, leading to 1,000,000 children learning from home virtually (Fox, 2004). The 2005 Hurricane Katrina event left 80,000 students displaced in the state of Mississippi (Ward et al., 2008). Finally, the 2020 COVID-19 global pandemic led to the closure of 85% of schools in 173 countries (Hu et al., 2020). While most schools have reopened after the 2020 COVID-19 Pandemic, variants of the virus still lead to partial closures of schools globally. The following is a breakdown of the investigations into these different events.

In an investigation of 8 teachers' experiences during the SARS pandemic, teachers felt underprepared to utilize technology properly as their primary tool for instruction (Fox, 2004). Teachers also reported concern about the quality of their instruction and the time required to develop online instructional resources for students affected by Hurricane Katrina (Omar, et al., 2007). Before teaching online during the COVID-19 pandemic, a nationwide survey of K-12 teachers found many concerns relating to teachers' ability to teach online (Trust & Whalen, 2020. These concerns included: a shortage of quality internet connection for instruction and student participation, a lack of knowledge of tools and resources, and effective teaching strategies (Trust & Whalen, 2020). Despite all the concerns and limitations expressed by educators before these large-scale events, researchers found many positive reports of utilizing technology for instruction during these events (Fox, 2004), as discussed in the following section.

During large-scale events requiring remote learning, teachers reported a shift in their instruction from being more teacher-centered to a more student-centered space (Fox, 2004). Additionally, online learning was used to recruit and retain students and improve the quality of education (Omar et al., 2007). Because of the implementation of technologies during the SARS pandemic, teachers could cover more information to help students in their developmental processes (Fox, 2004). As teachers shifted to an online platform, there were higher levels of accomplishment (Sokal et al., 2020). While these findings may illustrate the benefit of utilizing technology during emergencies, investigations into post-disaster perceptions of utilizing technology for instruction are less favorable.

The support available in schools impacted teachers' motivations to use technology after the pandemic (Fox, 2004). In a study of 1,626 Canadian P-12 educators, teachers reported high levels of burnout during the COVID-19 pandemic, which directly correlated to their attitudes toward the benefits of online instruction (Sokal et al., 2020). Similarly, online instruction impacted teachers' satisfaction with online instruction after Hurricane Katrina (Omar et al., 2007) and time management (Fox, 2004). Based on these studies, while teachers may see many positive results of technology integration, many variables still impact their motivation to implement it. While technology may undergo 100% implementation during times of crisis, this may not be enough for full-scale implementation efforts post-crisis. The full-scale implementation of technologies may not solve specific issues relating to teachers' motivations to implement technology. Therefore, further research is necessary, specifically relating to non-cognitive metrics, on how teachers integrate technology after the COVID-19 pandemic.

Gaps in the Literature

The current use of grit for the determination for technology integration within the educational leadership literature is limited. Given the many articles reporting comparisons of self-efficacy and grit, and because self-efficacy is the preferred method for technology integration investigations, it seemed prudent to conduct this investigation. This investigation adds to the existing academic research on educational technology integration in P-12 schools.

Summary, Implications, and Discussion

The review of the literature produced articles that illustrated the vast benefits of technology integration in P-12 schools—these benefits related to student learning, teacher practice, enhanced assessment, and deeper learning. While significant investments are currently being applied at the federal, state, and district levels to enhance these benefits for students, teachers still have many barriers such as access, socioeconomic impacts, preparation, professional development, support, and motivations. Researchers have applied investigations into teachers' self-efficacy relating to technology to understand these barriers better, showing that teachers with lower levels of self-efficacy report lower levels of technology use. Additionally, other characteristics relating to the instructor's personality traits of openness could potentially impact technology integration. Furthermore, new investigative methods of non-cognitive factors relating to teachers' perseverance when faced with complex tasks have presented a framework to understand how teachers' grit may impact their perspectives on technology integration. Finally, due to the 2020 global COVID-19 pandemic, teachers have experienced rapid technology integration efforts. However, without understanding specifics around non-cognitive parameters for teachers’ technology integration in their instruction, schools may continue to have diverse technology integration spaces, which could have drastic implications relating to equitable education opportunities for students in P-12 schools.

CHAPTER 3

METHODS

This chapter establishes the setting and research protocols of the study. The first part of this chapter will highlight the problems and questions this study addresses. Next, I present relevant literature related to the theoretical framework used for this investigation and the framework used for sampling, data collection, analysis, and reasoning for specific research approaches. Lastly, I discuss the limitations of the study.

Problems Addressed by this Study

The level of technology used in P-12 schools has increased exponentially since the late 1900s, with over 40% of public schools in the US having one device per student (Bigum, 2012) and billions of dollars invested in technologies for public schools (Morrison et al., 2019). The increase in technology use has led to positive impacts on student learning and teacher practice, such as enhanced assessment (Dalby & Swann, 2019; Townsend, 2017), supporting students with learning disabilities (Belson et al., 2013; Kennedy et al., 2015; Ok & Bryant, 2016; Shin & Bryant, 2017), remediation (Bartow, 2014; Hoyt & Sorensen, 2001; Hwang et al., 2011; Marino & Beecher, 2010; O'malley et al., 2013), deeper learning (Martinez & McGrath, 2014; McLeod & Graber, 2019), and digital citizenship (Chow & Jesness, 2012; Gleason & Gillern, 2018; Nelson, 2012). However, instructors' barriers to effective technology use have raised questions about how educators might better address school technology integration (Hampton et al., 2020; Hutchison & Reinking, 2011; Kaden, 2020; Khlaif, 2018). While districts have provided financial support to address cognitive metrics (Noonoo, 2018), such as teacher content knowledge (McCandless, 2015), research surrounding non-cognitive approaches is still emerging (Camadan et al., 2018; Cheng & Zamarro, 2018; Fabelico & Afalla, 2020; Kent & Giles, 2018;

Klassen et al., 2018; Perkman & Cevik, 2021). Authors examining grit as a non-cognitive factor have explored it as a tool for understanding how individuals face adversity and persevere (Duckworth et al., 2009; Kim & Shin, 20018; Robertson-Kraft & Duckworth, 2014; Yates et al., 2015). At the time of this study, grit has been applied minimally in the field of technology integration in P-12 schools, providing possible new approaches to assessing non-cognitive impacts in educational settings. This research will add to the academic conversation found in other fields regarding the application of grit as a suitable investigative technique in educational settings.

Research Questions

Five research questions drive this research:

1. Is there a relationship between teacher grit and the type of technology integration applied by instructors for student work?

2. Is there a relationship between teacher grit and the following characteristics:

a) subject area

b) years of instruction

c) age

d) gender

e) level of education

3. What is the effect of self-efficacy on levels of technology integration, after controlling for grit?

4. What is the effect of grit on levels of technology integration, after controlling for self-efficacy?

5. What is the effect of grit on overall technology integration, after controlling for self-efficacy?

Hypotheses

The following hypotheses drive this investigation:

H.1) There is a positive relationship between teacher grit and the level of technology integration applied by instructors for student work.

H.2) There is a positive relationship between grit, subject area, years of instruction, age, gender, and levels of education.

H.3) There is a positive relationship between self-efficacy and the level technology integration, after controlling grit.

H.4) There is a positive relationship between grit and the level of technology integration, after controlling for self-efficacy.

H.5) There is a positive relationship between grit and overall technology integration, after controlling for self-efficacy.

Research Design

The design of this research investigation was to determine variables that may correlate with teachers' perceived levels of technology integration. This study focuses on non-cognitive predictor variables of grit and technology self-efficacy, and variables of gender, years of instruction, and types of courses taught. Before describing the specific methods surrounding this investigation, I discuss the foundational works and theories which frame the methodology used to address the research questions. This is important to do because:

1. Methods should be grounded in appropriate philosophical perspectives supported in the research literature (Cresswell, 2009).

2. Supporting methods should be designed and implemented in the context of previous studies with sample sets and criteria supported with accurate and reliable statistical analyses (Singh, 2006).

3. Findings utilizing the methods in previous investigations of teacher grit, self-efficacy, and technology integration should be known to establish comparison analyses of the results from this study (Hutchison & Woodward, 2018).

The following sections will discuss methodological philosophy, instrument validity and reliability, and findings from previous investigations determining grit, self-efficacy, and level of instructional technology integration.

Philosophy of Research

Grit. Foundational research conducted on the topic of grit are found in psychology where initial inquiries examined how and why individuals with similar intellectual abilities outperform others (James, 1907). For example, James (1907) refers to the “power of the will” (p. 322) or an individual’s “second wind” (p. 326) when discussing why people do or do not refrain from moving forward when faced with “fatigue” (p. 323). Grit itself is not a new concept; psychologists have been looking at the zeal of successful business owners (Galton, 1892), the characteristics of geniuses (Webb, 1915), and the backgrounds of leaders (Cox, 1926) for decades. These forerunners of grit-related theory established four foundational criteria:

- evidence of psychometric soundness
- face validity for adolescents and adults pursuing goals in a variety of domains (e.g., not just work or school)
- low likelihood of ceiling effects in high-achieving populations,

- and most importantly, a precise fit with the grit construct" (Duckworth, et al., 2007, p. 1089).

From this foundational work, developed a method for determining what researchers refer to as grit, a metric of persistence and interest in completing long-term goals (Duckworth et al., 2007)

The measure of grit, or the grit scale (Duckworth et al., 2007), is a 12-item questionnaire intended to measure an individual's consistency of interest and perseverance of effort. The validity coefficient of the grit scale was reported as having values greater than 0.25 in studies reported by Duckworth et al. (2007). The reliability of the grit scale is well investigated, with Chronbach's alpha values reported as greater then .70 according to Duckworth et al., (2007). The grit scale has been applied to other studies of grit and its relationship to other variables as well (Aparicio, Bacao, & Oliveeira, 2017; Bazelais, Lemay, & Doleck 2016; Chang, 2014; Ivcevic & Brackett, 2014; Reed, 2014; Robertson-Kraft & Duckworth, 2014; Strayhorn, 2014).

Self-Efficacy. Investigations of self-efficacy determine individuals' belief in their ability to complete given tasks (Bandura, 1977). Measurements of self-efficacy are rooted in an individual's beliefs (Bandura, 1977). These beliefs relate to whether people can meet a certain level of completeness (Bandura, 1977; Kent & Giles, 2017). According to Bandura (1977), the more robust an individual's self-efficacy, the more active their efforts are in the face of adverse or difficult situations.

Levels of efficacy expectation break down into four significant influences: Performance accomplishment, vicarious experiences, verbal persuasion, and emotional arousal (Bandura, 1977). Performance accomplishments relate to how well an individual has completed a task in the past (Bandura, 1977). Vicarious experience results from seeing others complete a task with success and the belief that if someone can complete a given task, then we can as well (Bandura, 1977). Verbal persuasion increases efficacy levels due to persuasion by an outside entity; this method typically results in lower efficacy values and short-lived levels (Bandura, 1977). Finally, emotional arousal is a rise in perceived levels of efficacy due to physiological arousal (Bandura, 1977). The work of Bandura (1977) has led to many studies on self-efficacy and attempting to determine an individual's beliefs. One of the more common investigation methods for establishing self-efficacy in education spaces is the Ohio School Teacher Efficacy Scale (OSTES).

The OSTES is a 9-point Likert scale self-efficacy survey administered to teachers to establish teachers' beliefs. The OSTES survey reported high validity coefficient values greater than .30 and reliability values greater than 0.90. Questions on the survey relate to "How Much can you" or "to what extent can you" type questions (Tschannen-Moran & Woolfolk, 2001). The OSTES survey has been utilized in many investigations of Teacher self-efficacy, relating to support, preparation quality, student teaching (Knobloch & Whitting, 2002), career commitment (Knobloch & Whitting, 2003), and student achievement (Tschannen-Moran & Barr, 2004). An adapted version of the OSTES will be used in this investigation to determine self-efficacy levels relating to technology integration. I will determine the possible relationship of predictor variables of grit and self-efficacy and their relationship to levels of perceptions of technology integration. The following section will outline the philosophy of levels of technology integration and the methods used to measure levels of technology integration

Instructional Technology Integration. The methods used to determine the perceptions of technology integration levels are vital because technology integration used to improve student learning is essential to an educators' work (McLeod & Richardson, 2013). Previous methods for determining perceptions of technology integration by instructors involved the teacher technology integration survey (TTIS) (Reinhart & Banister, 2009), technology questionnaires (Almekhlafi & Almeqdadi, 2010), the technology integration standards configuration matrix (TISCM) (Mills & Tincher, 2003), levels of technology implementation (LoTi) (Barro et al. 2003), technology uses and perceptions survey (TUPS) (Sawyer, 2017), and surveys of teachers' perceptions of integrating information and communicative technologies (ICTs) (Hutchison & Reinking, 2011). For example, the survey developed by Hutchison and Reinking (2011) consisted of 69 Likert scale items that addressed teachers' perceptions of technology integration. The items on the survey ranged from perceptions of the extent of technology use, importance, obstacles, and stance (Hutchison & Reinking, 2011). Due to its high validity coefficients (i.e. correlation) (greater than 0.82) and high-reliability measurements (greater than .30).]. Portions of the Hutchison & Reinking (2011) survey were used in this study to determine teachers' level of technology integration.

Different analytical methods are used to analyze data for grit, self-efficacy, and technology integration. I next present those techniques.

Analytical Approaches

Several different analytical techniques investigate grit and self-efficacy and their relationship, among other variables. Tables 1.1 and 1.2 showcase studies involving grit, self-efficacy, and their relationships amongst other variables, significant findings, and analysis protocols. The method of HLRM was selected for this study and is discussed in the following section.

Table 1

Grit Investigations, Relationships, Findings, and Analysis Protocols

Source	Comparison Variable(s)	Findings	Analysis Protocol	Cronbach's Alpha Score
Aparicio et al. (2017)	Grit and e-learning success	Grit had a positive effect on e-learning success.	Structural equation modeling, partial least squares, construct and indicator reliability, convergent and divergent validity, Interconstruct correlations and square root of average variance extracted.	$\alpha > .70$
Duckworth, Peterson, Matthews, & Kelly (2007)	Grit, education, age, GPA, SAT scores, education completion, spelling bee competition	Achievement is achieved through sustained application of talent.	Binary logistic regression modeling, ordinal regression models, internal reliability coefficients, odds ratio, median split, incremental predictive validity, two-way analysis of variance, confirmatory factor analysis, exploratory factor analysis.	$\alpha = .83$
Ivcevic & Brackett (2014)	Grit, school success, conscientiousness, and emotion regulation ability	Grit did not show incremental validity when compared to conscientiousness and emotion regulation ability	HLRM	$\alpha = .72$
Reed (2014)	Grit and exercise behavior	Grit predictive capabilities for exercise scores.	HLRM, one-way ANOVA.	N/A
Robertson-Kraft & Duckworth (2014)	Grit, teacher retention and success.	Grittier teachers outperform less gritty colleagues and were less likely to leave.	Independent sample t-tests and binary logistic regression models.	N/A
Usher et al. (2013)	Grit, self-efficacy, and teacher outcomes.	Grit was not found to be necessary as a mediator of self-efficacy's relationship to outcomes.	Structural equation modeling, Comparative fit index, root mean square error of approximation, standardized root mean square residual, measurement of variance tests, independent sample t-tests, multi-variate analysis, means, standard deviation, latent bivariate correlations.	$.90 > \alpha > .80$

Table 2

Self-efficacy Investigations, Relationships, Findings, and Analysis Protocols

Source	Comparison Variable(s)	Findings	Analysis Protocol	Cronbach's Alpha Score
Abbitt (2011)	Teacher self-efficacy and technological pedagogical content knowledge (TPACK)	A dynamic relationship exists between TPACK domains and teachers' technology self-efficacy.	Multiple regression analysis.	$.95 > \alpha > .78$
Bakar et al. (2020)	Mathematics Teacher self-efficacy of technology integration and TPACK.	Strong association between teacher self-efficacy of technology integration and TPACK.	T-tests and One-way ANOVA.	$.93 > \alpha > .80$
Dobbins (2016)	Teacher self-efficacy and teacher grit.	Statistical relationship between teacher self-efficacy and teacher grit.	Correlational analysis and analysis of variance.	$.80 > \alpha > .72$
Holden & Rada (2011)	Technology self-efficacy and Technology acceptance.	Technology self-efficacy has an impact on acceptance of technology.	Generalized linear modeling.	$.94 > \alpha > .88$
Kent & Giles (2017)	Technology self-efficacy and technology use.	Positive technology efficacy is necessary for technology integration.	Descriptive statistics.	N/A
Martindale (2015)	Technology self-efficacy and intentions to adopt new technologies.	Technology self-efficacy was not determined to be a predictor of intentions to adopt new technologies.	Multiple Regression Analysis.	$\alpha > .79$

Hierarchical Linear Regression Model

HLRM is a technique used to investigate relationships between and within levels of grouped data (Woltman et al., 2012). Data is *grouped* through a process of aggregating individual responses into groups based on similar characteristics (Heitjan, 1989). In this study, the groups are grit and self-efficacy. Many investigations of grit use HLRM (Bazelais et al., 2016; Chang, 2014; Duckworth & Quinn, 2009; Reed, 2014; Strayhorn, 2014), self-efficacy (Abbitt, 2011; Martindale, 2015; O'Sullivan, 2011; Vancouver et al., 2002), and it has also been applied to investigations of technology integration (Hsu & Kuan, 2012; Vongkulluksn et al., 2018). HLRM is a more complex method of least squares regression in that it considers variances in predictor variables across multiple hierarchical levels of grouped data (Woltman et al., 2012). Predictor variables can be considered hierarchical when they are nested within each other, or they have a shared impact on the outcome variable(s) (Woltman et al., 2012). For instance, in this study, grit and self-efficacy are variables that are nested in technology integration. When considering the analysis of nested data, HLRM is the method of choice in social science research (Woltman et al., 2012). Because this study analyzes how levels of teacher technology integration are nested within self-efficacy and grit, HLRM is the most appropriate research protocol.

HLRM Equation and Variables

Equation (1) shows the overall equation for HLRM, which illustrates the measurement of the outcome variable due to single-level predictor variables. In applying the HLRM equation to this investigation of grit, self-efficacy, and technology integration, the following variables will be assigned to equation (1) as follows:

$$\text{Technology Int.} = ß_0 + ß_1\,\text{grit} + ß_2\text{Technology Self-Efficacy} + ß_3\,\text{grit} * \text{Technology Self-Efficacy} + ß_{3+i}\,X_i + r_i \quad (1)$$

Where:

$ß_o$ = intercept for the model

$ß_1$ = regression coefficient associated with grit

$ß_2$ = regression coefficient associated with self-efficacy

$ß_3$ = regression coefficient associated with cross-relationship between grit and self-efficacy

$ß_{3+i}X_i$ = Other demographic characteristics (i.e. subject area, years of instruction, etc.)

r_i = random error associated with the model

The following are the necessary conditions that must exist to apply the method of HLRM (Woltman et al., 2012):

1. There is no multicollinearity.

2. The self-efficacy and grit residuals are independent and normally distributed.

3. Self-efficacy and grit are independent of their level-related error, and their error terms are independent of each other.

HLRM Assumptions

Certain assumptions must be met to use HLRM as an analytical technique for this investigation. According to Jenkins and Quintana-Ascencio (2020), a minimum of 25 participants are required for HLRM to identify patterns in the data. For specific analysis protocols using HLRM, three assumptions should be applied, according to Bryk and Raudenbush (1987) and Woltman et al. (2012):

- The data is normally distributed random, independent variables.
- There is no multicollinearity. Each independent variable will be used separately as a predictor variable from the other for predicting technology integration.

- Use of a common metric. Predictor variables will be used to measure a common output variable of technology integration.
- Independence of errors. The variables used to predict technology integration will be free of errors due to other predictor variables.

The next section will be used to discuss the process of grouping similar participant responses by HLRM, using the method of EFA.

Exploratory Factor Analysis

EFA is a data analysis tool which can be used to establish constructs (Banoglu et al., 2015). EFA has been used in previous studies to determine constructs in response data (Banoglu et al., 2015; Hutchison & Reinking, 2011; Usher et al., 2018). The application of EFA in this study was to determine underlying patterns in technology integration and compare these patterns to possible non-cognitive predictor variables (i.e. self-efficacy and grit) using HLRM. The following section will be used to describe the specific survey instrument used to collect participant's responses.

Survey Instrument

Three survey instruments were used in this study to measure self-efficacy, grit, and technology integration. Teachers' technology self-efficacy was determined using the Mobile Teachers' Sense of Efficacy Scale (mTSES) (Power et al., 2014). Measurements for teacher grit were determined using the Grit Survey developed by Duckworth et al. (2007). Finally, determining teachers' perceived levels of technology integration will involve using the survey established by Hutchison and Reinking (2011).

Setting

The setting for this study is Clements District (a pseudonym), a rural school district in North

Carolina. This school district was selected for this study because it has an established technology policy which helped mitigate policy variability resulting from different school technology policies. Additionally, school demographics across different secondary education sites were similar, reducing any variability resulting from school sites. Clements District had reported funding for technological resources, according to NC DPI's 2017-2018 report. According to NC DPI's 2017-2018 expenditure report, Clements District established budget code items for specific technology purchases. Of these, ten items pertain to technology-related purchases in the district, including: computer software and supplies, monies spent on technology contract services, mobile communication costs, computer equipment (inventoried), computer repair costs, school connectivity, and digital resources.

A 2018 North Carolina statewide survey of teachers' use of technology ((North Carolina Working Conditions Survey, 2018) in Clements District revealed that thirty percent of teachers felt they did not have sufficient training to utilize instructional technologies fully, fifty-three percent needed additional professional development on integrating technology into instruction to teach students more effectively, fifty-seven percent of teachers reported they assigned work which did not require the internet to complete, and fifty-four percent reported at least once a month that they assigned work to students that required no access to digital devices at all. Given these preliminary results, Clements District was ideal for gaining further information regarding psychometric variables of self-efficacy and grit relating to technology and teacher perceptions of technology integration.

Sampling

Clements District consists of 25 schools, 15 elementary schools, nine middle schools, and six high schools. Of the six high schools, three are traditional and three are alternative schools (e.g., early college, applied science, etc.). For this investigation, data will be collected from the three traditional high schools to have consistency amongst sampling sites and reduce possible inconsistencies within the data due to different student demographics or performance expectations at alternative schools.

