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K-12 Teacher Perceptions of Online Learning and Information Technology Support Post COVID-19 Pandemic

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K-12 Teacher Perceptions of Online Learning and Information Technology Support Post COVID-19 Pandemic

by

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Dedication

This dissertation is dedicated to my amazingly supportive family. To my wife Jenna Carraway, your love and encouragement have been absolutely crucial to my journey towards earning a terminal degree. You are the best wife a man could ask for. To my father Mike Carraway, you have been extremely supportive and have always been my biggest cheerleader. To my mother Sandra Carraway, you have provided me the inspiration to even attempt this degree. Watching you as a child, I always admired you for obtaining your doctorate. Finally, to my beautiful children Victoria and Michael III, I hope that I have made you both proud. Afterall, everything I do is for the two of you and your mom.

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Vita

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Abstract

This study examines K-12 teacher technology acceptance through their perceptions of the learning management system Google Classroom, in the aftermath of the COVID-19 pandemic. This correlational research study is conducted through a survey adapted from the Technology Acceptance Model, Information technology support analysis, and a functionality usability survey. This study examines the relationships between functionality, usability, IT support, perceived usefulness (PU), perceived ease of use (PEOU), attitudes towards use (ATU), behavioral intention to use (BI), and actual usage (AU). Structural equation modelling is conducted at the construct level in order to determine relationships between constructs. Additionally, this study explores assessment and implementation problems experienced by teachers in the emergency period of online teaching during the COVID-19 pandemic. Structural equation modelling (SEM) results show that perceived usefulness and perceived ease of use have statistically significant relationships with attitude towards use and behavioral intention to use. SEM results also showed attitude towards use had a statistically significant relationship with behavioral intention to use. SEM results showed that behavioral intention to use had a small statistically significant relationship with actual usage. SEM results showed mixed relationships between functionality and perceived usefulness, IT support and perceived usefulness, IT support and perceived ease of use, and usability with perceived ease of use. Additionally, based on Pearson correlations, perceived ease of use had statistically significant relationships with behavioral intention to use. Qualitative results showed that teachers faced academic dishonesty problems, technology problems, and teacher specific problems while implementing online learning. This study is intended to inform leaders in the education field about teacher perceptions, along with problems faced by teachers, in an effort to better support K-12 schools in the event of another emergency and for the betterment of online learning as a whole.

Keywords: *Technology Acceptance, functionality, usability, information technology support, perceived ease of use, perceived usage, attitudes towards use, behavioral intention to use, assessment problems, implementation problems, structural equation modelling.*

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Chapter 1: Introduction

Background of the Problem

The advent of the Coronavirus 2019 (COVID-19) caused extreme disruptions in the day-to-day lives of billions of people. According to the Centers for Disease Control (CDC) (2022), the first cities in the United States of America (USA) began to institute lockdowns around March 15, 2020, in an attempt to slow the spread of the virus. The school closures because of the COVID-19 lockdown directly impacted millions of students, teachers, and parents. According to the CDC, the New York City School District alone was responsible for 1.1 million students when it shifted to online learning. Over the next months, school districts across the country would close their doors and force their students and teachers to begin relying