Participants

Participants in this study will be secondary school teachers from three traditional high schools in the Clements District. Teachers will be sent an electronic survey to assess their technology self-efficacy, grit, and perceived levels of technology integration. All teachers from Armendariz School, Bressman School, and Caleb Academy (Pseudonyms) will be provided with electronic surveys. Participants were assigned identifiers (Teacher 1, Teacher 2, Teacher 3) to protect user identity and security. 200 teachers in the three traditional high schools in Clements District were surveyed for this investigation. Similar participant numbers have been reported in other investigations of grit and self-efficacy (Table 3).

Table 3

Previous Studies of Grit and Self-efficacy with Linear Regression Modeling

Study	Participants
Usher et al. (2013)	1 Urban School District's Teachers and Students
Kearns (2015)	50 superintendents
Duckworth et al. (2009)	390 Teach for America Teachers
Yates et al. (2012)	15 African American Male Pre-service teachers
Robertson-Kraft and Duckworth, (2014)	154 first and second year teachers

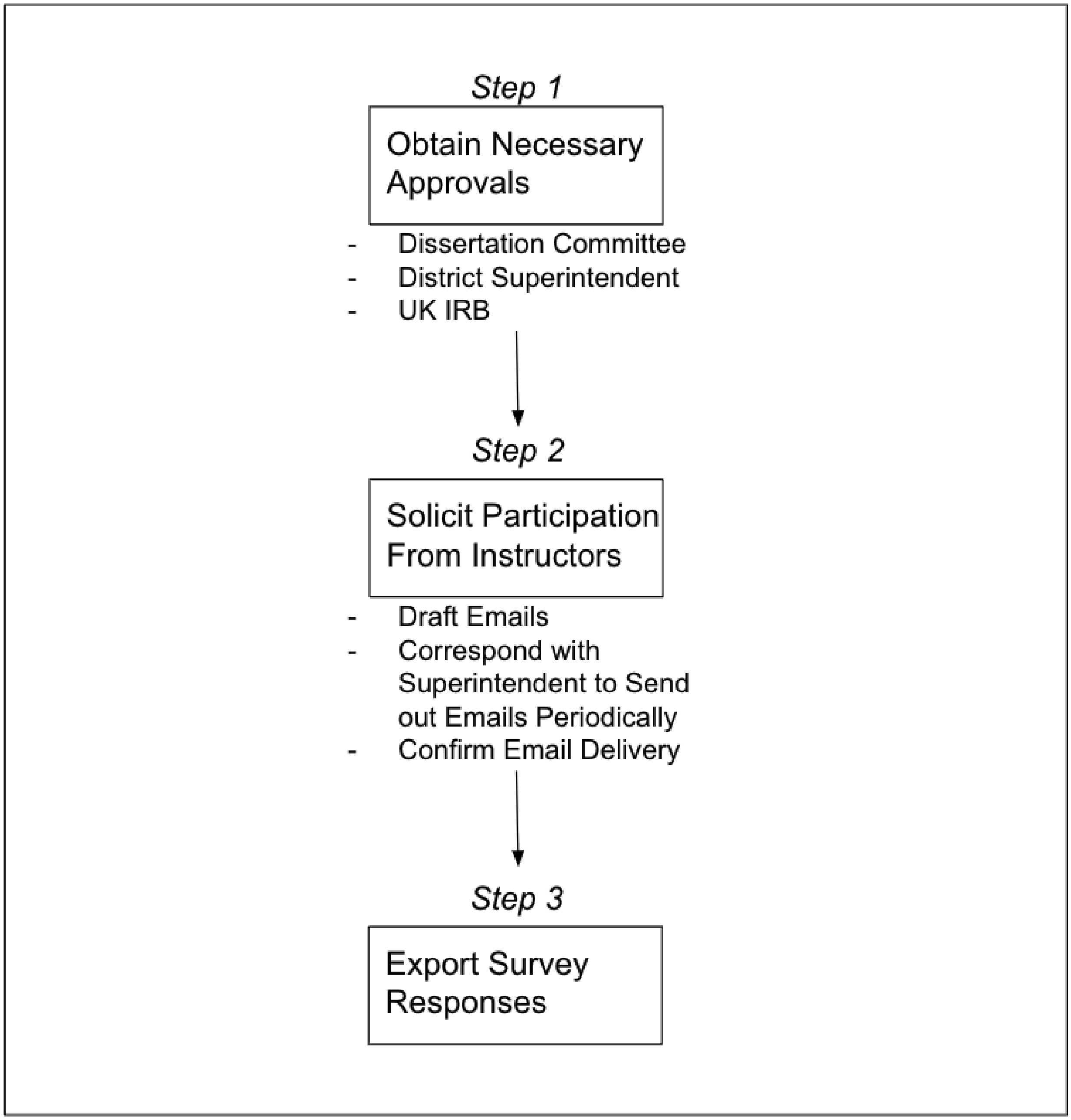
Teachers surveyed were full-time employees of the school district. Teachers were not selected based on other identifiers as full-time employees. I will present specific information regarding the information collected from each participant in the following section.

Data Collection

Data was collected in multiple steps (Figure 1). First, the study was approved by the school district superintendent (Appendix D) and the University of Kentucky Institutional Review Board (Appendix B). All teachers from the three traditional high schools in Clements District were emailed an online survey to complete over several weeks. Survey data was collected and stored using Qualtrics online software. Data was collected to assess teacher technology self-efficacy, grit, and teacher-perceived levels of technology integration.

Figure 1

Data Collection Steps

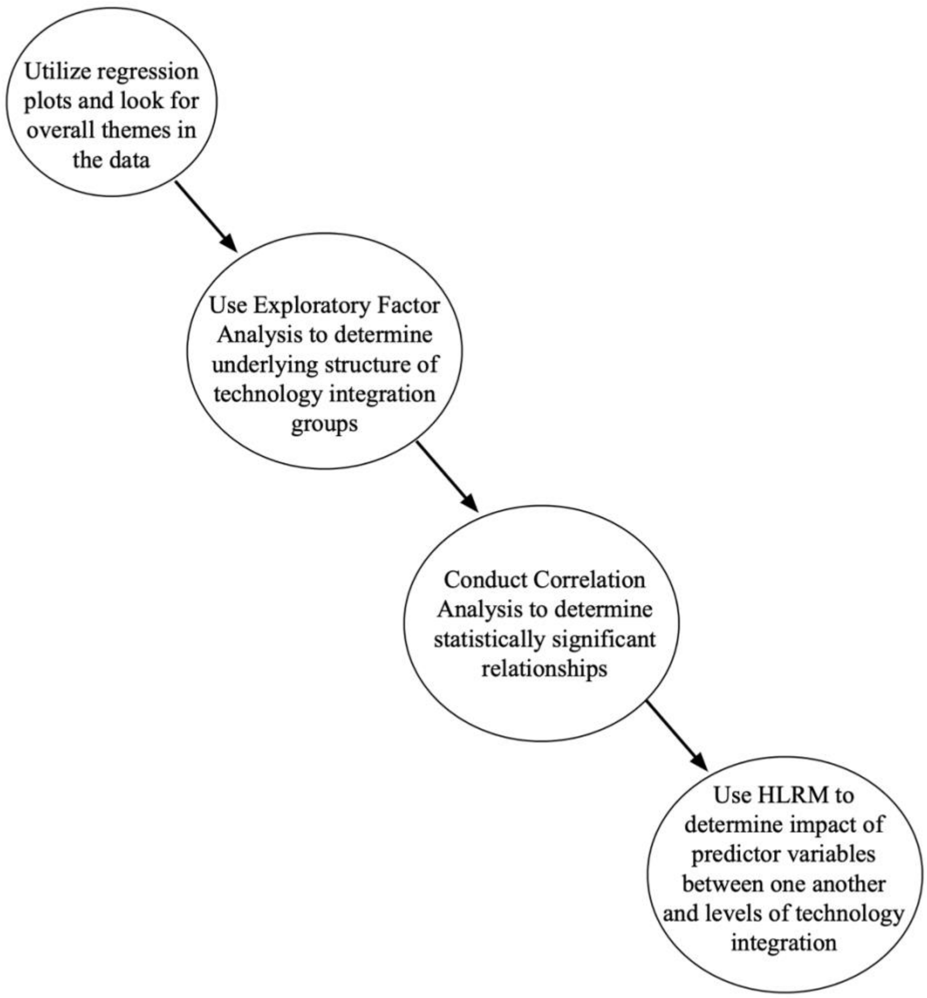


Analysis

Data from returned surveys were imported into SPSS statistical analysis software for analysis. A data analysis framework was used to determine relationships between variables (Figure 2). First, relationships between predictor variables and technology integration were analyzed for correlations. Once any possible relationships have been identified, HLRM will be applied to determine any correlations from adding additional variables (Marsh, 2018; Woltman et al., 2012). Next, significant differences in R values were used to determine whether variables were correlated with technology integration. The last step in the analysis process was to determine the level of interaction between grit, self-efficacy, and other predictor variables.

Figure 2

Data Analysis Framework



Limitations

A limitation of this study is that it occurred during the international COVID-19 pandemic. While many steps have been taken to ensure the validity and reliability of this investigation, it is difficult to predict the impact of a global pandemic on self-efficacy, grit, and levels of technology integration. Therefore, while data can be compared to prior investigations, this would go beyond the scope of this current study relating to the COVID-19 pandemic.

Next, the selected sampling site and participants were selected based on their representation of other school districts across the US. Assuming that the results of this investigation are reflective of all P-12 institutions would be cautioned against as this study only looks at variables relating to secondary schools in a rural school district in North Carolina. This study would need to be replicated in several other settings before such assumptions could be considered.

Finally, while most variables were considered, other effects may be correlated with teachers' grit, self-efficacy, or perceived technology integration. While I have attempted to include variables that occurred in the literature, additional studies would need to consider school demographics, student success rates, and other non-psychometric variables to determine their relationships. In addition, variables that instructors could not directly report were not considered for this investigation.

Summary

This chapter described the methods used to determine teacher technology self-efficacy, grit, and perceived technology integration in a rural school district in North Carolina by describing variables, sampling, data collection, and data analysis protocols. Ch. 4 will be used to discuss the results upon performing data analysis procedures.

CHAPTER 4

Results

While many studies have been conducted regarding the relationship between grit and self-efficacy (Alhadabi & Karpinski 2020; Fabelico & Bonimar, 2020; Faust, 2017; Usher et al., 2013), and self-efficacy and technology integration (Abbitt, 2011; Bakar et al., 2020; Kent & Giles, 2017), there is limited research on the relationships between grit and technology integration; except for determining possible non-cognitive precursors to technology integration (Liu et al., 2022). Using the previous investigative protocols for grit, self-efficacy, and technology integration, data was collected from three traditional high school instructors in a rural school district in the United States to determine possible relationships between these variables. In this chapter, I present results from analyses to determine the relationship between the dependent variables of self-efficacy and grit with technology integration. The following is the list of research questions used for this investigation.

Research Questions

1. Is there a relationship between teacher grit and the type of technology integration applied by instructors for student work?

2. Is there a relationship between teacher grit and the following characteristics:

   a) subject area

   b) years of instruction

   c) age

   d) gender

   e) level of education

3. What is the effect of self-efficacy on levels of technology integration, after controlling for grit?

4. What is the effect of grit on levels of technology integration, after controlling for self-efficacy?

5. What is the effect of grit on overall technology integration, after controlling for self-efficacy?

Addressing Research Questions

To contemplate the relationship between self-efficacy, grit, and technology integration, a set of analytical steps must be taken in order. To address research question one, I first established the constructs of technology integration to determine the relationship of these constructs with teacher grit. To determine the constructs of technology integration, I employed EFA. Based on the results of EFA, I determined R^2 values by comparing grit and the constructs of technology integration to establish if there was a relationship between these variables. Then, to address question two, correlation analysis was applied to determine whether statistically significant relationships exist between teacher grit and dependent variables relating to teachers' age, years of instruction, subject area, gender, and levels of education. I addressed questions three, four, and five by using HLRM to determine the strength of relationships between self-efficacy, grit, and levels of technology integration. In the following section, I will show how I addressed and confirmed assumptions of the analysis protocols used to determine the results.

Table 4

Data Analysis Protocols

Research Questions	Analysis Protocols
R.Q. 1	Exploratory Factor Analysis
R.Q. 2	Correlation Analysis
R.Q. 3-5	Regression Analysis

Addressing Research Assumptions

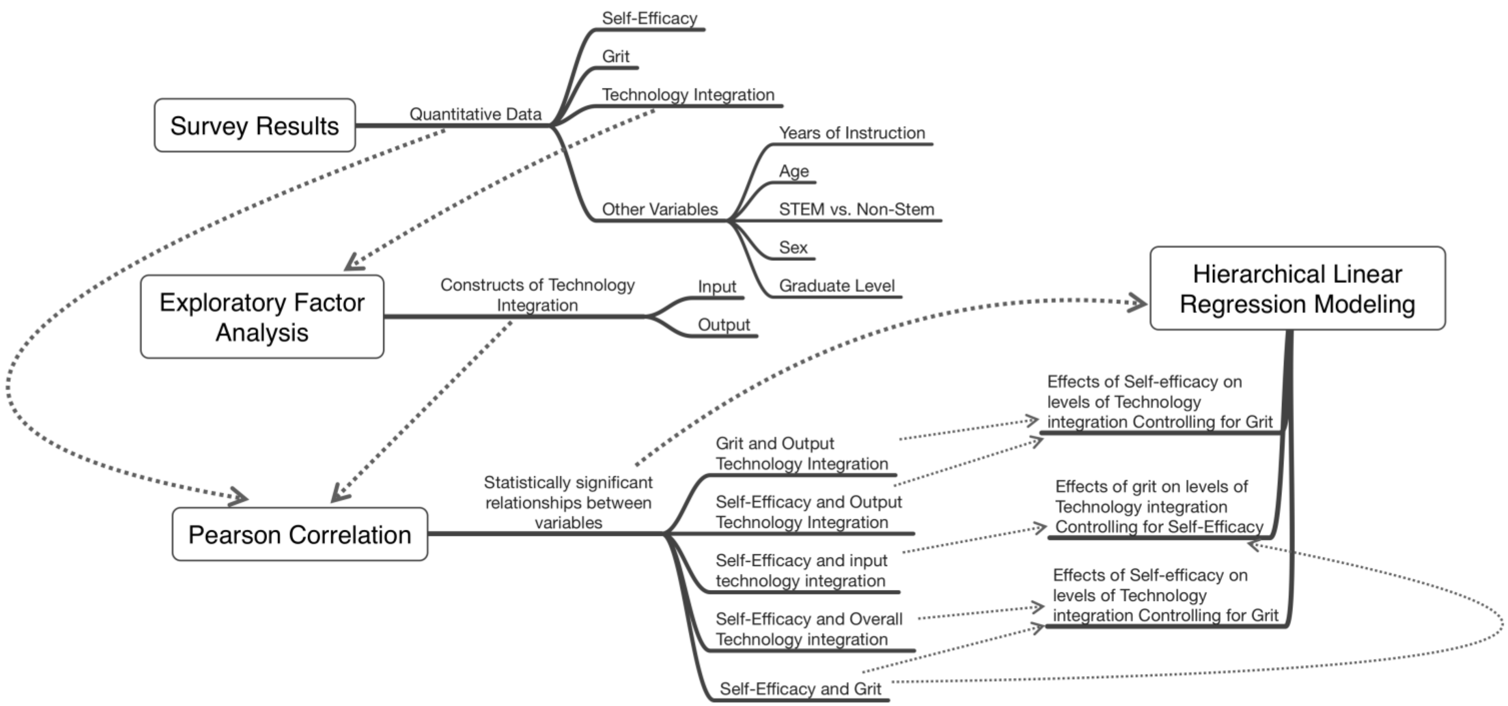
Several assumptions are crucial when applying HLRM, including normality, non-collinearity, and independence of error terms. To address these assumptions, I first confirmed the data to be normally distributed by conducting Shapiro-Wilk normality tests, which showed all models had a p-value 0.05. In this test for normality, any model which did not have a p-value > 0.05 was not considered to be normally distributed (Zelenak, 2015). Next, I confirmed non-collinearity between variables by performing collinearity tests on each model, which met acceptable variance inflation factor (VIFs) levels between 10 and 2.5 and tolerance levels greater than 0.1 (Joo et al., 2018). I determined error terms to be independent of each another by analyzing residual plots of each HLRM analysis and confirming random patterns (Martindale, 2015). Lastly, I used a common metric for each model analysis (i.e. input technology integration, output technology integration, and overall technology integration). In the next section, I will present how I structured the research analysis protocols, followed by the results from the survey analysis by presenting analytics regarding response rates for key domains of grit, self-efficacy, and technology integration.

Results Analysis Protocol

Survey results provided quantitative data regarding participants' self-efficacy, grit, technology integration, age, years of instruction, STEM vs. non-STEM courses taught, sex, and graduation level (i.e. bachelors, masters, etc.) (figure 3). Through EFA, I used participants' technology integration scores to develop technology integration constructs. I combined the constructs determined through EFA with the survey dependent variables of self-efficacy, grit, years of instruction, age, types of courses taught, sex, and graduate level to determine statistically significant relationships by Pearson correlation analysis. Then I analyzed the results of the correlations analysis by HLRM to determine the correlations of adding additional variables to models which showed statistical significance. I will present the results from each of the analysis protocols shown in Figure 3 in the following section.

Figure 3

Results Analysis Protocol



Survey Results

Of 200 surveys distributed 58 respondents returned their surveys. Of the surveys returned, 33 surveys met the criteria for further data analysis. Incomplete surveys did not meet qualifications to be considered for further analysis. Of the surveys returned, STEM instructors made up 24% (8) and non-stem instructors made up 76% (25). The return rate satisfied the required 25 necessary participants as described by Jenkins and Quintana-Ascencio (2020). Participants' scores on the key domains of the survey ranged as follows:

- Grit: $M = 3.40$, $SD = 0.35$, scale of 1 to 4.
- Technology self-efficacy: $M = 6.05$, $SD = 1.12$, scale of 1 to 9.
- Overall technology integration: $M = 2.03$, $SD = 0.49$, scale of 1 to 4.

I analyzed R^2 values for the key domains between grit and overall technology integration (Figure 4), self-efficacy and overall technology integration (Figure 5), and self-efficacy and grit (Figure 6). The correlation between teacher grit and overall technology integration showed a low R^2 value between teacher grit and overall technology integration ($R^2 = 0.007$, $p > 0.05$). Self-efficacy and overall technology integration showed a statistically significant relationship ($R^2 = 0.269$, $p < 0.01$). Finally, grit and self-efficacy showed a statistically significant relationship ($R^2 = .251$, $p < 0.01$). Based on these results, I conducted further in-depth statistical analyses on the key domains and relationships between grit, self-efficacy, and technology integration to address research questions 1-5.

Figure 4

Regression plot of Grit and Overall Technology Integration

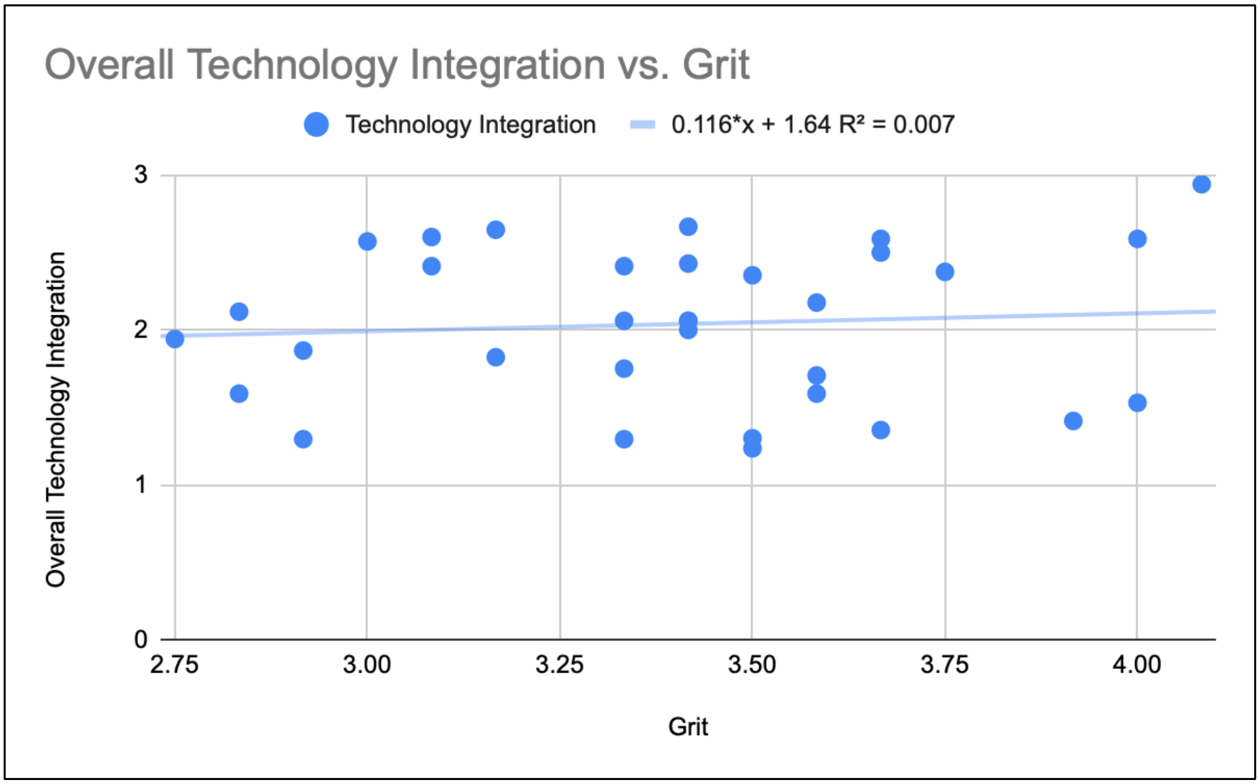


Figure 5

Regression plot of Grit and Overall Technology Integration

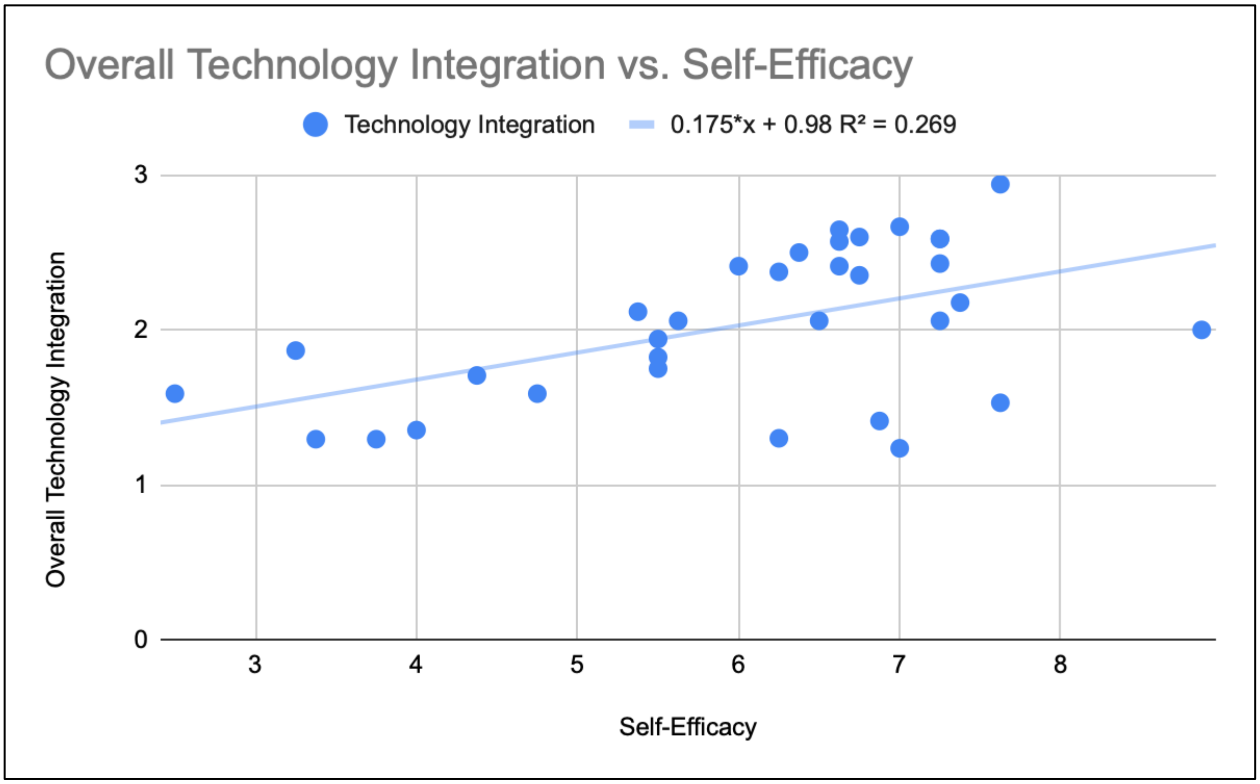
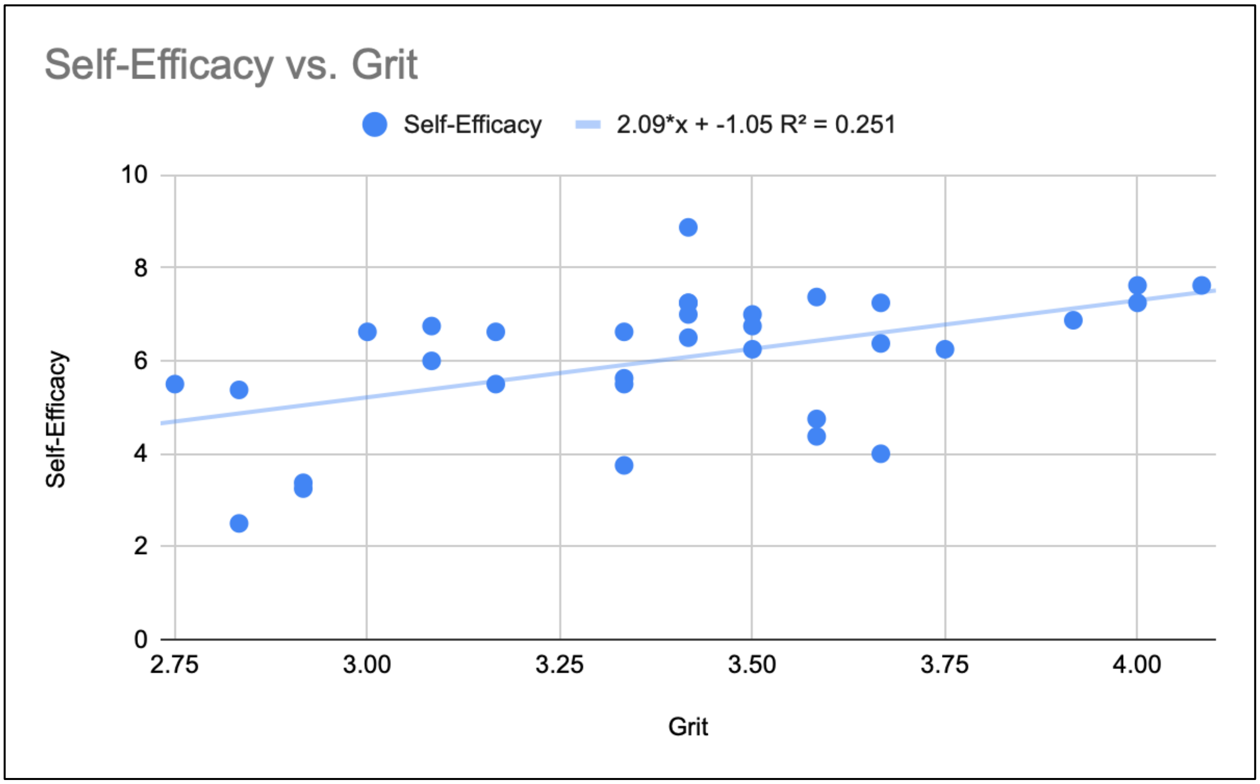


Figure 6

Regression plot of Grit and Self-Efficacy



Research Question One

Introduction to the Analysis. Teachers do not uniformly use technology (Hutchison & Reinking, 2011); rather, different teachers utilize different technology for different applications and use in their classrooms. Based on these different uses, assessing teacher technology integration should include multiple metrics, particularly related to tools and applications. The survey employed in this study contained 17 items designed to capture different technology tools and applications. The data from responses can be subjected to EFA, deriving constructs of technology integration. These constructs can be further analyzed for their relationship to variables of grit and self-efficacy. What follows is the analysis of teachers' technology integration responses and the constructs developed through exploratory factor analysis. I also present the relationship between these constructs and a teacher's grit score.

Research question one is: Is there a relationship between teacher grit and the type of technology integration applied by instructors for student work? To address this question, an analysis of technology integration was conducted using steps described by Banoglu et al. (2015), Hutchison and Reinking (2011), and Usher et al. (2018), where grit was the predictor variable and technology integration was the dependent variable. The steps included:

1. Determine constructs of technology integration by EFA.

2. Use EFA results and determine the relationship between grit and the constructs.

Exploratory factor analysis was used to determine if an underlying pattern of responses emerged regarding technology integration (Table 5). Two-factor groups emerged which I called "input" and "output." These factors were selected based on a cut-off value of .40 (Stevens, 2012). A total of 13 items were greater than the .40 cut-off value. The factor loading values of the two factors, input and output, ranged from .408 to .894. Next, a chi-squared test of the two-factor model, shown in table 4, yielded a p-value <.001, affirming that responses for technology integration were separated into two constructs.

Table 5

Exploratory Factor Analysis of Technology Integration Survey Responses

Survey Response	**Input**	**Output**	**Uniqueness**
Creating a presentation	0.741	.	0.418
Creating a word document	0.625	.	0.449
Evaluating online information	0.785	.	0.408
Formulating questions to research online	0.650	0.432	0.502
Gathering Pictures	0.408	.	0.813
Location information online	0.697	.	0.532
Play games online	.	.	0.998
Publishing a blog	.	0.573	0.683
Publishing information online	.	0.538	0.717
Reading a book online	.	.	0.854
Searching for information online	0.894	.	0.100
Searching for information online with a strategy	0.686	.	0.519
Send email	0.474	.	0.634
Synthesizing online information	0.735	.	0.479
Using References Sites	0.808	.	0.370
collaborating with students online	.	.	0.937
communication using instant messenger	.	.	0.793

Chi-squared Test

	Value	**df**	**p**
Model	231.210	103	< .001

In examining the EFA output, three items stood out from the other technology integration survey responses. Those items pertained to:

1. Formulating questions to research online,
2. Publishing a blog, and
3. Publishing information online

These three items were categorized as *Output* technology integration constructs, while all other technology integration variables were classified as *Input* technology integration constructs. The rationale for this decision is output technology integration is defined as questions in the survey that related to students' creation, such as publishing or formulating questions (Cator et al., 2015, Sawyer, 2017). Input technology integration is defined as questions in the survey relating to using technology for taking in content, such as gathering pictures or searching the internet (Ertmer, 2005; Pittman & Gaines, 2015). I used these two constructs as variables in a subsequent analysis to examine the relationship between grit, input technology integration, and output technology integration, which will be discussed in the following sections.

To determine the relationship between the constructs of input and output from the EFA and grit, I calculated correlation values for grit and output technology integration (Figure 7), and grit and input technology integration (Figure 8). A regression of grit on output technology integration showed statistically significant model (r (31) = .44, $p < 0.01$). While regression of grit and input technology integration showed a model which was not statistically significant (r (31) = .082, $p > 0.05$). So, for research question one, there is a positive relationship between grit and levels of technology integration, specifically relating to output technology integration. However, there is no statistically significant correlation between grit and input technology integration. In the following section, I will explain the results of examining the relationship between grit and other variables.

Figure 7

Regression Plot of Grit and Output Technology Integration

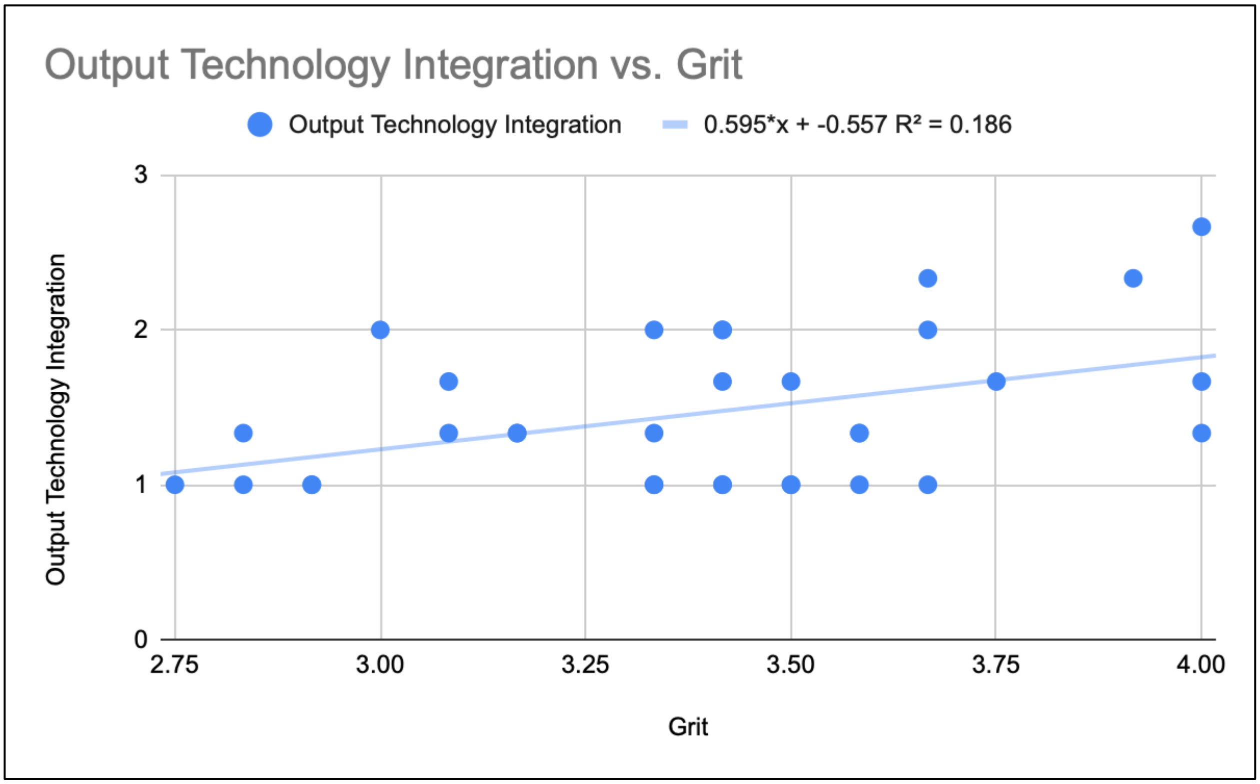
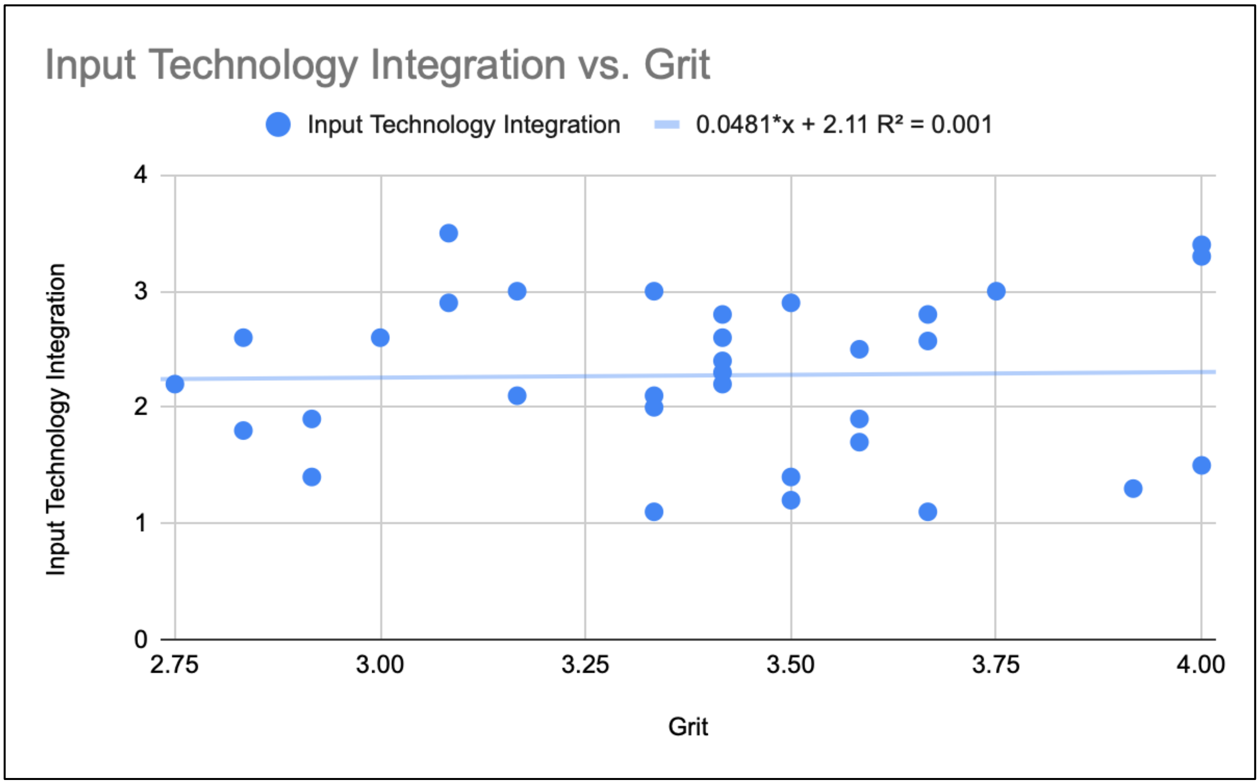


Figure 8

Regression Plot of Grit and Input Technology Integration



Research Question Two

Introduction to the Analysis. Grit has been found to positively correlate with many variables in educational settings, such as educational attainment (Fabelico & Afalla, 2020) and teaching strategies (Kim & Shin, 2018). I wanted to determine if there is a relationship between grit, the predictor variable, and other dependent variables to see if any additional considerations needed to be made regarding grit and other possible factors in this investigation. To do this, I conducted a Pearson correlation analysis. Variables that show positive statistically significant correlations are used in the subsequent HLRM analyses in research questions three, four, and five.

Research question two is: Is there a relationship between teacher grit and the following characteristics:

a) subject area

b) years of instruction

c) age

d) gender

e) level of education

To address this question, a Pearson correlation analysis was conducted. Table 6 shows the Pearson correlation coefficients for all variables, including years of instruction (years), age, STEM instructors (STEM), sex, graduate school completion (Grad School), grit, self-efficacy, technology integration, input technology integration, output technology integration.

Table 6

Pearson Correlation Coefficient Analysis for Variable Relationships

	1	2	3	4	5	6	7	8	9	10
1. Years	—									
2. Age	0.626**	—								
3. STEM	0.027	0.158	—							
4. Sex	0.270	-0.160	0.029	—						
5. Grad School	0.089	-0.152	0.159	-0.087	—					
6. Grit	0.092	0.055	-0.022	-0.097	0.079	—				
7. Self-Efficacy	0.147	0.244	0.331	-0.215	0.125	0.501**	—			
8. Overall Tech. Integ.	-0.155	0.146	-0.114	-0.242	-0.082	0.082	0.519**	—		
9. Input Tech. Integ.	-0.063	0.134	-0.088	-0.262	-0.040	0.073	0.486**	0.949	—	
10. Output Tech. Integ.	0.034	0.235	-0.208	-0.166	-0.013	0.444**	0.409*	0.563	0.468	—

$^{*}p < 0.05$. $^{**}p < 0.01$

Variables are considered for subsequent HLRM analysis based on statistically significant correlations of $p < .05$. Five pairs of variables met the criteria:

- self-efficacy and grit ($r = .50$, $p < .01$),
- grit and output technology integration ($r = .44$, $p < 0.01$),
- self-efficacy and overall technology integration ($r = 0.519$, $p < 0.01$),
- self-efficacy and input technology integration ($r = 0.486$, $p < 0.01$), and
- self-efficacy and output technology integration ($r = .409$, $p < 0.01$).

Research Question Three

Introduction to the Analysis. Grit has been shown to be correlated with certain teacher characteristics (Fabelico & Afalla, 2020; Yates et al., 2015). Similarly, self-efficacy has been found to have a positive, statically signification correlation between grit (Dobbins, 2016), and teacher characteristics (Fabelico & Afalla, 2020; Nordlöf, et al., 2019). As a result of the Pearson correlation analysis, there was a statically significant positive correlation which was presented between teacher grit and output technology integration (r (31) = .44, $p < 0.01$). Additionally, there was a positive, statically significant correlation between self-efficacy and grit (r (31) = .50, $p < 0.01$). Based on the previous studies on teacher characteristics, grit, self-efficacy, and the results of research question 2, I elected to examine how adding self-efficacy would alter the model of grit and output technology integration. An HLRM analysis could show if adding self-efficacy to the model of grit and output technology integration explains more variance.

Research question three was: What is the effect of self-efficacy on levels of technology integration, after controlling for grit? To address this question, an HLRM analysis was conducted to determine how grit and self-efficacy, predictor variables, correlate with teachers' output technology integration, the dependent variable. The result of the first step of the HLRM analysis revealed a statistically significant model, $F(1,31) = 7.07$, $p = 0.012$, $R^2 = 0.186$, indicating grit is statistically significantly associated with output technology integration (beta = 0.431, $t = 2.755$, $p = 0.010$). The R^2 value of 0.186 associated with this regression model suggests that grit accounts for 18.6% of the variation in output technology integration, suggesting that 81.4 % of the variation in output technology integration is not explained by grit. For the second step of the HLRM investigation, self-efficacy was added to the analysis. The resulting model was statistically significant ($F(2,30) = 4.63$, $p = 0.018$, $R^2 = 0.236$); however, the results of the second step did not show marked improvement from the first model $\Delta F(1,30) = 1.97$, $p = 0.171$, $\Delta R^2 = 0.0501$ (Table 9). The results suggest grit does have a correlation with output technology integration and adding self-efficacy to the model does not influence the relationship between grit and output technology integration at a statistically significant level.

Table 7

HLRM Model Fit Measures

Model	R	R^2	Adjusted R^2	F	df1	df2	p
1	0.431	0.186	0.159	7.07	1	31	0.012
2	0.486	0.236	0.185	4.63	2	30	0.018

Table 8

Model Comparisons of Grit & Self-Efficacy on Output Technology Integration

Models	ΔR^2	F	df1	df2	p
1 - 2	0.0501	1.97	1	30	0.171

Table 9

Model Coefficient Values of Models 1 and 2

Models	Predictor	Estimate	SE	t	p	Standard Estimate
1	Grit	.595	0.224	2.755	0.010	.431
2	Grit	.4168	0.2546	1.637	.112	.302
	Self-efficacy	.0846	0.0603	1.403	.171	.259

Research Question Four

Introduction to the Analysis. Self-efficacy has been shown to have a relationship with teachers' level of technology integration (Dussault & Deaudelin, 2004). However, there is limited data on how grit is correlates with self-efficacy and technology integration. Findings from research question 2 suggest there is a positive, statically significant correlation between self-efficacy and input technology integration (r = .44, $p < 0.05$), and self-efficacy and grit (r = .50, $p < 0.01$). Even though grit showed no statistically significant positive correlation for input technology integration, it was necessary to determine how adding grit altered the model of self-efficacy and input technology integration.

Research question four was: What is the effect of grit on levels of technology integration, after controlling for self-efficacy? To address this question, an HLRM analysis was conducted to determine how grit and self-efficacy correlate with input technology integration. In the first step of the HLRM analysis, the predictor variable of self-efficacy on the dependent variable of input technology integration was analyzed. The result of the first step revealed a statistically significant model $F(1,31) = 9.92$, $p = <0.01$, $R^2 = 0.242$. Therefore, self-efficacy is significantly associated with input technology integration (beta = 0.492, $t = 1.86$, $p = <0.01$). The second step of the analysis ($F(2,30) = 6.67$, $p = <0.01$, $R^2 = 0.308$) which included grit (beta = -0.295, $t = -1.68$, $p = 0.103$) (Table 12) did not show significant improvement from the first model $\Delta F(1,30) = 2.83$, $p = 0.103$, $\Delta R^2 = 0.0653$ (Table 11). Based on these results, self-efficacy does have a significant correlation with input technology integration; however, adding grit to the model does not strengthen the relationship between self-efficacy and input technology integration at a statistically significant level.

Table 10

HLRM Model Fit Measures

Model	R	R^2	Adjusted R^2	F	df1	df2	p
1	0.492	0.242	0.218	9.92	1	31	<0.01
2	0.555	0.308	0.262	6.67	2	30	<0.01

Table 11

Model Comparisons of Grit & Self-Efficacy on Input Technology Integration

Models	ΔR^2	F	df1	df2	p
1 – 2	0.0653	2.83	1	30	0.103

Table 12

Model Coefficient Values of Models 1 and 2

Models	Predictor	Estimate	SE	t	p	Standard Estimate
1	Self-Efficacy	.234	.0742	1.86	<0.01	0.492
2	Self-Efficacy	0.304	0.0833	3.65	<0.001	0.640
	Grit	-0.592	0.3518	-1.68	.103	-0.295

Research Question Five

Introduction to the Analysis. Self-efficacy and grit have been found to be positively correlated, according to Alhadabi and Karpinski (2020), Fabelico and Afalla (2020, and Phillips-Martinez (2017). Similar results were found according to the Pearson correlation analysis of grit and self-efficacy ($R = .50$, $p < 0.01$). There was also positive, statically significant correlation between self-efficacy and overall technology integration ($R = .52$, $p < 0.01$). While grit did not show a statistically significant correlation for overall technology integration ($R = .08$, $p > .05$), adding grit to the model of self-efficacy and overall technology integration could provide a more accurate model for determining overall technology integration. To determine this, I added grit to the statical model of self-efficacy and overall technology integration via HLRM.

Research question five is: What is the effect of grit on overall technology integration, after controlling for self-efficacy? To address this question, an HLRM analysis was conducted to determine how the predictor variables of grit and self-efficacy correlate with the dependent variable of overall technology integration. Recall that overall technology integration is defined by the variables of both input technology integration and output technology integration. The first step in this analysis involved the predictor variable self-efficacy and revealed a statistically significant model $F(1,31) = 11.42$, $p = <0.01$, $\mathrm{R}^2 = 0.269$. Therefore, self-efficacy is significantly associated with overall technology integration (beta = 0.519, $t = 3.38$, $p = <0.01$). The R^2 value of 0.269 associated with this regression model suggests that self-efficacy accounts for 26.9 % of the variation in output technology integration, suggesting that 73.1 % of the variation in overall technology integration cannot be due to self-efficacy. For the second step of the HLRM analysis, the predictor variable grit was added to the analysis with self-efficacy. The results of the second step ($F(2,30) = 6.96$, $p = <0.01$, $\mathrm{R}^2 = 0.317$) which included grit (beta = -0.253, $t = -1.45$, $p = 0.157$) (Table 15) did not show a statistically significant improvement from the first model $\Delta\mathrm{F}(1,30) = 2.10$, $p = 0.157$, $\Delta R^2 = 0.0479$ (Table 14). Based on these results, self-efficacy does have a significant correlation with overall technology integration. The combination of self-efficacy and grit does not improve the strength of the relationship between self-efficacy and overall technology integration at a statistically significant level.

Table 13

HLRM Model Fit Measures

Model	R	R^2	Adjusted R^2	F	df1	df2	p
1	0.519	0.269	0.246	11.42	1	31	<0.01
2	0.563	0.317	0.272	6.96	2	30	<0.01

Table 14

Model Comparisons of Grit & Self-Efficacy on Overall Technology Integration

Models	ΔR^2	F	df1	df2	p
1 – 2	0.0479	2.10	1	30	0.157

Table 15

Model Coefficient Values of Models 1 and 2

Models	Predictor	Estimate	SE	t	p	Standard Estimate
1	Self-Efficacy	0.175	0.0517	3.38	<0.01	0.519
2	Self-Efficacy	0.217	0.0587	3.70	<0.001	0.645
	Grit	-0.360	0.2480	-1.45	0.157	-0.253

Summary

The purpose of this chapter was to provide the results of the analysis of the quantitative survey data collected by traditional high school teachers in a rural school district. Based on the methods outlined in Ch. 3, I analyzed the results of the survey data using EFA, Pearson correlation analysis, and HLRM. I presented the results of the analyses and summarized the statical data related to the five research questions. In the following section, I will discuss the findings of these results within the research literature, recommendations for further studies, the limitations of this investigation, and conclusions.

CHAPTER 5

Discussion and Conclusions

In this section, I present the major findings of the study. These findings relate to levels of technology integration and grit, self-efficacy, years of instruction, age, graduation level, sex, and STEM instruction. These findings have implications for the field of educational technology, leadership, and the application of non-cognitive psychometric techniques in the field of educational research. I will also present the limitations of this investigation. I close with the implications of this study for policy, practice, and further research.

Study Summary

Problem Overview

Every year, billions of dollars are spent on public education (Barnum, 2022; McCandless, 2015). Integrating educational technologies is one of the most expensive investments (USDOE, 2018). When it comes to the utilization of educational technologies, there is a great deal of variability among teachers due to various factors, such as teachers' technology self-efficacy (Cai et al., 2019). These differences in integrating educational technologies can tremendously impact students' experiences with technology in public education (Hampton et al., 2020; Martinez & McGrath, 2014). Addressing the problem of teachers' technology integration is paramount for providing equitable technology opportunities for students in public education institutions (Kaden, 2020).

Purpose Statement

This study was used to investigate the literature regarding technology integration and investigative protocols for providing the best approach for understanding barriers to technology integration in P-12 schools. From the literature review, an investigation was conducted to determine the relationships between teacher technology integration, grit, and self-efficacy. The findings of this study will add to the literature regarding the application of psychometric investigations into technology integration and the application of grit theory into the field of instructional practice.

Research Design

This exploratory study sought to expand upon limited research on grit and technology integration in public P-12 schools. Variables for this study were levels of teacher technology integration, teacher technology self-efficacy, and teacher grit. Additional variables investigated related to other areas of correlation between teacher demographic information and grit, such as subject area, years of instruction, age, gender, and level of education. A quantitative approach was applied to investigate the relationship between variables. A hierarchical linear regression model (HLRM) provided analytical parameters.

Research Questions

1. Is there a relationship between teacher grit and the type of technology integration applied by instructors for student work?

2. Is there a relationship between teacher grit and the following characteristics:

   a) subject area

   b) years of instruction

   c) age

   d) gender

   e) level of education

3. What is the effect of self-efficacy on levels of technology integration, after controlling for grit?

4. What is the effect of grit on levels of technology integration, after controlling for self-efficacy?

5. What is the effect of grit on overall technology integration, after controlling for self-efficacy?

Methodology

There are 115 school districts in the state of North Carolina. From all these districts, one rural school district was chosen. Approval was acquired from the district's superintendent to administer surveys across three traditional high schools in the school district. Other schools in the district listed as non-traditional public schools did not meet the requirements for this investigation. This district was representative of a rural school district in North Carolina. Each school that participated in the study had consistent technology policies and access to technology available from the district. There were 200 teachers surveyed for this study.

Grit was considered a predictor variable for technology integration using HLRM. Additional variables, including technology self-efficacy, were added to determine their possible relationship with grit and technology integration. Statistical correlation analyses determined the correlations between other variables and technology integration.

Major Findings

Several findings in this study add to the research literature on the relationship between grit and self-efficacy with technology integration. First, I found two primary constructs to describe teachers’ technology integration. These two constructs were deemed as input and output technology integration. Second, grit is significantly statistically correlated with output technology integration. Third, self-efficacy is statistically significantly correlated with input and overall technology integration. Fourth, grit is not significantly statistically correlated with teachers' age, gender, years of instruction, STEM-based instruction, or degree level obtained. Fifth, despite their significant statistical correlation, neither grit nor self-efficacy improves the model effectiveness of each variable nor their relationship with technology integration. In the following discussion, I will present a synthesis of the major findings, relate these results to the research literature, and discuss the contribution of these findings to the field of educational technology research.

Discussion

Levels of Technology Integration and Grit

I analyzed survey data using EFA and found two different constructs, input technology integration, and output technology integration. These constructs showed statistically significant differences in responses regarding technology integration based on exploratory factor analysis results. Teachers' responses to technology integration could be grouped based on these two constructs. The results of the EFA constructs of input and output were used to determine the relationship between teacher grit and input and output technology integration.

Through correlation analyses, I determined grit was highly correlated with output technology integration (Table 9). Regarding research question 1, "Is there a relationship between teacher grit and the type of technology integration applied by instructors for student work," the data confirm that grit has a relationship with the type of technology integration for student work. Teachers with higher grit assign work to students categorized as output technology integration or give work that requires students to produce content using technology, such as publishing a blog or publishing information online. At the same time, teachers with lower grit assign work to students categorized as input technology integration or give work that requires teachers to be content generators, such as having students generate emails or perform research online. This conclusion is not surprising when considering the types of teachers in the research literature who identify themselves as having higher levels of grit (Duckworth et al., 2009; Duckworth & Robertson-Kraft, 2014; Fabelico & Afalla, 2020; Grohman et al., 2017). Such teachers are more effective, retained, and creative, as will be discussed in the following section.

Grit has been shown to have a positive relationship with levels of novice teacher effectiveness (Duckworth et al., 2009; Duckworth & Robertson-Kraft, 2014), teacher retention (Duckworth & Robertson-Kraft, 2014); teacher academic achievement (Fabelico & Afalla, 2020), managing strategies for students with behavioral issues (Kim & Shin, 2018), and teacher creativity (Grohman et al., 2017). As presented in chapter 4, grit was positively correlated with output technology integration. For every one-unit increase in grit, teachers increased the output technology integration by 0.43. The beta (β) value corresponds to the change in the outcome variable, in this case, output technology integration, for every change in 1-unit of the predictor variable (Cribari-Neto & Zeileis, 2010). This suggests that teachers with higher grit assign tasks requiring the student to use technology to produce new content or publish material. Having students communicate their ideas and apply classroom content knowledge through publication is foundational to the principle of deeper learning (Rickles et al., 2019). The goal of technology integration should be to not only have students use technologies but use technologies for creative processes relating to deeper learning and higher cognitive skills (McLeod & Richardson, 2013). Any technology used solely to absorb content does not address the principles of multimedia learning, where students are tasked with becoming metacognitive, deep conceptual learners capable of transferring knowledge to new problems and situations (Mayer, 2021). When considering input technology integration, grit did not have the same relationship.

Grit was not found to have a relationship with input levels of technology integration, such as evaluating online information or having students conduct research using websites. These activities were classified as input technology variables because they require teachers to use technologies for inputting content to students instead of students generating content. Similar results have also been found regarding the use of grit and self-efficacy in educational settings (Usher et al., 2019), where grit was not an adequate predictor variable compared to self-efficacy regarding student academic success. In the next section, I discuss the relationship of demographic data with variables on technology integration and the relationship of these variables to self-efficacy and grit.

Demographic Correlations with Self-efficacy, Grit, and Technology Integration

I used the EFA results of the survey data and combined them with all teachers' responses regarding gender, years of instruction, age, courses taught, and graduate-level completed for further analysis using Pearson correlation analysis to determine the level of statistically significant relationships between all variables. The results of the correlation analysis showed no statistically significant associations between demographic data (i.e., years of instruction, gender, age) and technology integration, self-efficacy, and grit. These findings are consistent with Duckworth and Robertson (2014) and Fablicio and Afalla (2020), who found no statistically significant relationship between grit and demographic information. While grit is a powerful tool used in investigations into the rigorous demands of teaching, the literature suggests that grit does not align with demographic variables (Duckworth & Robertson, 2014). Demographic variables, such as years of instruction, may often be associated with perseverance and passion for completing long-term goals; however, grit was not found to have a relationship with these variables (Duckworth & Robertson, 2014; Fablicio & Afalla, 2020). These results can be significant when considering the applications of non-cognitive research protocols relating to academic success and teacher retention. According to the findings, non-cognitive parameters did not have a statistically significant relationship with graduation levels, years of instruction, or course types. In the following section, I will present the finding of the relationships between 3 major domains of self-efficacy, grit, and levels of technology explored through HLRM.

Self-Efficacy Correlations with Technology Integration

To address research questions 3-5, HLRM analyses were applied to the survey data for variables that showed statically significant correlations between self-efficacy, grit, and technology integration. As shown in table 9, grit has a statistically significant relationship with output technology integration; however, when adding self-efficacy to this model, the relationship was no longer significant. These results are consistent with findings on the relationship between grit and self-efficacy on instructional components of educational attainment (Fabelico & Afalla, 2020). Fabelico and Afalla (2020) found that while grit and self-efficacy were highly correlated, grit was correlated with educational attainment, while self-efficacy was not. In other words, adding self-efficacy to a model where grit is used as a predictor variable does not always provide a more effective predictor model, despite the relationship between grit and self-efficacy. Self-efficacy was also shown to have a statistically significant correlation on input technology integration. HLRM was employed to determine how adding grit to self-efficacy and input technology integration altered the model.

When analyzing the results of self-efficacy and input technology integration, table 12 shows there is a statistically significant relationship between self-efficacy and input technology integration. When adding grit to this model, the correlation of self-efficacy with input technology integration was slightly improved. Still, this improvement was not a statistically significant change in the model. These results are consistent with research using teachers' evaluations of student motivations for reading and math (Usher et al. 2019), who determined that self-efficacy is mediated by grit. In other words, when adding grit to self-efficacy models, where self-efficacy is shown to be a vital predictor variable, grit may be used to improve the model. These findings were also found regarding components of grit as a mediator for student success with academic self-efficacy (Jian et al., 2020); in this case, adding grit with students' self-efficacy improves students' academic success. The inclusion, therefore, of grit provides an enhanced model in some cases (Jian et al., 2020). However, in this study, grit did not improve the model of self-efficacy and input technology integration at a statically significant level. Yet, self-efficacy was also found to have a statistically significant relationship with overall technology interaction, providing another possible model for improvement through incorporating grit. In the following section, I will present how adding grit changed the self-efficacy and overall technology integration model.

Research question 5 was designed to determine the relationship between grit and self-efficacy and whether this relationship could alter levels of technology integration. As a result of the correlation analysis shown in Table 6, there was a statistically significant relationship between grit and self-efficacy. These results are consistent with the research literature regarding grit and academic self-efficacy (Alhadabi & Karpinski, 2020; Jian et al., 2020), grit and self-efficacy as predictors for teacher ratings for student motivations (Usher et al., 2019), and grit and teaching self-efficacy (Fabelico & Afalla, 2020; Kim & Shin, 2018). Specifically, grit and self-efficacy have a statistically significant relationship, and this relationship may improve models relating to technology integration. The self-efficacy and overall technology integration model showed a statistically significant correlation. When adding grit to this model, the correlation of self-efficacy with overall technology integration was slightly improved.

When addressing research question five, “What is the effect of grit on overall technology integration, after controlling for self-efficacy,” it appears that the correlation between these two variables does improve the model. However, not at a statistically significant level. Similar results have shown that not all relationships between self-efficacy and grit can be mediated by one another at a statistically significant level (Jian et al., 2020; Usher et al., 2019). Each variable, independent of the other, was found to correlate with certain levels of technology integration (i.e., input and output). Grit appears to be correlated with output technology integration. In contrast, self-efficacy is correlated with input technology integration, which can be improved by grit but not at a statistically significant level. Therefore, based on these findings, grit and self-efficacy have a statistically significant relationship, but this relationship does not correspond to all levels of technology integration. In the following section, I will explain the limitations of these findings as well as the implications of these findings to policy, practice, and future research.

Limitations

One of the limitations of this study was the sample size and the district used for sampling. While these effects did not alter the analysis protocols for this investigation, more participants would have only added to the model's fitness. Additionally, this study looked at three traditional high schools in a rural district to reduce factors relating to different student demographics based on alternative schools and early college-type programs. Yet, consistency between student bodies was not considered a parameter in this study, as all schools had the same institutional policies regarding technology implementation regardless of population. Finally, other non-cognitive parameters were not considered for this investigation, only grit, and self-efficacy. Other parameters may be better indicators of levels of technology integration as they are developed and tested in future investigations. In the next section, I will discuss the implications of policy, practice, and future research for the findings of this study.

Implications

Policy

This investigation addressed the relationship between teachers' grit, technology self-efficacy, and technology integration. As shown, grit has a correlation with output technology integration. In contrast, technology self-efficacy correlates with input technology integration, which can be improved by grit but not at a statistically significant level. Based upon the findings shown here, several implications can be made in technology implementation policy, non-cognitive research, deeper-learning practices, and professional development.

The research literature is inundated with the applications of grit in different educational spaces, such as the success rates of California Superintendents (Kearns, 2015), teacher retention and effectiveness (Robertson-Kraft & Duckworth, 2014), student career-related attitudes (Lee & Sohn, 2017), student academic success (Aparicio et al., 2017; Duckworth et al., 2007; Rimfeld et al., 2016; Usher et al., 2019; Wang et al., 2017), student-teacher relationships (Lan & Moscardino, 2019), and teacher performance (Fabelico & Afalla, 2020). This is the first article that has applied the grit investigative tool in an educational setting within a specific demographic to determine the correlation with non-cognitive parameters of technology integration. While grit was not found to have a correlation with input technology, it was found to be correlated with output technology or the utilization of instructional techniques which require students to use technology to produce new content. Since this is the first study in this area, this is an important finding regarding the application of grit as a metric for levels of technology integration and the potential use of this tool for future investigations in educational technology. These findings also play a role in utilizing self-efficacy or grit psychometric research techniques in technology integration investigations and educational technology policy.

The findings of the separation of self-efficacy and grit and their correlations with levels of technology integration add to the research literature on the robustness of self-efficacy in technology integration and the universal application of grit. While self-efficacy was found to be correlated with input technology integration, it was determined that this variable did not alter the model of grit and output technology integration. These findings suggest that teachers with higher self-efficacy scores relating to technology integration may not integrate technologies that require students to generate content using these tools compared to teachers with higher grit scores. Additionally, teachers with higher levels of self-efficacy may use technologies in their classroom but not assign work that requires higher-order thinking processes and deeper learning using these technologies compared to teachers with higher grit scores. The implications of these findings could be helpful when evaluating the work that students are doing in courses and finding a way of improving the general applications of technologies in high school settings and deeper-learning practices and policies, as will be presented in the following section.Implementing new technologies in public schools can be very daunting and costly. With this investment comes the expectation that instructors will utilize the tools. As shown here, the integration of technologies can vary between instructors based on levels of grit. Based on these findings, school district administrators may consider adjusting their implementation policies to train teachers on integrating technologies for different pedagogical practices, such as the principles related to deeper learning.

In deeper learning, students are encouraged to create and produce content using digital media tools. These practices lead to higher-order thinking practices of creativity, evaluation, and other components associated with advancing through Bloom's taxonomy (Hopson et al., 2017). As a result of the COVID-19 global pandemic, educational institutions across the globe were required to transfer their instructional practices to an online platform based on state and district-mandated policies. While research is still being conducted on the impact of this global pandemic on educational settings, one possible implication could be the lack of utilizing technologies for more than content delivery. This study has shown that grit is correlated with instructors' use of technology integration for having students use technology to produce content beyond the parameters of technology access and availability. The implications of the findings presented here provide additional parameters that need to be addressed when utilizing technology for deeper learning and the implications of non-cognitive variables such as grit and self-efficacy to evaluate educational technology policies.

Practice

As the literature has shown, teachers' experiences with technology professional development tend to be lacking in how to utilize certain technologies in the classroom (Ertmer et al., 2012; Grant et al., 2015; Hutchison & Reinking, 2011). In this investigation, I present a possible metric for determining areas for further professional development regarding teachers with lower grit scores. Teachers with lower levels of grit may benefit significantly from professional development for using technologies to help students create and generate content. Additionally, professional development sessions that focus more on using technologies for higher-order thinking processes may be very beneficial to teachers with lower levels of grit. Another possible area of professional development regarding teacher technology integration could be through mentorship programs utilized for many first-year teachers (Heirdsfiled, 2008) and teacher leaders within schools (Clements, 2018).

This study adds to the current literature on non-cognitive correlations with technology integration. Previously, there were limited resources regarding how grit is correlated with technology integration in specific academic settings. The implications of the findings shown here may be beneficial regarding how technologies are used for instruction to support student learning and knowledge construction and the diverse applications of non-cognitive research investigations.

Future Research

Since this is the first study of grit and levels of technology integration, the first area for further research would be to replicate this study in another rural school district with the traditional high school teaching faculty. This study could also be applied to other school demographics, such as K-8, early colleges, and non-traditional high schools to determine whether similar findings could be resolved with different teaching populations.

While this study broke down two constructs of technology integration, further studies may consider using even more constructs of technology integration which broke down the constructs of integration even further. Additionally, qualitative studies investigating observed teacher use might be applicable as researchers could design parameters of technology use based on observing teachers' technology use for a period. Strict parameters regarding the coding of teacher levels of technology integration would need to be heavily considered to address inter-rater reliability.

Finally, future studies could involve a larger sampling frame across schools and districts to determine whether similar findings are produced within diverse populations and schools across a district, state, and nationally. This study focused on one district and similar schools within that district to reduce the difference between school district technology policies and leadership practices. Future studies would need to be conducted to determine if similar findings are presented despite population demographics and location changes.

Conclusion

I have shown how the grit investigative tool can be applied, for the first time, in an educational technology investigation. Through advanced quantitative statistical analyses, I have also presented a way to reevaluate teachers' levels of technology integration based on the constructs of input and output techniques employed by secondary education instructors. While self-efficacy showed correlations with technology integration, utilizing grit provided a new investigative approach that had previously not been applied to this field. Grit was found to be correlated with teachers' levels of output technology integration, while self-efficacy was found to be associated with teachers' input technology integration. Despite the relationships between these variables, neither was found to improve the other regarding levels of technology integration at a statistically significant level.

There are many benefits to the incorporation of technology in educational settings. The implementation and support of instructors' use of technologies vary widely. This study provides additional applications of non-cognitive investigative practices, such as self-efficacy and grit, for determining possible variables for the differences amongst instructors regarding technology integration. While highly scrutinized for its application in determining success, grit may provide a possible variable to address further support for instructors in their approach to implementing new classroom tools for furthering students' knowledge construction, meta-cognition, and deep-conceptual understanding.

APPENDIX A

IRB APPROVAL

IRB Approval
5/24/2022
IRB # 76568
Exempt

PROTOCOL TYPE

1 u
co

Which IRB

Medical NonMedical

Protocol Process Type

Exemption
Expedited (Must be risk level 1)
Full

IMPORTANT NOTE: You will not be able to change your selections for "Which IRB" and "Protocol Process Type" after saving this section. If you select the wrong IRB or Protocol Process Type, you may need to create a new application.

See below for guidance on these options, or refer to ORI's "Getting Started" page. Please contact the Office of Research Integrity (ORI) at 859-257-9428 with any questions prior to saving your selections.

Which IRB

The **Medical IRB** reviews reviews research from the Colleges of:

- Dentistry
- Health Sciences
- Medicine
- Nursing
- Pharmacy and Health Sciences
- and Public Health.

The **Nonmedical IRB** reviews research from the Colleges of:

- Agriculture
- Arts and Sciences
- Business and Economics
- Communication and Information
- Design; Education
- Fine Arts
- Law
- and Social Work

Note: Studies that involve administration of drugs, testing safety or effectiveness of medical devices, or invasive medical procedures must be reviewed by the **Medical IRB** regardless of the college from which the application originates.

Which Protocol Process Type

Under federal regulations, the IRB can process an application to conduct research involving human subjects in one of three ways:

- by exemption certification
- by expedited review.
- by full review;

The investigator makes the preliminary determination of the type of review for which a study is eligible. Please refer to ORI's "Getting Started" page for more information about which activities are eligible for each type of review.

The revised Common Rule expanded exemption certification category 4 for certain secondary research with identifiable information or biospecimens. The regulations no longer require the information or biospecimens to be existing. For more information see the Exemption Categories Tool.

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EXEMPTION CATEGORIES

0 unresolved comment(s)

LIMITATIONS: Certain research activities **cannot** be exempt because additional protection has been granted by federal regulations for vulnerable populations. The categories of research that cannot be exempt are as follows:

- Research involving the surveying or interviewing of children (exempt category 2);
- Research involving educational test or the observation of public behavior of children if the investigators participate in the activities being observed (exempt category 2);
- Research involving benign behavioral intervention with children (exempt category 3);
- Research involving prisoners (unless the research is aimed at involving a broader subject population and the involvement of the prisoner(s) is only incidental).

Please note: *The revised common rule regulations now allow for the application of all exempt categories to research involving the use of pregnant women, human fetuses, and neonates, assuming* ***all*** *the research activities fall within one or more categories of exempt research as determined by the IRB.*

Research activities are exempt from the human research protection regulations when the only involvement of human subjects falls within one or more of below categories. **Research categories 1-5 do not apply to Food and Drug Administration (FDA) regulated research.** For additional guidance, see the UK ORI Exemption Categories Tool or the Issues to be Addressed with Exempt Review document.

Check the appropriate category(ies) that apply(ies) to your research project:

☐ (1) Research, conducted in established or commonly accepted educational settings that specifically involves normal educational practices that are not likely to adversely impact students' opportunity to learn required educational content or the assessment of educators who provide instruction. This includes most research on regular and special education instruction strategies, and research on the effectiveness of or the comparison among instructional techniques, curricula or classroom management methods.

☑ (2) Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures with adults, or observation of public behavior including visual or auditory recording (with minors as long a study personnel do not interact when observing), if at least **one** of the following criteria is met:

i. The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects; or
ii. Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or
iii. The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review.

If retaining identifiers, complete and attach the Limited Review Form under the Additional Information section using the Additional Materials attachment button.

☐ (3) (i) Research involving benign behavioral interventions in conjunction with the collection of information from an adult subject through verbal or written responses (including data entry) or audiovisual recording if the subject prospectively agrees to the intervention and information collection and at least one of the following criteria is met:

A. The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects; or
B. Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or
C. The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review.

(ii) For the purpose of this provision, benign behavioral interventions are brief in duration, harmless, painless, not physically invasive, not likely to have a significant adverse lasting impact on the subjects, and the investigator has no reason to think the subjects will find the interventions offensive or embarrassing. Provided all such criteria are met, examples of such benign behavioral interventions would include having the subjects play an online game, having them solve puzzles under various noise conditions, or having them decide how to allocate a nominal amount of received cash between themselves and someone else.

(iii) If the research involves deceiving the subjects regarding the nature or purposes of the research, this exemption is not applicable unless the subject authorizes the deception through a prospective agreement to participate in research in circumstances in which the subject is informed that he or she will be unaware of or misled regarding the nature or purposes of the research.

If retaining identifiers, complete and attach the Limited Review Form [PDF] under the Additional Information section using the Additional Materials attachment button.

☐ (4) Secondary research for which consent is not required: Secondary research uses of identifiable private information or identifiable biospecimens that have been or will be collected for some other 'primary' or 'initial' activity, if at least one of the following criteria is met:

i. The identifiable private information or identifiable biospecimens are publicly available;
ii. Information, which may include information about biospecimens, is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained directly or through identifiers linked to the subjects, the investigator does not contact the subjects, and the investigator will not re-identify subjects;
iii. The research involves only information collection and analysis involving the investigator's use of identifiable health information when that use is regulated under HIPAA, for the purposes of "health care operations" or "research" as those terms are defined at 45 CFR 164.501 or for "public health activities and purposes" as described under 45 CFR 164.512(b); or
iv. The research is conducted by, or on behalf of, a Federal department or agency using government-generated or government-collected information obtained for nonresearch activities, if the research generates identifiable private information that is or will be maintained on information technology that is subject to and in compliance with section 20B(b) of the E-Government Act of 2002, 44 U.S.C. 3501 note, if all of the identifiable private information collected, used, or generated as part of the activity will be maintained in systems of records subject to the Privacy Act of 1974, 5 U.S.C. 552a, and, if applicable, the information used in the research was collected subject to the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 *et seq.*

☐ (5) Research and demonstration projects that are conducted or supported by a Federal department or agency, or otherwise subject to the approval of department or agency heads (or the approval of the heads of bureaus or other subordinate agencies that have been delegated authority to conduct the research and demonstration projects), and that are designed to study, evaluate, improve, or otherwise examine public benefit or service programs, including procedures for obtaining benefits or services under those programs, possible changes in or alternatives to those programs or procedures, or possible changes in methods or levels of payment for benefits or services under those programs. Such projects include, but are not limited to, internal studies by Federal employees, and studies under contracts or consulting arrangements, cooperative agreements, or grants. Exempt projects also include waivers of otherwise mandatory requirements using authorities such as sections 1115 and 1115A of the Social Security Act, as amended.

- Each Federal department or agency conducting or supporting the research and demonstration projects must establish, on a publicly accessible Federal Web site or in such other manner as the department or agency head may determine, a list of the research and demonstration projects that the Federal department or agency conducts or supports under this provision. The research or demonstration project must be published on this list prior to commencing the research involving human subjects.

☐ (6) Taste and food quality evaluation and consumer acceptance studies:

i. If wholesome foods without additives are consumed; or
ii. If a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

Exemption Category 7 and Category 8 both require "Broad consent" provisions and involve storage or maintenance of identifiable private information or identifiable biospecimens for potential secondary research (7) OR research involving the use of identifiable private information or identifiable biospecimens for secondary research use (8). These categories are not an option at the University of Kentucky at this time, as the provisions require institution-wide tracking of individuals who do not agree to secondary use of their identifiable private information or identifiable biospecimens.

☐ This protocol is approved by a Non-UK IRB. This category should be chosen only after you have contacted the ORI Reliance Team and submitted the Reliance Registration Form [PDF]. If you have not submitted the Reliance Registration Form to ORI Reliance staff, please contact us at irbreliance@uky.edu.

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PROJECT INFORMATION

0 unresolved comment(s)

Title of Project: (Use the exact title listed in the grant/contract application, if applicable).
If your research investigates any aspect of COVID-19, please include "COVID19" at the beginning of your Project Title and Short Title

AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN TEACHER GRIT, TECHNOLOGY SELF-EFFICACY, AND TECHNOLOGY INTEGRATION

Short Title Description
Please use a few key words to easily identify your study - this text will be displayed in the Dashboard listing for your study.

Grit, Self-Efficacy, and Technology Integration

Anticipated Ending Date of Research Project: 8/31/2022

Maximum number of human subjects (or records/specimens reviewed) 200

After approval, will the study be open to enrollment of new subjects or new data/specimen collection? (•) Yes ( ) No

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PI CONTACT INFORMATION

0 unresolved comment(s)

Principal Investigator (PI) role for E-IRB access
The PI is the individual holding primary responsibility on the research project with the following permissions on the E-IRB application:

1. Read;
2. write/edit;
3. receive communications; and
4. submit to the IRB (IR, CR, MR, Other Review*).

If research is being submitted to or supported by an extramural funding agency such as NIH, a private foundation or a pharmaceutical/manufacturing company, the PI listed on the grant application or the drug protocol must be listed as PI here.

Please fill in any blank fields with the appropriate contact information (gray shaded fields are not editable). Required fields left blank will be highlighted in pink after you click "Save".

To change home and work addresses, go to myUK and update using the Employee Self Service (ESS) portal. If name has changed, the individual with the name change will need to submit a 'Name Change Form' to the Human Resources Benefits Office for entering into SAP. The new name will need to be associated with the individual's Link Blue ID in SAP before the change is reflected in E-IRB. Contact the HR Benefits Office for additional information.

The Principal Investigator's (PI) contact information is filled in automatically based on who logged in to create the application.

If you are not the Principal Investigator, do NOT add yourself as study personnel.
To change the PI contact information on an application in Researcher edit status:

- click "Change Principal Investigator";
- search for the PI's name using the search feature;
- click "Select" by the name of the Principal Investigator, then "Save Contact Information".

You will automatically be added as study personnel with editing permissions to continue editing the application.

Change Principal Investigator:

First Name: Joshua

[redacted]

Last Name: Marsh

Middle Name: Jeremiah Shiloh

Department: Educational Leadership Studi...

Dept Code: 8G010

PI's Employee/Student ID#: [redacted]

PI's Telephone #:

PI's e-mail address:

Rank: Ph.D Candidate

Degree: Ph.D. Candidate

PI's FAX Number:

PI is R.N. ○ Yes ● No

Trained: Yes

Date Trained: 2/10/2022

RCR Trained: Yes

Do you, the PI, have a significant financial interest related to your responsibilities at the University of Kentucky (that requires disclosure per the UK administrative regulation 7:2)?

○ Yes ● No

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RISK LEVEL

0 unresolved comment(s)

Indicate which of the categories listed below accurately describes this protocol

- (x) (Risk Level 1) Not greater than minimal risk
- ( ) (Risk Level 2) Greater than minimal risk, but presenting the prospect of direct benefit to individual subjects
- ( ) (Risk Level 3) Greater than minimal risk, no prospect of direct benefit to individual subjects, but likely to yield generalizable knowledge about the subject's disorder or condition.
- ( ) (Risk Level 4) Research not otherwise approvable which presents an opportunity to understand, prevent, or alleviate a serious problem affecting the health or welfare of subjects.

*"Minimal risk" means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves from those ordinarily encountered in daily life or during the performance of routine physical or psychological examination or tests.

*****For Expedited and Exempt Applications, the research activities must be Risk Level 1 (no more than minimal risk to human subjects).*****

Refer to UK's guidance document on assessing the research risk for additional information.

SUBJECT DEMOGRAPHICS

0 unresolved comment(s)

Age level of human subjects: (i.e., 6 mths.; 2yrs., etc..) 18 to 99

Indicate the targeted/planned enrollment of the following members of minority groups and their subpopulations. Possible demographic sources: Census Regional Analyst Edition, Kentucky Race/Ethnic Table, Kentucky Population Data.
(Please note: The IRB will expect this information to be reported at Continuation Review time for Pre-2019 FDA-regulated Expedited review and Full review applications):

Enter Numbers Only!

Ethnic Origin	#Male	#Female
American Indian/Alaskan Native:		
Asian:		
Black/African American:		
Hispanic/Latino:		
Native Hawaiian/Pacific Islander:		
White/Caucasian:		
Other or Unknown:		

If unknown, please explain why: Demographic information relating to teaching faculty will be collected when surveys are administered.

Indicate the categories of subjects and controls to be included in the study. You may be required to complete additional forms depending on the subject categories which apply to your research. If the study does not involve direct intervention or direct interaction with subjects, (e.g., record-review research, outcomes registries), do not check populations which the research does not specifically target. For example: a large record review of a diverse population may incidentally include a prisoner or an international citizen, but you should not check those categories if the focus of the study has nothing to do with that status.

Check All That Apply (at least one item must be selected)

- ☐ Children (individuals under age 18)
- ☐ Wards of the State (Children)
- ☐ Emancipated Minors
- ☐ Students
- ☐ College of Medicine Students
- ☐ UK Medical Center

ADDITIONAL INFORMATION:

Please visit the IRB Survival Handbook for more information on:

- Children/Emancipated Minors
- Students as Subjects
- Prisoners
- Impaired Consent Capacity Adults:

Residents or House Officers

- ☐ Impaired Consent Capacity Adults
- ☐ Pregnant Women/Neonates/Fetal Material
- ☐ Prisoners
- ☐ Non-English Speaking
- ☐ International Citizens
- ☑ Normal Volunteers
- ☐ Military Personnel and/or DoD Civilian Employees
- ☐ Patients
- ☐ Appalachian Population

Other Resources:

- UKMC Residents or House Officers [see requirement of GME]
- Non-English Speaking [see also the E-IRB Research Description section on this same topic]
- International Citizens [DoD SOP may apply]
- Military Personnel and/or DoD Civilian Employees

Assessment of the potential recruitment of subjects with impaired consent capacity (or likelihood):

☐ Check this box if your study does NOT involve direct intervention or direct interaction with subjects (e.g., record-review research, secondary data analysis). If there is no direct intervention/interaction you will not need to answer the impaired consent capacity questions.

Does this study focus on adult subjects with any conditions that present a high *likelihood* of impaired consent capacity or *fluctuations* in consent capacity? (see examples below)

○ Yes ◉ No

If Yes and you are not filing for exemption certification, go to "Form T", complete the form, and attach it using the button below.

Examples of such conditions include:

- Traumatic brain injury or acquired brain injury
- Severe depressive disorders or Bipolar disorders
- Schizophrenia or other mental disorders that involve serious cognitive disturbances
- Stroke
- Developmental disabilities
- Degenerative dementias
- CNS cancers and other cancers with possible CNS involvement
- Late stage Parkinson's Disease
- Late stage persistent substance dependence
- Ischemic heart disease
- HIV/AIDS
- COPD
- Renal insufficiency
- Diabetes
- Autoimmune or inflammatory disorders
- Chronic non-malignant pain disorders
- Drug effects
- Other acute medical crises

Attachments

INFORMED CONSENT/ASSENT PROCESS/WAIVER

0 unresolved comment(s)

For your informed consent attachment(s), please download the most up-to-date version listed in "All Templates" under the APPLICATION LINKS menu on the left, and revise to be in accord with your research project.

Additional Resources:

- Sample Repository/Registry/Bank Consent (Word)
- Instructions for Proposed Informed Consent Document
- Instructions for Proposed Assent Form

Consent/Assent Tips:

- If you have multiple consent documents, be sure to upload each individually (not all in a combined file).
- Changes to consent documents (e.g., informed consent form, assent form, cover letter, etc...) should be reflected in a 'tracked changes' version and uploaded separately with the Document Type "Highlighted Changes".
- It is very important that only the documents you wish to have approved by the IRB are attached; DELETE OUTDATED FILES -- previously *approved* versions will still be available in Protocol History.
- Attachments that are assigned a Document Type to which an IRB approval stamp applies will be considered the version(s) to be used for enrolling subjects once IRB approval has been issued.
  Document Types that do NOT get an IRB approval stamp are:
  - "Highlighted Changes",
  - "Phone Script", and
  - "Sponsor's Sample Consent Form".

How to Get the Informed Consent Section Check Mark

1. **You must check the box for at least one of the consent items and/or check mark one of the waivers, then if applicable attach the corresponding document(s) as a PDF (if open to enrollment).**
2. **If you no longer need a consent document approved (e.g., closed to enrollment), or, the consent document submitted does not need a stamp for enrolling subjects (e.g., umbrella study, or sub-study), only check mark the "Stamped Consent Doc(s) Not Needed".**
3. **If none of the consent items or waiver requests apply to your research, you may check mark the box for "Not Applicable" in order to get your Informed Consent section check mark.**
4. **After making your selection(s) be sure to scroll to the bottom of this section and SAVE your work!**

☐ Not applicable

Check All That Apply

☐ Informed Consent Form (and/or Parental Permission Form)
☐ Assent Form
☑ Cover Letter (for survey/questionnaire research)
☐ Phone Script
☐ Informed Consent/HIPAA Combined Form
☐ Debriefing and/or Permission to Use Data Form
☐ Sponsor's sample consent form for Dept. of Health and Human Services (DHHS)-approved protocol
☐ Stamped Consent Doc(s) Not Needed

Attachments

Attach Type	File Name
CoverLetter	Informed Consent Document.pdf

☐ Request for Waiver of Informed Consent Process

If you are requesting IRB approval for waiver of the requirement for the informed consent process, or alteration of some or all of the elements of informed consent (i.e. medical record review, deception research, or collection of biological specimens), complete Section 1 and Section 2 below.

Note: The IRB does not approve waiver or alteration of the consent process for greater than minimal risk research, except for planned emergency/acute care research as provided under FDA regulations. Contact ORI for regulations that apply to single emergency use waiver or acute care research waiver (859-257-9428).

SECTION 1.

Check the appropriate item:

☐ I am requesting waiver of the requirement for the informed consent process.

☐ I am requesting alteration of the informed consent process.

If you checked the box for this item, describe which elements of consent will be altered, and/or omitted, and justify the alteration.

SECTION 2.

The IRB may consider your request provided that **all** of the following conditions apply to your research and are appropriately justified. Explain in the space provided for each condition how it applies to your research.

a) The research involves no more than minimal risk to the subject.

b) The rights and welfare of subjects will not be adversely affected.

c) The research could not practicably be carried out without the requested waiver or alteration.

d) Whenever possible, the subjects or legally authorized representatives will be provided with additional pertinent information after they have participated in the study.

e) If the research involves using or accessing identifiable private information or identifiable biospecimens, the research could not practicably be carried out without using such information or biospecimens in an identifiable format.

- Private information/specimens are "identifiable" if the investigator may ascertain the identity of the subject or if identifiers are associated with the information (e.g., medical records). This could be any of the 18 HIPAA identifiers including dates of service.
- If not using identifiable private information or identifiable biospecimens, insert N/A below.

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☑ Request for Waiver of Documentation of Informed Consent Process

If you are requesting IRB approval for waiver of the requirement for documentation of informed consent (i.e. telephone survey or mailed survey, internet research, or certain international research), **your research activities must fit into one of three regulatory options**:

1. The only record linking the participant and the research would be the consent document, and the principal risk would be potential harm resulting from a breach of confidentiality (i.e., a study that involves participants who use illegal drugs).
2. The research presents no more than minimal risk to the participant and involves no procedures for which written consent is normally required outside of the research context (i.e. a cover letter on a survey, or a phone script).
3. The participant (or legally authorized representative) is a member of a distinct cultural group or community in which signing forms is not the norm, and the research presents no more than minimal risk to the subject and there is an appropriate alternative mechanism for documenting that informed consent was obtained.

Select the option below that best fits your study, and explain in the space provided how your study meets the criteria for the selected regulatory option.

Note: The IRB cannot waive the requirement for documentation or alter the consent form for FDA-regulated research unless it meets Option #2 below. FDA does not accept Option #1.

Note: Even if a waiver of the requirement for documentation is approved by the IRB, participants must still be provided oral or written (e.g., cover letter) information including all required and appropriate elements of consent so they have the knowledge and opportunity to consider whether or not to participate. To help ensure required elements are included in your consent document, please use the **Cover Letter Template** as a guide: *English*- [WORD], Spanish- [WORD] The cover letter template was developed specifically for survey/questionnaire research; however, it may be useful as a guide for developing a consent document for other types of research as well.

○ **Option 1**

a) The only record linking the participant and the research would be the consent document:

b) The principal risk would be potential harm resulting from a breach of confidentiality (i.e., a study that involves subjects who use illegal drugs).

Under this option, each participant (or legally authorized representative) must be asked whether (s)he wants to sign a consent document; if the participant agrees to sign a consent document, only an IRB approved version should be used.

◉ **Option 2**

a) The research presents no more than minimal risk to the participant:

The only information collected from participants will be based upon demographics, self-efficacy, grit, and technology integration. There is minimal risk to participants based upon the data that will be collected.

b) Involves no procedures for which written consent is normally required outside of the research context (i.e. a cover letter on a survey, or a phone script):

A cover letter will be supplied to participants on the survey.

○ **Option 3**

a) The subject (or legally authorized representative) is a member of a distinct cultural group or community in which signing forms is not the norm.

b) The research presents no more than minimal risk to the subject.

c) There is an appropriate alternative mechanism for documenting that informed consent was obtained.

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STUDY PERSONNEL

0 unresolved comment(s)

Do you have study personnel who will be assisting with the research?
After selecting 'Yes' or 'No' you must save by hitting the 'Save Study Personnel Information' button.

◉ Yes ○ No

Manage Study Personnel

Identify other study personnel assisting in research project:

- The individual listed as PI in the 'PI Contact Information' section should NOT be added to this section.
- If the research is being completed to meet the requirements of a University of Kentucky academic program, the faculty advisor is also considered study personnel and should be listed as such below. ***Residents and students who are PI's are encouraged to designate at least one other individual (e.g., faculty advisor) as a contact with an editor role (DP).***
- Role: DP = Editor (individual can view, navigate, and edit the application for any review phase (IR, CR/FR, MR) or 'Other Review", and submit Other Reviews on behalf of the PI.)
- Role: SP = Reader (individual can view and navigate through the currently approved application only.)

To add an individual via the below feature, search for applicable personnel first, then click "select" by the listing for the person you want to add as study personnel to your protocol. For each individual selected, be sure to specify responsibility in the project, whether authorized by the principal investigator to obtain informed consent, AND denote who should regularly receive E-IRB notifications.

NOTE: Study personnel are required to receive human research protection (HSP) training before implementing any research procedures (e.g., CITI). For information about mandatory training requirements for study personnel, visit UK's FAQ's on Mandatory Training web page, or contact ORI at 859-257-9428. If you have documentation of current HSP training other than that acquired through UK CITI, you may submit it to ORI (HSPTrainingSupport@uky.edu) for credit.

Study personnel assisting in research project:

Last Name	First Name	Responsibility In Project	Role	A C	Contact	Degree	StatusFlag	(HSP)	(HSP)Date	(RCR)	Removed?	Last Updated	SFI
Nash	John	Faculty Advisor	DP	Y	Y	Ph. D.	P	Y	04/26/2020	Y	N	05/06/2022	N
Marsh	Joshua	Co-Investigator	DP	N	Y		S	Y	02/10/2022	Y	Y	05/06/2022	N

RESEARCH DESCRIPTION

0 unresolved comment(s)

You may attach a sponsor's protocol pages in the "Additional Information" section and refer to them where necessary in the Research Description. However, each prompt that applies to your study should contain at least a summary paragraph.

****!!!PLEASE READ!!!** Known Issue: The below text boxes do not allow symbols, web addresses, or special characters (characters on a standard keyboard should be ok). If something is entered that the text boxes don't allow, user will lose unsaved information.**

Workaround(s):

- **Save your work often to avoid losing data.**
- **Use one of the attachment buttons in this section, or under the Additional Information section to include the information with your application. During the document upload process, you will be able to provide a brief description of the attachment.**

Background: Provide an introduction and background information. Describe past experimental and/or clinical findings leading to the formulation of your study. You may reference grant application/sponsor's relevant protocol pages and attach as an appendix in the E-IRB "Additional Information" section, however, a summary paragraph must be provided in the text box below. Provide a summary of research reported in the literature that forms the scientific background for the present study.

Many investigations have sought to understand teacher's approaches to technology integration relating to cognitive factors, such as access (Amore, 2020; Collins, Karsenti, Ndimubandi, & Saffari, 2016; Glasmeier, 2021; Grant et al., 2015; Hampton et al., 2020; Harris, Ziedan, & Hassig, 2021; Hutchison & Reinking, 2011; Kaden, 2020; Khlaif, 2018; Kurt & Cliftci, 2012; McElrath, 2020; Romano, 2020; Sangani, 2013), experience (Abbitt, 2011, Hutchison & Woodward, 2018; Khlaif, 2018; Li, 2007), testing protocols (Cifuentes, Maxwell, & Bulu, 2011; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Wang, Hsu, Campbell, Coster, & Longhurst, 2014), and professional development (Ertmer et al., 2012; Grant et al., 2015; Hutchison & Woodward, 2018). More recent investigations into teacher non-cognitive factors, such as teachers' levels of technology self-efficacy (Joo, Park, & Lim, 2018; Kent & Giles, 2018), have sought to dig deeper into variables impacting teachers' approaches to technology integration. This study explores the relationship between teachers' perceived levels of technology integration, technology self-efficacy, and teacher grit. This investigation will add to the body of literature on psychometric studies and will apply grit as an investigative tool for understanding technology integration.

Objectives: List your research objectives. You may reference grant application/sponsor's relevant protocol pages and attach as an appendix in the E-IRB "Additional Information" section, however, a summary paragraph must be provided in the text box below.

The following research questions will guide this investigation:
1. Does there exist a relationship between teacher grit score and the following characteristics:
a) subject area
b) years of instruction
c) age
d) gender
e) level of education
2. Does there exist a relationship between teacher grit and levels of technology integration vary as a function of self-efficacy levels?
3. Does there exist a relationship between self-efficacy and levels of technology integration vary as a function of grit levels?
4. Do grit and self-efficacy interact with one another? Furthermore, how does the possible interaction affect levels of technology integration?

Study Design: Describe the study design (e.g., control and experimental groups, etc.). Indicate whether or not the subjects will be randomized for this study. Address whether deception will be involved in the study. You may reference sponsor's protocol pages and attach as an appendix in the E-IRB "Additional Information" section, however, a summary paragraph must be provided in the text box below. (Including the study design table from a sponsor's protocol is helpful to IRB members.)

Community-Based Participatory Research: If you are conducting community-based participatory research (CBPR), describe strategies for involvement of community members in the design and implementation of the study, and dissemination of results from the study.

Research Repositories: If the purpose of this submission is to establish a Research Repository (bank, registry) indicate whether the material you plan to collect would or would not be available from a commercial supplier, clinical lab, or established IRB approved research repository. Provide scientific justification for establishment of an additional repository collecting duplicate material. Describe the repository design and operating procedures. For relevant information to include, see the UK Research Biospecimen Bank Guidance or the UK Research Registry Guidance.

There are [redacted]. From all these districts, one rural school district will be used for investigation. Approval will be acquired from the district's superintendent to administer surveys across three traditional high schools in the school district. Other schools in the district which are listed as non-traditional public schools will not be investigated. This district is representative of a rural school district in North Carolina. There were approximately 200 teachers which will be surveyed for this study.

Grit will be considered as a predictor variable for technology integration using Hierarchical Linear Regression Modeling (HLRM). Additional variables, including technology self-efficacy, will be added to determine their possible relationship with grit and technology integration. Statistical correlation analyses will be used to determine the correlations between other variables and technology integration. Additional Analyses will be used to determine differences between variables.

Data Analysis. I will use statistical analysis on the quantitative data gathered from full-time instructors at each of the three traditional high schools in the district. I will use SPSS statistical software for analyzing the data. To analyze correlations, I will use several steps. During the first step of the analysis, correlations will be investigated between variables to determine any statistically significant relationships. These relationships will be determined based on statistical analysis protocols relating to correlation coefficients and R-squared analysis. Any variable which did not exhibit significant correlations will not be viewed as significant. I will also consider relationships between independent variables to improve any shifts in variability which may result from significant correlation.

In the second step of the analysis, I will use hierarchical linear regression by predicting the level of teacher perceived technology integration by grit score and technology self-efficacy, and additional demographic information. Again, significant changes in R-squared values will indicate variables that impacted the dependent variable of technology integration. Finally, I will use descriptive statistics to determine significant differences between the final independent variables and technology integration in the final analysis step.

Attachments

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Study Population: Describe the characteristics of the subject population, such as anticipated number, age range, gender, ethnic background and health status. Identify the criteria for inclusion and exclusion. Explain the rationale for the use of special classes such as fetuses, pregnant women, children, institutionalized, adults with impaired consent capacity, prisoners, economically or educationally disadvantaged persons or others who are likely to be vulnerable.

If women or minorities are included, please address how the inclusion of women and members of minority groups and their subpopulations will help you meet your scientific objectives. Exclusion of women or minorities requires clear and compelling rationale that shows inclusion is inappropriate with respect to the health of the subjects or that inclusion is inappropriate for the purpose of the study. Cost is not an acceptable reason for exclusion except when the study would duplicate data from other sources. Women of childbearing potential should not be excluded routinely from participation in clinical research.

Provide the following information:

- A description of the subject selection criteria and rationale for selection in terms of the scientific objectives and proposed study design;
- A compelling rationale for proposed exclusion of any sex/gender or racial/ethnic group;
- The proposed dates of enrollment (beginning and end);
- The proposed sample composition of subjects.

You may reference grant application/sponsor's relevant protocol pages and attach as an appendix using the below attachment button,

[redacted]

Attachments

Subject Recruitment Methods & Privacy: Using active voice, describe plans for the identification and recruitment of subjects, including how the population will be identified, and how initial contact will be made with potential subjects by those having legitimate access to the subjects' identity and the subjects' information.

Describe the setting in which an individual will be interacting with an investigator or how and where members of the research team will meet potential participants. If applicable, describe proposed outreach programs for recruiting women, minorities, or disparate populations as participants in clinical research. Describe steps taken to minimize undue influence in recruiting potential participants.

Please note: Based upon both legal and ethical concerns, the UK IRB does not approve finder's fees or "cold call" procedures made by research staff unknown to the potential participant. The ORI/IRB does not control permission to any UK listserv, mass mailing list, etc. Investigators must secure prior approval for access and use from owners/managers.

For additional details, see topic "Recruitment of Subjects/Advertising" on ORI's IRB Survival Handbook web page and the PI Guide to Identification and Recruitment of Human Subjects for Research.

[redacted]

[redacted]

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Advertising: Specify if any advertising will be performed. If yes, please see "IRB Application Instructions - Advertisements" for instructions on attaching copies of the information to be used in flyers or advertisements. Advertisements must be reviewed and approved by the IRB prior to use. For additional details, see topic "Recruitment of Subjects/Advertising" on ORI's IRB Survival Handbook web page for the *PI Guide to Identification and Recruitment of Human Subjects for Research* [D7.0000] document [PDF]. If you will be recruiting subjects via advertising at non-UK owned or operated sites, you should include a copy of written permission from that site to place the advertisement in their facilities.

Note: Print and media advertisements that will be presented to the public also require review by UK Public Relations (PR) to ensure

[redacted]

Attachments

Informed Consent Process: Using active voice, describe the consent/assent procedures to be followed, the circumstances under which consent will be sought and obtained, the timing of obtaining informed consent, whether there is any waiting period between informing the prospective subject and obtaining consent, who will seek consent., steps taken to minimize the possibility of coercion or undue influence, the method used for documenting consent, and if applicable who is authorized to provide permission or consent on behalf of the subject. Note: all individuals authorized to obtain informed consent should be designated as such in the E-IRB "Study Personnel" section of this application.

Describe provisions for obtaining consent/assent among any relevant special populations such as children (see Children in Research Policy [PDF] for guidance), prisoners (see Summary of Prisoner Regulations [PDF] for guidance), and persons with impaired decisional capacity (see Impaired Consent Capacity Policy [PDF] for guidance). Describe, if applicable, use of specific instruments or techniques to assess and confirm potential subjects' understanding of the nature of the elements of informed consent and/or a description of other written materials that will be provided to participants or legally authorized representatives. If you have a script, please prepare it using the informed consent template as a guide, and submit it on a separate page.

Informed Consent for Research Involving Emancipated Individuals
If you plan to enroll some or all prospective subjects as emancipated, consult with UK legal counsel **when preparing the IRB application and prior to submitting the application to the IRB**. Include legal counsel's recommendations (legal counsel's recommendations may be attached in the E-IRB "Additional Information" section as a separate document, if necessary). For a complete definition of emancipated minors, see the section on *Emancipated Individuals* in the Informed Consent SOP [PDF].

Informed Consent for Research Involving Non-English Speaking Subjects
If you are recruiting non-English speaking subjects, the method by which consent is obtained should be in language in which the subject is proficient. Describe the process for obtaining informed consent from prospective subjects in their respective language (or the legally authorized representative's respective language). In order to ensure that individuals are appropriately informed about the study when English is their second-language, describe a plan for evaluating the level of English comprehension, and the threshold for providing a translation, or explain why an evaluation would not be necessary. For additional information on inclusion of non-English speaking subjects, or subjects from a foreign culture, see IRB Application Instructions for Recruiting Non-English Speaking Participants or Participants from a Foreign Culture.

Research Repositories
If the purpose of this submission is to establish a research repository describe the informed consent process. For guidance regarding consent issues, process approaches, and sample language see the Sample Repository/Registry/Bank Consent Template [PDF]

Participants will receive an email invitation to participate in the survey from the district. When they click on the link to the survey they will first see the consent form followed by a multiple choice survey question asking if they have read the information above, meet the eligibility requirements, and agree to participate. Participants will only be allowed to advance once they checked the box affirming that they consent. Otherwise, they will be thanked for their time and the survey will end.

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Research Procedures: Describe the research procedures that will be followed. Identify all procedures that will be carried out with each group of subjects. If applicable, differentiate between procedures that involve standard/routine procedures for care/treatment from those that will be performed specifically for this research project.

Participants will receive an email requesting their participation (see advertisement message above). Once they open the link to the survey, they will see the consent form for the study. The consent form will be displayed at the beginning of the electronic survey. Participants will not be allowed to move forward into the survey instrument without completing the consent form. Once participants have checked off that they consent to complete the survey then they will be allowed to complete the survey.

Attachments

Data Collection: List the data or attach a list of the data to be collected about or from each subject (e.g. interview script, survey tool, data collection form for existing data).

If the research includes survey or interview procedures, the questionnaire, interview questions or assessment scales should be included in the application (use attachment button below).

The data collection instrument(s) can be submitted with your application in draft form with the understanding that the final copy will be submitted to the IRB for approval prior to use (submit final version to the IRB for review as a modification request if initial IRB approval was issued while the data collection instrument was in draft form).

Note: The IRB approval process does not include a statistical review. Investigators are strongly encouraged to develop data management and analysis plans in consult with a statistician.

Data Collection. Data collection will occur in two phases. During phase one, information regarding the number of full-time instructors at each high school will be collected which is publicly available. This information will be used to determine the % of teachers who participated in the survey.

During the second phase of the study, I will collect data from each teacher in three high schools using a survey. The survey will be used to collect information, including gender, age, years of instruction, courses taught, perceived levels of technology integration, technology self-efficacy, and grit.

The survey will consist of 5 short answer questions, 21 multiple choice questions, and 9 Likert scale questions. Please see the attached survey for all survey questions.

Data collected will then be analyzed using the HLRM approach.

Attachments

Attach Type	File Name
DataCollection	Survey .docx

Resources: Describe what resources/facilities are available to perform the research (i.e., staff, space, equipment). Such resources may include a) staffing and personnel, in terms of availability, number, expertise, and experience; b) psychological, social, or medical services, including counseling or social support services that may be required because of research participation; c) psychological, social, or medical monitoring, ancillary care, equipment needed to protect subjects; d) resources for subject communication, such as language translation services, and e) computer or other technological resources, mobile or otherwise, required or created during the conduct of the research. Please note: Some mobile apps may be considered mobile medical devices under FDA regulations (see FDA Guidance). Proximity or availability of other resources should also be taken into consideration, for example, the proximity of an emergency facility for care of subject injury, or availability of psychological support after participation.

Research activities conducted at performance sites that are not owned or operated by the University of Kentucky, at sites that are geographically separate from UK, or at sites that do not fall under the UK IRB's authority, are subject to special procedures for coordination of research review. Additional information is required (see IRB Application Instructions - Off-Site Research web page); supportive documentation can be attached in the E-IRB "Additional Information" section. Provide a written description of the role of the non-UK site(s) or non-UK personnel who will be participating in your research. The other site may need to complete its own IRB review, or a cooperative review arrangement may need to be established. Contact the Office of Research Integrity at (859) 257-9428 if you have questions about the participation of non-UK sites/personnel.

If the University of Kentucky is the lead site in a multi-site study, or the UK investigator is the lead investigator, describe the plan for managing the reporting of unanticipated problems, noncompliance and submission of protocol modifications and interim results from the non-UK sites.

Surveys will be administered via email and data will be collected via Qualtrics Data collection software. Data will be stored and password protected on the researcher's personal computer for analysis purposes and analyzed using SPSS Statistical analysis software.

Potential Risks: Describe any potential risks subjects may encounter while in the study, e.g., physical, psychological, social, legal or other, and assess their likelihood and seriousness. Where appropriate, describe alternative treatments or procedures that might be advantageous to the subjects.

Data will be aggregated from all sites and there will be no identifying location information for participants or other information which could identify individual participants in the study. Therefore, there is no potential risk to participants.

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Safety Precautions: Describe the procedures for protecting against or minimizing any potential risks, *including risks of breach of confidentiality or invasion of privacy*. Where appropriate, discuss provisions for ensuring necessary medical or professional intervention in the event of adverse events, or unanticipated problems involving subjects. Also, where appropriate, describe the provisions for monitoring the data collected to ensure the safety of subjects. If vulnerable populations other than adults with impaired consent capacity are to be recruited, describe additional safeguards for protecting the subjects' rights and welfare.

There are no precautions that are required for this investigation.

Benefit vs. Risk: Describe potential benefits to the subject(s); include potential benefits to society and/or general knowledge to be gained. Describe why the risks to subjects are reasonable in relation to the anticipated benefit(s) to subjects and in relation to the importance of the knowledge that may reasonably be expected to result. If you are using vulnerable subjects (e.g., impaired consent capacity, pregnant women, etc…), justify their inclusion by describing the potential benefits of the research in comparison to the subjects' vulnerability and the risks to them. For information about inclusion of certain vulnerable populations, see the IRB/ORI Standard Operating Procedure for Protection of Vulnerable Subjects [C3.0100] [PDF].

Significant investments are being made in public education institutions annually, especially in the area related to educational technologies. These technologies benefit both teachers and students, yet many barriers exist to effectively integrating these tools for educators. While there are many investigative tools to mitigate technology integration by instructional staff, these techniques may not be effective because of teachers' non-cognitive traits relating to self-efficacy and grit. Teacher grit impacts teacher job performance and retention, but there is limited information in previous studies regarding the application of grit to technology integration. This investigation would add a great deal of necessary information to the research literature regarding the application of grit and self-efficacy to investigations of technology integration in public schools.

Available Alternative Treatment(s): Describe alternative treatments and/or procedures that might be available to subjects who choose not to participate in the study which offer the subject equal or greater advantages. If applicable, this should include a discussion of the current standard of care treatment(s).

There would not be any alternative treatments associated with this investigation.

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Research Materials, Records and Privacy: Identify the sources of research material obtained from living human subjects. Indicate what information (specimens, records, data, genetic information, etc.) will be recorded and whether use will be made of existing specimens, records or data. Explain why this information is needed to conduct the study.

Return of Research Results or Incidental Findings (if applicable):
If research has the potential to identify individual results or discover incidental findings that could affect the health of a subject, describe plans to assess, manage, and if applicable disclose findings with individual subjects or provide justification for not disclosing. For IRB expectations, refer to the UK IRB "Frequently Asked Questions (FAQs) on the Return of Research Results or Incidental Research Findings" [PDF].

The only research materials for this investigation would be school demographic makeup and survey data.

Confidentiality: Specify where the data and/or specimens will be stored and how the researcher will ensure the privacy and confidentiality of both. Please address the following items or indicate if the following has been addressed in a HIPAA or Limited Review form:

- physical security measures (e.g., locked facility, limited access);
- data security (e.g., password-protection, data encryption);
- who will have access to the data/specimens and identifiers;
- safeguards to protect identifiable research information (e.g., coding, links, certificate of confidentiality);
- procedures employed when sharing material or data, (e.g., honest broker if applicable, written agreement with recipient not to re-identify, measures to ensure that subject identifiers are not shared with recipients).
- management after the study

Describe whether data/specimens will be maintained indefinitely or destroyed. If maintained, specify whether identifiers will be removed from the maintained information/material. If identifiers will not be removed, provide justification for retaining them. If the data/specimens will be destroyed, describe how and when the data/specimens will be destroyed. For multi-site studies, the PI consults the study sponsor regarding retention requirements, but must maintain records for a minimum of six years after study closure. Also, specify who will access the identified data/specimens, and why they need access. If applicable, describe what measures will be taken to ensure that subject identifiers are not given to the investigator. If applicable, describe procedures for sharing data/specimens with entities not affiliated with UK (If the research is non-sponsored you need a data use agreement to share data/specimens [Transfer Agreements]).

HIPAA/FERPA Minimal Access Standards: The IRB expects researchers to access the minimal amount of identifiers to conduct the study and comply with applicable HIPAA and Family Educational Rights and Privacy Act (FERPA) requirements. If data are going to be collected, transmitted, and/or stored electronically, for appropriate procedures please refer to the guidance document "Confidentiality and Data Security Guidelines for Electronic Data" [PDF].

Cloud storage: For storage of data on cloud services other than UK OneDrive, please verify security settings are sufficient and in accordance with respective departmental, UK Corporate Compliance, and/or UK Information Technology requirements.

Creation of digital data application/program: If a research protocol involves the creation and/or use of a computer program or application, mobile or otherwise, please specify whether the program/application is being developed by a commercial software developer or the research team and provide any relevant information regarding the security and encryption standards used, how data is stored and/or transmitted to the research team, what information about the subjects the program/application will collect, etc. For relevant information to include, see Considerations for Protocol Design Concerning Digital Data [PDF]. The IRB may require software programs created or used for research purposes be examined by a consultant with appropriate Internet technology expertise to ensure subject privacy and data are appropriately protected.

Management after study: Describe how the collected data/specimens will be managed after the end of the study. Specify whether identifiers will be removed from the maintained information/material. If identifiers will not be removed, provide justification for retaining them and specify what steps will be taken to secure the data/specimens (e.g., maintaining a coded list of identifiers separate from the data/specimens).

If the data/specimens will be destroyed, describe how, when, and why this will be done. Note that destruction of primary data may violate NIH and NSF retention and sharing requirements, journal publication guidance, and University Data-Retention policies. Additionally, primary data may be necessary for other purposes (to validate reproducibility, for data sharing, or for evidence in various investigations). PIs should carefully consider whether the destruction of data is justified.

The investigator is responsible for retaining signed consent and assent documents and IRB research records for at least six years after study closure, as outlined in the Study Closure SOP [PDF]. If the research falls under the authority of the FDA or other regulatory agencies, or a study sponsor is involved, additional requirements may apply.

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No physical storage of the survey data will be kept. Data will be secured on a password-protected computer, to which only I will have access. Survey data will provide demographic information but instructor names and other identifiable data will not be collected. Instructors will only be identified based upon letter appreciation (i.e. Teacher A, Teacher B, etc.). Data will be continued to be stored on a password-protected computer after the completion of the study.

I will retain research data and IRB-related materials for a minimum of 6 years after the IRB-approval period.

I will not be collecting IP addresses from users who complete the survey and will disable this feature within the Qualtrics program by using the Anonymize Responses setting.

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Payment: Describe the incentives (e.g., inducements) being offered to subjects for their time during participation in the research study. If monetary compensation is offered, indicate how much the subjects will be paid and describe the terms and schedule of payment. (It is IRB policy that provision should be made for providing partial payment to subjects who withdraw before the completion of the research. Monetary payments should be prorated or paid in full.)

There will be no payments associated with this investigation.

Costs to Subjects: Describe any costs for care associated with research (including a breakdown of standard of care procedures versus research procedures), costs of test drugs or devices, and research procedure costs that are the subject's responsibility as a consequence of participating in the research. Describe any offer for reimbursement of costs by the sponsor for research related injury care.

The are no costs to subjects for this investigation.

Data and Safety Monitoring: The IRB requires review and approval of data and safety monitoring plans for greater than minimal risk research, or NIH-funded clinical investigations.

If you are conducting greater than minimal risk research, or your clinical investigation is NIH-funded, describe your Data and Safety Monitoring Plan (DSMP). Click here for additional guidance on developing a Data and Safety Monitoring Plan.

If this is a *non-sponsored investigator-initiated* protocol considered greater than minimal risk research, *and* if you are planning on using a Data and Safety Monitoring Board (DSMB) as part of your DSMP, click here for additional guidance for information to include with your IRB application.

Data and safety monitoring are not required for this investigation.

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Subject Complaints: Describe procedures (other than information provided in consent document) for handling subject complaints or requests for information about the research. The procedures should offer a safe, confidential, and reliable channel for current, prospective, or past research subjects (or their designated representative) permitting them to discuss problems, concerns and questions, or obtain information.

Participants will be allowed to email any questions they have regarding the investigation or any concerns they might have.

Are you recruiting or expect to enroll **Non-English Speaking Subjects or Subjects from a Foreign Culture**? (does not include short form use for incidentally encountered non-English subjects)

○ Yes ● No

Non-English Speaking Subjects or Subjects from a Foreign Culture

Describe how information about the study will be communicated to potential subjects appropriate for their culture, and if necessary, how new information about the research may be relayed to subjects during the study.

Include contact information for someone who can act as a cultural consultant for your study. The person should be familiar with the culture of the subject population and/or be able to verify that translated documents are the equivalent of the English version of documents submitted. The consultant should not have any direct involvement with the study. If you do not know someone who would be willing to act as your cultural consultant, the Office of Research Integrity will try to find someone to fill this role (this may delay the approval process for your protocol). Please include the name, address, telephone number, and email of the person who will act as the cultural consultant for your study. For more details, see the

IRB Application Instructions on Research Involving Non-English Speaking Subjects or Subjects from a Foreign Culture.

For recruitment of Non-English speaking subjects, the consent document needs to be in the subject's native language. Download the informed consent template available in the E-IRB "Informed Consent/Assent Process" section and use it as a guide for developing the consent document. (Note: Your translated consent document can be attached to your application in the "Informed Consent" section; **be sure to save your responses in this section first**.)

If research is to be conducted at an international location, identify local regulations, laws, or ethics review requirements for human subject protection. If the project has been or will be reviewed by a local Ethics Committee, attach a copy of the review to the UK IRB using the attachment button below. You may also consult the current edition of the International Compilation of Human Research Standards

Does your study involve **HIV/AIDS research and/or screening for other reportable diseases (e.g., Hepatitis C, etc...)**?

○ Yes ◉ No

HIV/AIDS Research

If you have questions about what constitutes a reportable disease and/or condition in the state of Kentucky, see ORI's summary sheet: "Reporting Requirements for Diseases and Conditions in Kentucky" [PDF].

HIV/AIDS Research: There are additional IRB requirements for designing and implementing the research and for obtaining informed consent. Describe additional safeguards to minimize risk to subjects in the space provided below.

For additional information, visit the online IRB Survival Handbook to download a copy of the "Medical IRB's requirements for Protection of Human Subjects in Research Involving HIV Testing" [D65.0000] [PDF], and visit the Office for Human Research Protections web site for statements on AIDS research, or contact the Office of Research Integrity at 859-257-9428.

PI-Sponsored FDA-Regulated Research

Is this an investigator-initiated study that:

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1) involves testing a Nonsignificant Risk (NSR) Device, or
2) is being conducted under an investigator-held Investigational New Drug (IND) or Investigational Device Exemption (IDE)?

○ Yes ◉ No

PI-Sponsored FDA-Regulated Research

If the answer above is yes, then the investigator assumes the regulatory responsibilities of both the investigator and sponsor. The Office of Research Integrity provides a summary list of sponsor IND regulatory requirements for drug trials [PDF], IDE regulatory requirements for SR device trials [PDF], and abbreviated regulatory requirements for NSR device trials [PDF]. For detailed descriptions see FDA Responsibilities for Device Study Sponsors or FDA Responsibilities for IND Drug Study Sponsor-Investigators.

- Describe the experience/knowledge/training (if any) of the investigator serving as a sponsor (e.g., previously held an IND/IDE); and
- Indicate if any sponsor obligations have been transferred to a commercial sponsor, contract research organization (CRO), contract monitor, or other entity (provide details or attach FDA 1571).

IRB policy requires mandatory training for all investigators who are also FDA-regulated sponsors (see Sponsor-Investigator FAQs). A sponsor-investigator must complete the applicable Office of Research Integrity web based training, (drug or device) before final IRB approval is granted.

Has the sponsor-investigator completed the mandatory PI-sponsor training prior to this submission?

○ Yes ○ No

If the sponsor-investigator has completed equivalent sponsor-investigator training, submit documentation of the content for the IRB's consideration.

Attachments

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HIPAA

0 unresolved comment(s)

Is HIPAA applicable? ○ Yes ◉ No

(Visit ORI's Health Insurance Portability and Accountability Act (HIPAA) web page to determine if your research falls under the HIPAA Privacy Regulation.)

If yes, check below all that apply and attach the applicable document(s):

- ☐ HIPAA De-identification Certification Form
- ☐ HIPAA Waiver of Authorization

Attachments

STUDY DRUG INFORMATION

0 unresolved comment(s)

The term drug may include:

- FDA approved drugs,
- unapproved use of approved drugs,
- investigational drugs or biologics,
- other compounds or products intended to affect structure or function of the body, and/or
- complementary and alternative medicine products such as dietary supplements, substances generally recognized as safe (GRAS) when used to diagnose, cure mitigate, treat or prevent disease, or clinical studies of e-cigarettes examining a potential therapeutic purpose.

Does this protocol involve a drug including an FDA approved drug; unapproved use of an FDA approved drug; and/or an investigational drug?

○ Yes ◉ No

If yes, complete the questions below. Additional study drug guidance.

LIST EACH DRUG INVOLVED IN STUDY IN THE SPACE BELOW

Drug Name:

Note: Inpatient studies are required by Hospital Policy to utilize the Investigational Drug Service (IDS). Use of IDS is highly recommended, but optional for outpatient studies. Outpatient studies not using IDS services are subject to periodic inspection by the IDS for compliance with drug accountability good clinical practices.

Indicate where study drug(s) will be housed and managed:

☐ Investigational Drug Service (IDS) UK Hospital

Other Location:

Is the study being conducted under a valid Investigational New Drug (IND) application?

○ Yes ○ No

If Yes, list IND #(s) and complete the following:

IND Submitted/Held by:

Sponsor: ☐	Held By:
Investigator: ☐	Held By:
Other: ☐	Held By:

☐ Checkmark if the study is being conducted under FDA's Expanded Access Program (e.g., Treatment IND) or if this is an Individual Patient Expanded Access IND (FDA Form 3926).

FDA's Expanded Access Program Information for Individual Patient Expanded Access INDs, and attach the following:

- FDA Form 3926;
- FDA expanded access approval or correspondence;
- Confirmation of agreement from manufacturer or entity authorized to provide access to the product.

For guidance and reporting requirements at the conclusion of treatment see the "Expanded Access SOP" [PDF].

Please also complete and attach the Study Drug Form (PDF) (required):

Attachments

STUDY DEVICE INFORMATION

0 unresolved comment(s)

A DEVICE may be a:

- component, part, accessory;
- assay, reagent, or in-vitro diagnostic device;
- software, digital health, or mobile medical app;
- other instrument if intended to affect the structure or function of the body, diagnose, cure, mitigate, treat or prevent disease; or
- a homemade device developed by an investigator or other non-commercial entity and not approved for marketing by FDA.

For additional information, helpful resources, and definitions, see ORI's Use of Any Device Being Tested in Research web page.

Does this protocol involve testing (collecting safety or efficacy data) of a medical device including an FDA approved device, unapproved use of an approved device, humanitarian use device, and/or an investigational device?

○ Yes ◉ No

[Note: If a marketed device(s) is only being used to elicit or measure a physiologic response or clinical outcome, AND, NO data will be collected on or about the device itself, you may answer "no" above, save and exit this section, (Examples: a chemo drug study uses an MRI to measure tumor growth but does NOT assess how effective the MRI is at making the measurement; an exercise study uses a heart monitor to measure athletic performance but no safety or efficacy information will be collected about the device itself, nor will the data collected be used for comparative purposes against any other similar device).]

If you answered yes above, please complete the following questions.

LIST EACH DEVICE BEING TESTED IN STUDY IN THE SPACE BELOW

Device Name:

Is the study being conducted under a valid Investigational Device Exemption (IDE), Humanitarian Device Exemption (HDE) or Compassionate Use?

○ Yes ○ No

If Yes, complete the following:
IDE or HDE #(s)

IDE/HDE Submitted/Held by:

Sponsor: ☐ Held By:

Investigator: ☐ Held By:

Other: ☐ Held By:

☐ Check if this is a Treatment IDE or Compassionate Use under the Food and Drug Administration (FDA) Expanded Access program.

For Individual or Small Group Expanded Access, see FDA's Early Expanded Access Program Information, and attach the following:

- FDA expanded access approval or sponsor's authorization;
- An independent assessment from an uninvolved physician, if available;
- Confirmation of agreement from manufacturer or entity authorized to provide access to the product.

For guidance and reporting requirements at the conclusion of treatment see the "Medical Device Clinical Investigations, Compassionate Use, and Treatment IDE SOP" [PDF]

Does the intended use of any research device being tested (not clinically observed) in this study meet the regulatory definition of Significant Risk (SR) device?

- Yes. Device(s) as used in this study presents a potential for serious risk to the health, safety, or welfare of a subject and (1) is intended as an implant; or (2) is used in supporting or sustaining human life; or (3) is of substantial importance in diagnosing, curing, mitigating or treating disease, or otherwise prevents impairment of human health; or (4) otherwise presents a potential for serious risk to the health, safety, or welfare of a subject.
- No. All devices, as used in this study do not present a potential for serious risk to the health, safety, or welfare of subjects/participants.

Please also complete and attach the Study Device Form (PDF) (required):

Attachments

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RESEARCH SITES

1 unresolved comment(s)

In order for this section to be considered complete, you must click "SAVE" after ensuring all responses are accurate.

A) Check all the applicable sites listed below at which the research will be conducted. If none apply, you do not need to check any boxes.

UK Sites

- ☐ UK Classroom(s)/Lab(s)
- ☐ UK Clinics in Lexington
- ☐ UK Clinics outside of Lexington
- ☐ UK Healthcare Good Samaritan Hospital
- ☐ UK Hospital

Schools/Education Institutions

- ☐ Fayette Co. School Systems *
- ☐ Other State/Regional School Systems
- ☐ Institutions of Higher Education (other than UK)

***Fayette Co. School systems, as well as other non-UK sites, have additional requirements that must be addressed. See ORI's IRB Application Instructions - Off-site Research web page for details.**

Other Medical Facilities

- ☐ Bluegrass Regional Mental Health Retardation Board
- ☐ Cardinal Hill Hospital
- ☐ Eastern State Hospital
- ☐ Norton Healthcare
- ☐ Nursing Homes
- ☐ Shriner's Children's Hospital
- ☐ Veterans Affairs Medical Center
- ☐ Other Hospitals and Med. Centers

- ☐ Correctional Facilities
- ☐ Home Health Agencies
- ☐ International Sites

List all other non-UK owned/operated locations where the research will be conducted:*

[redacted]

*A letter of support and local context is required from non-UK sites. See *Letters of Support and Local Context* on the IRB Application Instructions - Off-Site Research web page for more information.

Attachments

Attach Type	File Name
-Letter of Support & Local Context	Letter from School Superintendent.pdf

B) Is this a multi-site study for which you are the lead investigator or UK is the lead site? ○ Yes ◉ No

If **YES**, you must describe the plan for the management of reporting unanticipated problems, noncompliance, and submission of protocol modifications and interim results from the non-UK sites in the E-IRB "Research Description" section under *Resources*.

If the non-UK sites or non-UK personnel are *engaged* in the research, there are additional federal and university requirements which need to be completed for their participation, such as the establishment of a cooperative IRB review agreement with the non-UK site. Questions about the participation of non-UK sites/personnel should be discussed with the ORI staff at (859) 257-9428.

RESEARCH ATTRIBUTES

0 unresolved comment(s)

Indicate the items below that apply to your research. Depending on the items applicable to your research, you may be required to complete additional forms or meet additional requirements. Contact the ORI (859-257-9428) if you have questions about additional requirements.

☐ Not applicable

Check All That Apply

- ☑ Academic Degree/Required Research
- ☐ Aging Research
- ☐ Alcohol Abuse Research
- ☐ Cancer Research
- ☐ Certificate of Confidentiality
- ☐ CCTS-Center for Clinical & Translational Science
- ☐ Clinical Research
- ☐ Clinical Trial
- ☐ Clinical Trial Multicenter(excluding NIH Cooperative Groups)
- ☐ Clinical Trial NIH cooperative groups (i.e., SWOG, RTOG)
- ☐ Clinical Trial Placebo Controlled Trial
- ☐ Clinical Trial UK Only
- ☐ Collection of Biological Specimens
- ☐ Collection of Biological Specimens for Banking
- ☐ Community-Based Participatory Research
- ☐ Data & Safety Monitoring Board
- ☐ Data & Safety Monitoring Plan
- ☐ Deception
- ☐ Drug/Substance Abuse Research
- ☐ Educational/Student Records (e.g., GPA, test scores)
- ☐ Emergency Use (Single Patient)
- ☐ Genetic Research
- ☐ Gene Transfer
- ☐ GWAS (Genome-Wide Association Study) or NIH-funded study generating large scale genomic data
- ☐ International Research
- ☑ Internet Research
- ☐ Planned Emergency Research Involving Waiver of Informed Consent
- ☐ Pluripotent Stem Cell Research
- ☐ Recombinant DNA
- ☑ Survey Research
- ☐ Transplants
- ☐ Use of radioactive material, ionizing radiation, or x-rays [Radiation Safety Committee review required]
- ☐ Vaccine Trials

Click applicable listing(s) for additional requirements and/or information:

- Cancer Research (MCC PRMC)
- Certificate of Confidentiality (look up "Confidentiality/Privacy...")
- CCTS (Center for Clinical and Translational Science)
- Clinical Research (look up "What is the definition of....)
- Clinical Trial (look up "What is the definition of....)

  Determine if research meets NIH definition of clinical trial;
  *Reminder: Ensure compliance with applicable requirements including:
  - Clinicaltrials.gov registration;
  - Good Clinical Practice (GCP) training; and
  - Consent Posting Requirement [PDF] for federal funded trials.

- Collection of Biological Specimens for Banking (look up "Specimen/Tissue Collection...")
- Collection of Biological Specimens (look up "Specimen/Tissue Collection...")
- Community-Based Participatory Research (look up "Community-Engaged...")
- Data & Safety Monitoring Board (DSMB)

  *For Medical IRB: Service Request Form for CCTS DSMB

- Data & Safety Monitoring Plan
- Deception*

  *For deception research, also go to the E-IRB Application Informed Consent section, checkmark and complete "Request for Waiver of Informed Consent Process"

- Emergency Use (Single Patient) [attach Emergency Use Checklist] (PDF)
- Genetic Research (look up "Specimen/Tissue Collection...")
- Gene Transfer
- HIV/AIDS Research (look up "Reportable Diseases/Conditions")
- Screening for Reportable Diseases [E2.0000] (PDF)
- International Research (look up "International & Non-English Speaking")
- NIH Genomic Data Sharing (GDS) Policy (PDF)
- Planned Emergency Research Involving Waiver of Informed Consent*

  *For Planned Emergency Research Involving Waiver of Informed Consent, also go to the E-IRB Application Informed Consent section, checkmark and complete "Request for Waiver of Informed Consent Process"

- Use of radioactive material, ionizing radiation or x-rays for research

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FUNDING/SUPPORT

0 unresolved comment(s)

If the research is being submitted to, supported by, or conducted in cooperation with an external or internal agency or funding program, indicate below all the categories that apply.

☑ Not applicable

Check All That Apply

- ☐ Grant application pending
- ☐ (HHS) Dept. of Health & Human Services
  - ☐ (NIH) National Institutes of Health
  - ☐ (CDC) Centers for Disease Control & Prevention
  - ☐ (HRSA) Health Resources and Services Administration
  - ☐ (SAMHSA) Substance Abuse and Mental Health Services Administration
- ☐ (DoJ) Department of Justice or Bureau of Prisons
- ☐ (DoE) Department of Energy
- ☐ (EPA) Environmental Protection Agency
- ☐ Federal Agencies Other Than Those Listed Here
- ☐ Industry (Other than Pharmaceutical Companies)
- ☐ Internal Grant Program w/ proposal
- ☐ Internal Grant Program w/o proposal
- ☐ National Science Foundation
- ☐ Other Institutions of Higher Education
- ☐ Pharmaceutical Company
- ☐ Private Foundation/Association
- ☐ U.S. Department of Education
- ☐ State

Other:

Click applicable listing(s) for additional requirements and/or information:

- (HHS) Dept. of Health & Human Services
- (NIH) National Institutes of Health
- (CDC) Centers for Disease Control & Prevention
- (HRSA) Health Resources & Services Administration
- (SAMHSA) Substance Abuse & Mental Health Services Administration
- Industry (Other than Pharmaceutical Companies) [IRB Fee Info]
- National Science Foundation
- (DoEd) U.S. Department of Education [PDF]
- DoJ) Department of Justice or Bureau of Prisons ([PDF]
- (DoE) Department of Energy Summary [PDF] and Department of Energy Identifiable Information Compliance Checklist [PDF]
- (EPA) Environmental Protection Agency [PDF]

Specify the funding source and/or cooperating organization(s) (e.g., National Cancer Institute, Ford Foundation, Eli Lilly & Company, South Western Oncology Group, Bureau of Prisons, etc.):

Add Related Grants

If applicable, please search for and select the OSPA Account number or Electronic Internal Approval Form (eIAF) # (notif #) associated with this IRB application using the "Add Related Grants" button.
If required by your funding agency, upload your grant using the "Grant/Contract Attachments" button.

Add Related Grants

Grant/Contract Attachments

The research involves use of Department of Defense (DoD) funding, military personnel, DoD facilities, or other DoD resources. (See DoD SOP [PDF] and DoD Summary [PDF] for details)

○ Yes ◉ No

Using the "attachments" button (below), attach applicable materials addressing the specific processes described in the DoD SOP.

DOD SOP Attachments

Additional Certification: (If your project is federally funded, your funding agency may request an Assurance/ Certification/Declaration of Exemption form.) Check the following if needed:

☐ Protection of Human Subjects Assurance/Certification/Declaration of Exemption (Formerly Optional Form – 310)

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OTHER REVIEW COMMITTEES

0 unresolved comment(s)

If you check any of the below committees, additional materials may be required with your application submission.

Does your research fall under the purview of any of the other review committees listed below? [*If yes, check all that apply and attach applicable materials using the attachment button at the bottom of your screen.*]

○ Yes ◉ No

Additional Information

- ☐ Institutional Biosafety Committee
- ☐ Radiation Safety Committee
- ☐ Radioactive Drug Research Committee
- ☐ Markey Cancer Center (MCC) Protocol Review and Monitoring Committee (PRMC)
- ☐ Graduate Medical Education Committee (GME)
- ☐ Office of Medical Education (OME)

- Institutional Biosafety Committee (IBC)--Attach required IBC materials
- Radiation Safety Committee (RSC)-- For applicability, see instructions
- Radioactive Drug Research Committee (RDRC)--information
- Markey Cancer Center (MCC) Protocol Review and Monitoring Committee (PRMC)**--Attach MCC PRMC materials, if any, per instructions
- See requirement of Office of Medical Education (OME)
- See requirement of Graduate Medical Education Committee (GME)

Attachments

**** If you are proposing a study involving cancer research, be sure to have "Cancer Research" marked in the E-IRB "Research Attributes" section.** If your study involves cancer research, ORI will provide a copy of your research protocol to the Markey Cancer Center (MCC) Protocol Review and Monitoring Committee (PRMC). The MCC PRMC is responsible for determining whether the study meets the National Cancer Institute (NCI) definition of a clinical trial and for issuing documentation to you (the investigator) which confirms either that PRMC approval has been obtained or that PRC review is not required. Your IRB application will be processed and reviewed independently from the PRMC review.

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ADDITIONAL INFORMATION/MATERIALS

0 unresolved comment(s)

Do you want specific information inserted into your approval letter? ○ Yes ◉ No

Approval Letter Details (e.g., serial #):

Submission Description: If you wish to have specific details included in your approval letter (e.g., serial #, internal tracking identifier, etc…), type in the box below exactly what you wish to see on the approval letter. What you type will automatically appear at the top of all approval letters, identical to how you typed it, until it is changed by you (Hint: don't include instructions or questions to ORI staff as those will appear in your approval letter). **If these details need to be changed as a result of revisions, continuation review, or modifications to the application, you are responsible for updating the content of the field below accordingly.**

Protocol/Product Attachments - For each item checked, please attach the corresponding material.

- ☐ Detailed protocol
- ☐ Dept. of Health & Human Services (DHHS) approved protocol (such as NIH sponsored Cooperative Group Clinical Trial)
- ☐ Drug Documentation (e.g., Investigator Brochure; approved labeling; publication; FDA correspondence, etc.)
- ☐ Device Documentation (e.g., Manufacturer information; patient information packet; approved labeling; FDA correspondence, etc.)
- ☑ Other Documents

Protocol/Product Attachments

NOTE: Instructions for Dept. of Health & Human Services (DHHS)-approved protocol]

If you have password protected documents, that feature should be disabled prior to uploading to ensure access for IRB review.

Additional Materials:

If you have other materials you would like to include in your application for the IRB's consideration, please attach using the Attachments button below.

[To view what materials are currently attached to your application, go to "Application Links" in the menu bar on the left and click "All Attachments".]

Attachments

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SIGNATURES (ASSURANCES)

0 unresolved comment(s)

On all IRB applications there is a requirement for additional assurances by a Department Chairperson (or equivalent) [hereafter referred to as "Department Authorization" (DA)], and when applicable, a Faculty Advisor (FA) (or equivalent), which signifies the acceptance of certain responsibilities and that the science is meritorious and deserving of conduct in humans. Note: the individual assigned as DA *should not* also be listed in the Study Personnel section, the individual assigned as FA *should* be listed in the Study Personnel section.

For a list of responsibilities reflected by signing the Assurance Statement, download the guidance document "What does the Department Chairperson's Assurance Statement on the IRB application mean? [PDF]"

Required Signatures:

First Name	Last Name	Role	Department	Date Signed	
Justin	Bathon	Department Authorization	Educational Leadership Studies	05/04/2022 04:39 PM	View/Sign
John	Nash	Faculty Advisor	Educational Leadership Studies	05/04/2022 05:14 PM	View/Sign
Joshua	Marsh	Principal Investigator	Educational Leadership Studies	05/04/2022 12:36 PM	View/Sign

Department Authorization

☑ This is to certify that I have reviewed this research protocol and that I attest to the scientific validity and importance of this study; to the qualifications of the investigator(s) to conduct the project and their time available for the project; that facilities, equipment, and personnel are adequate to conduct the research; and that continued guidance will be provided as appropriate. When the principal investigator assumes a sponsor function, the investigator has been notified of the additional regulatory requirements of the sponsor and by signing the principal investigator Assurance Statement, confirms he/she can comply with them.

*If the Principal Investigator is also the Chairperson of the department, the Vice Chairperson or equivalent should complete the "Department Authorization".

**IF APPLICABLE FOR RELIANCE: I attest that the principal investigator has been notified of the regulatory requirements of both the Reviewing and Relying IRBs, according to the information provided in the E-IRB application. The attached Reliance Assurance Statement, signed by the principal investigator, confirms that he/she can comply with both sets of IRB requirements.

Faculty Advisor's Assurance Statement

☑ This is to certify that I have reviewed this research protocol and that I attest to the scientific merit of this study; to the qualifications of the investigator(s) to conduct the project; that facilities, equipment, and personnel are adequate to conduct the research; and that continued guidance will be provided as appropriate.

**If the Principal Investigator is completing this project to meet the requirements of a University of Kentucky academic program, in addition to Department Authorization, the student's faculty advisor should sign the Assurance Statement. The student's faculty advisor is accepting a supervisory role in guiding the student in conducting regulatory compliant research and therefore must be certified in human research protection training throughout the life of the protocol.

Principal Investigator's Assurance Statement

I understand the University of Kentucky's policies concerning research involving human subjects and I agree:

1. To comply with all IRB policies, decisions, conditions, and requirements;
2. To accept responsibility for the scientific and ethical conduct of this research study;
3. To obtain prior approval from the Institutional Review Board before amending or altering the research protocol or implementing changes in the approved consent/assent form;
4. To report to the IRB in accord with IRB/IBC policy, any adverse event(s) and/or unanticipated problem(s) involving risks to subjects;
5. To complete, on request by the IRB for Full and Expedited studies, the Continuation/Final Review Forms;
6. To notify the Office of Sponsored Projects Administration (OSPA) and/or the IRB (when applicable) of the development of any financial interest not already disclosed;
7. Each individual listed as study personnel in this application has received the mandatory human research protections education (e.g., CITI);
8. Each individual listed as study personnel in this application possesses the necessary experience for conducting research activities in the role described for this research study.
9. To recognize and accept additional regulatory responsibilities if serving as both a sponsor and investigator for FDA regulated research.

☑ Furthermore, by checking this box, I also attest that:

- I have appropriate facilities and resources for conducting the study;
- I am aware of and take full responsibility for the accuracy of all materials submitted to the IRB for review;
- If applying for an exemption, I also certify that the only involvement of human subjects in this research study will be in the categories specified in the Protocol Type: Exemption Categories section.
- If applying for an Abbreviated Application (AA) to rely on an external IRB, I understand that certain items above (1, 3, 4, 7-8) may not apply, or may be altered due to external institutional/IRB policies. I document my agreement with the Principal Investigator Reliance Assurance Statement by digitally signing this application.

*You will be able to "sign" your assurance after you have sent your application for signatures (use Submission section). Please notify the personnel required for signing your IRB application after sending for signatures. Once all signatures have been recorded, you will need to return to this section to submit your application to ORI.

SUBMISSION INFORMATION

0 unresolved comment(s)

Each Section/Subsection in the menu on the left must have a checkmark beside it (except this Submission section) indicating the Section/Subsection has been completed; otherwise your submission for IRB review and approval will not be able to be sent to the Office of Research Integrity/IRB.

Please remember to update, when applicable, the Approval Letter Details text box under the Additional Information section to ensure verbiage you want on your approval letter is accurate.

If your materials require review at a convened IRB meeting which you will be asked to attend, it will be scheduled on the next available agenda and a message will be forthcoming to notify you of the date.

If you are making a change to an attachment, you need to delete the attachment, upload a highlighted version that contains the changes (use Document Type of "Highlighted Changes"), and a version that contains the changes without any highlights (use the appropriate Document Type for the item(s)). Do **not** delete approved attachments that are still in use.

Your protocol has been submitted.

76568

	Document Type	File Loaded	Document Description	File Size	Modified By	Mod Date
	ApprovalLetter	ApprovalLetter.pdf		0.098	DEH223	5/24/2022 2:50:58 PM
	Stamped Consent Form	Informed Consent Document.pdf		0.085	DEH223	5/24/2022 2:50:57 PM
	-Letter of Support & Local Context	Letter from School Superintendent.pdf		0.066	jjma229	5/12/2022 8:55:26 AM
	CoverLetter	Informed Consent Document.pdf		0.082	jjma229	5/9/2022 2:51:47 PM
	DataCollection	Survey .docx		0.024	jjma229	5/9/2022 2:45:29 PM

APPENDIX B

IRB APPROVAL LETTER

University of Kentucky | Office of Research Integrity
IRB, RDRC

EXEMPTION CERTIFICATION

IRB Number: 76568

TO:	Joshua Marsh, Ph.D. Candidate Educational Leadership Studies PI phone #: 828-719-8374 PI email: joshua.marsh@uky.edu
FROM:	Chairperson/Vice Chairperson Nonmedical Institutional Review Board (IRB)
SUBJECT:	Approval for Exemption Certification
DATE:	5/24/2022

On 5/24/2022, it was determined that your project entitled "*AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN TEACHER GRIT, TECHNOLOGY SELF-EFFICACY, AND TECHNOLOGY INTEGRATION*" meets federal criteria to qualify as an exempt study.

Because the study has been certified as exempt, you will not be required to complete continuation or final review reports. However, it is your responsibility to notify the IRB prior to making any changes to the study. Please note that changes made to an exempt protocol may disqualify it from exempt status and may require an expedited or full review.

The Office of Research Integrity will hold your exemption application for six years. Before the end of the sixth year, you will be notified that your file will be closed and the application destroyed. If your project is still ongoing, you will need to contact the Office of Research Integrity upon receipt of that letter and follow the instructions for completing a new exemption application. It is, therefore, important that you keep your address current with the Office of Research Integrity.

For information describing investigator responsibilities after obtaining IRB approval, download and read the document "PI Guidance to Responsibilities, Qualifications, Records and Documentation of Human Subjects Research" available in the online Office of Research Integrity's IRB Survival Handbook. Additional information regarding IRB review, federal regulations, and institutional policies may be found through ORI's web site. If you have questions, need additional information, or would like a paper copy of the above mentioned document, contact the Office of Research Integrity at 859-257-9428.

see blue.

405 Kinkead Hall | Lexington, KY 40506-0057 | P: 859-257-9428 | F: 859-257-8995 | www.research.uky.edu/ori/

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Section 1 Page 1 of 1

APPENDIX C

CONSENT FORM

IRB Approval
5/24/2022
IRB # 76568
Exempt

Greetings,

Researchers at the University of Kentucky are inviting you to take part in a survey regarding relationships between technology self-efficacy, grit, and technology integration in [redacted]

To be eligible for this survey you must be a full-time instructor in [redacted].

Although you may not get personal benefit from taking part in this research study, your responses may help us understand more about issues relating to technology integration in public high schools. Some volunteers experience satisfaction from knowing they have contributed to research that may possibly benefit others in the future.

Researchers will review and collect information from your survey, but no identifiable information will be required. Survey questions will be related to years of instruction, technology use, and approaches to challenging situations.

If you do not want to be in the study, there are no other choices except not to take part in the study.

The survey/questionnaire will take about 15 minutes to complete.

There are no known risks to participating in this study. We will make every effort to safeguard your data, but as with anything online, we cannot guarantee the security of data obtained via the Internet. Third-party applications used in this study may have Terms of Service and Privacy policies outside of the control of the University of Kentucky.

Your response to the survey is anonymous which means no names, IP addresses, email addresses, or any other identifying information will be collected with the survey responses. We will not know which responses are yours if you choose to participate.

We hope to receive completed questionnaires from about 150 people, so your answers are important to us. Of course, you have a choice about whether to complete the survey/questionnaire, but if you do participate, you are free to skip any questions or discontinue at any time. You will not be penalized in any way for skipping or discontinuing the survey.

If you have questions about the study, please feel free to ask; my contact information is given below.

Thank you in advance for your assistance with this important project. To ensure your responses will be included, please submit your completed survey by June 6th, 2022.

Sincerely,

Joshua Jeremiah Shiloh Marsh
Educational Leadership Studies, University of Kentucky
[redacted]

Faculty Advisor
John Nash
[redacted]

76568

If you have complaints, suggestions, or questions about your rights as a research volunteer, contact the staff in the University of Kentucky Office of Research Integrity at 859-257-9428 or toll-free at 1-866-400-9428.

Please provide your response to the question regarding consent below:

(Check one below)

_____ I have read the information above. I consent to the use of this data for this research investigation and confirm that I am eligible to complete the survey.

_____ I do not consent to this research investigation.

APPENDIX D

LETTER OF SUPPORT AND LOCAL CONTEXT

[redacted]

May 13, 2022

To Whom it May Concern:

"I agree to allow Joshua J. S. Marsh to conduct research in [redacted] using a survey that will address the topic of grit, self-efficacy, and technology integration for full-time teachers in [redacted]

Joshua will provide the district with a recruitment invitation email that will be emailed to all full-time instructors in [redacted] in the district, once he has obtained approval from IRB. [redacted]

I have reviewed the study to be conducted by Joshua Marsh in [redacted]. There are no issues with respect to appropriateness for human subject populations and the facilities are adequate to perform the procedures as approved by the UK IRB."

Sincerely,

[redacted]

APPENDIX E

GRIT, SELF-EFFICACY, AND TECHNOLOGY INTEGRATION SURVEY

<u>Survey Questions</u>

1. What subject area do you teach?

2. How many years have you been a high school instructor?

3. How old are you?

4. What is your gender identification?

5. What level of education have you completed?

For questions 6-17, please respond to the following items

6. I have overcome setbacks to conquer an important challenge.
   - ❑ Very much like me
   - ❑ Mostly like me
   - ❑ Somewhat like me
   - ❑ Not much like me
   - ❑ Not like me at all

7. New ideas and projects sometimes distract me from previous ones.
   - ❑ Very much like me
   - ❑ Mostly like me
   - ❑ Somewhat like me
   - ❑ Not much like me
   - ❑ Not like me at all

8. My interests change from year to year.
   - ❑ Very much like me
   - ❑ Mostly like me
   - ❑ Somewhat like me
   - ❑ Not much like me
   - ❑ Not like me at all

9. Setbacks don't discourage me.
   - ❑ Very much like me
   - ❑ Mostly like me
   - ❑ Somewhat like me
   - ❑ Not much like me
   - ❑ Not like me at all

10. I have been obsessed with a certain idea or project for a short time but later lost interest.*
   - ❑ Very much like me
   - ❑ Mostly like me
   - ❑ Somewhat like me
   - ❑ Not much like me
   - ❑ Not like me at all

11. I am a hard worker.
   - ❑ Very much like me
   - ❑ Mostly like me
   - ❑ Somewhat like me
   - ❑ Not much like me
   - ❑ Not like me at all

12. I often set a goal but later choose to pursue a different one.*
   - ❑ Very much like me
   - ❑ Mostly like me
   - ❑ Somewhat like me
   - ❑ Not much like me
   - ❑ Not like me at all

13. I have difficulty maintaining my focus on projects that take more than a few months to complete.
   - ❑ Very much like me
   - ❑ Mostly like me
   - ❑ Somewhat like me
   - ❑ Not much like me
   - ❑ Not like me at all

14. I finish whatever I begin.
   - ❑ Very much like me
   - ❑ Mostly like me
   - ❑ Somewhat like me
   - ❑ Not much like me
   - ❑ Not like me at all

15. I have achieved a goal that took years of work.
    - ❑ Very much like me
    - ❑ Mostly like me
    - ❑ Somewhat like me
    - ❑ Not much like me
    - ❑ Not like me at all

16. I become interested in new pursuits every few months.
    - ❑ Very much like me
    - ❑ Mostly like me
    - ❑ Somewhat like me
    - ❑ Not much like me
    - ❑ Not like me at all

17. I am diligent.
    - ❑ Very much like me
    - ❑ Mostly like me
    - ❑ Somewhat like me
    - ❑ Not much like me
    - ❑ Not like me at all

For questions 18-26, Respond with your opinion about each of the statements. Please indicate your opinion about each of the statements below. Your answers are confidential.

Respond based on the following scale:

1 – Nothing
2
3 – Very Little
4
5 – Some Influence
6
7 – Quite a bit
8
9 – A great Deal

18. How much can you gauge student comprehension of content delivered using technology resources?

    Scale choice: ____

19. How much can you gauge student comprehension of content delivered using technology resources?

Scale choice: ___

20. How much can you use alternative (technology-based) resources to get through to the most difficult students?

    Scale choice: ___

21. How much can you use alternative (technology-based) resources to help your students value learning?

    Scale choice: ___

22. How well can you implement alternative (technology-based) strategies in your classroom?

    Scale choice: ___

23. How much can you use a variety of technology-based assessment strategies?

    Scale choice: ___

24. How much can you use alternative (technology-based) resources to help your students think critically?

    Scale choice: ___

25. How much can you use technology to foster student creativity?

    Scale choice: ___

26. How much can you use alternative (technology-based) resources to improve the understanding of a student who is failing?

    Scale choice: ___

For questions 27-29, Respond with your opinion about each of the statements. Please indicate your opinion about each of the statements below.

27. During the previous school year, how often did you use technology as a part of instruction? (e.g., the internet, creating multimedia presentations, sending email, etc.).

- Not at all
- A few times during the year
- About once a month
- Two to three times a month
- About once a week
- A few times each week
- Daily

28. During the previous school year, about how often did your students use technology as a part of instruction?

- Not at all
- A few times during the year
- About once a month
- Two to three times a month
- About once a week
- A few times each week
- Daily

29. To what extent do you present students in your typical class with online work that involves using computers or the internet in the following ways:

A. Creating a Word Document

- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

B. Sending Email

- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

C. Playing educational games online

- Not at all
- Small extent
- Moderate extent

- Large extent
- Not applicable

D. Gathering pictures online
- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

E. Reading a book or story online
- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

F. Creating a multimedia presentation (i.e. Powerpoint)
- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

G. Using reference sites online (Ex. Dictionary.com)
- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

H. Publishing information on a wiki or blog
- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

I. Publishing Information on a website
- Not at all

- Small extent
- Moderate extent
- Large extent
- Not applicable

J. Communication using instant messenger or other chat tools

- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

K. Formulating questions to research online

- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

L. Locating information online

- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

M. Evaluating information online

- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

N. Synthesizing information online

- Not at all
- Small extent
- Moderate extent
- Large extent
- Not applicable

O. Searching for information online

- o Not at all
- o Small extent
- o Moderate extent
- o Large extent
- o Not applicable

P. Using specific search strategies to search for information online

- o Not at all
- o Small extent
- o Moderate extent
- o Large extent
- o Not applicable

Q. Collaborating online with students from other classes

- o Not at all
- o Small extent
- o Moderate extent
- o Large extent
- o Not applicable

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Publications:

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Marsh, J. J. S. (2020, November 25). The vibrations of creative work. *Lenoir News-Topic*, p. A3.

Marsh, J. J. S. (2020, November 11). Change your routine, not your goals. *Lenoir News-Topic*, p. A3.

Marsh, J. J. S. (2020, October 23). Close friends make time and standstill. *Lenoir News-Topic*, p. A3.

Marsh, J. J. S. (2020, October 14). Simple acts provide the best motivation. *Lenoir News-Topic*, p. A3.

Marsh, J. J. S. (2020, July 22). We need more memory makers. *Lenoir News-Topic*, p. A3

Marsh, J. J. S. (2020, July 15). Shared thinking leads to big ideas. *Lenoir News-Topic*, p. A3.

Marsh, J. J. S. (2020, July 8). I'll get there eventually. *Lenoir News-Topic*, p. A2.
Marsh. J. J. S. (2020, July 1). Iterative failure works as a recipe for success. *Lenoir News-Topic,* p. A3.
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*Sleighter, R.L., Marsh, J. J. S., Boschi, V. L., Grannas A. M., & Hatcher, P. G. (2011). Molecular characterization of dissolved organic matter from Greenland ice cores by Fourier transform ion cyclotron resonance mass spectrometry (FTICR-MS). *Journal of the American Society for Mass Spectrometry*, *22*, 126.
Marsh, J. J. (2010). Comparison of ice core dissolved organic matter (dom) from a Greenland ice core by nanospray Fourier transform ion cyclotron resonance mass spectrometry. (Master's thesis). Old Dominion University.

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Research Assistant

Presentations:

Marsh, J. (May 2020) "STEM"ulating OER Applications, North Carolina's Statewide Library Cooperative Conference, online zoom conference.

Marsh, C., Marsh, J. (January 2020) "STEM"ulating OER Applications, Faculty Professional Development for Central Carolina Community College, Sanford,NC.

Marsh, J. (October 2019) "STEM"ulating OER Applications, North Carolina Community College Associations of Distance Learning, Cary, NC.

Marsh, C., Marsh, J. (October 2019) "STEM"ulating OER Applications, Open Educational

Resources (OER) Conference, Sanford, NC.

Marsh, J. (September 2019) 20 Technology Tools Every Teacher Should Know About, Science Faculty Professional Development, Hudson, NC.

Marsh, J., Hallem, C. (July 2019) Adopt an Open Textbook with Open Education North Carolina, North Carolina Community College Performance Partnership Summit, Cary, NC.

Marsh, J. (January 2017) The Effective Use of ChamberMaster, Caldwell Chamber of Commerce, Lenoir, NC.

Marsh, J. (March 2016) Redesigning a Media Center for a Design-Thinking Approach, Collaborative Conference for Student Achievement, Greensboro, NC.

Marsh, J. (March 2016) What is Design Thinking, North Carolina Technology in Education Society Annual Conference, Raleigh, NC.

Marsh, J. (February 2016) What is Entrepreneurship, Entrepreneurship Panel for the Watauga Leadership Challenge, Boone, NC.

Marsh, J. (November 2015) Designing for Secondary Education, Barnes and Noble Maker Faire, Winston-Salem, NC.

Marsh, J. (October 2015) The Watauga High School Design lab, Education Committee Meeting for the Town of Boone, Boone, NC.

Marsh, J., Clements, T. (February 2015) Session for Teachers Who Can't Tweet Good (And Who Wanna Learn To Do Other Stuff Good Too), Kentucky Society for Technology in Education, Spring Conference, Louisville, KY.

Clements, T., Marsh, J. (February 2015) Horton Hears a 1:1 Initiative without Innovative Leadership, Kentucky Society for Technology in Education, Spring Conference, Louisville, KY.

Marsh, J. (October 2014). Using Technology in the Classroom, Jefferson County Public School at Ballard High School, Louisville, KY.

Marsh, J. (September 2014). Going Paper Free, TeachMeet Kentucky, Western Kentucky University, Bowling Green, KY.

Marsh, J. (July 2014). Using Google Plus, Jefferson County Public School Technoversity, Louisville, KY.

Marsh, J. (July 2014). Using Cell Phones in the Classroom, Jefferson County Public School Technoversity, Louisville, KY.

Marsh, J. & Clements, T. (March 2013). My Pad, Your Pad, Why Pad? Ipad!, Waggener High School Professional Development Seminar, Louisville, KY.

Clements, T., Marsh, J. & Day, M. (April 2013). My Pad, Your Pad, Why Pad? Ipad!, National Science Teachers Association National Convention, Louisville, KY.2

Marsh, J. (February 2013). Collaborating with Special Needs Teachers Using Technology, Jefferson County Public School Professional Development Seminar, Louisville, KY.

Marsh, J. (January 2012). Effectively using iPads in the Science Classroom, Professional Development Seminar For the Faculty at Pleasure Ridge Park High School, Louisville, KY.

Marsh, J. (April 2011). A Novel Approach to Analyzing Dissolved Organic Matter in Ice Cores by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry, Old Dominion University Department of Chemistry and Biochemistry, Norfolk, VA.

Marsh, J. (July 2010). High Sensitivity Measurement of Diverse Vascular Plant-derived Biomarkers in High-altitude Ice Cores (Geophysical Research Letter, 2009), Presentation of Recent Literature During the Hatcher Group Geochemistry Seminar, Norfolk, VA.

Marsh, J. (July 2010). A Novel Approach to Analyzing Dissolved Organic Matter in Ice Cores by Fourier Transform Ion Cyclotron Resonance Mass Spectrometry." Poster presentation (prepared by Joshua Marsh, presented by Dr. Patrick Hatcher) at the 15th Meeting of the International Humic Substances Society, Tenerife, Canary Islands.

Marsh, J. (August 2008) Microwave Effect on Competing Trans-esterifications: An Application to the Synthesis of Biodiesel Blends. Senior Undergraduate Presentation for the Department of Chemistry at Appalachian State University, Boone, NC.

Marsh, J., Wilson, I. & Bennett, N. (May 2008) Probing the influence of the Microwave Effect on Competing Trans-esterifications: An Application to the Synthesis of Biodiesel Blends." Poster Presentation at the 6th Annual International Microwaves in Chemistry Conference, Boston, MA.

Honors and Awards:

Old Dominion University's 40 Under 40 Distinguished Alumni Award - 2022
Editor's Choice Award, North Carolina Community College Journal of Teaching Innovations – 2022
News-topic 2018 Festival of the Year
North Carolina Festivals and Events Poster of the Year - 2017
Carolina Association of Chamber of Commerce Executives Scholarship (2017)
Chamber of Commerce Education Grant (2016) – Boone Chamber of Commerce
Dean's List (2015) – University of Kentucky
Dean's List (2014) – University of Kentucky
Dean's List (2013) – University of KentuckyN
New Science Teacher Academy Fellowship – NSTA
Dean's List – Appalachian State University
Summa Cum Laude Graduate – Tidewater Community College
Dean's List – Tidewater Community College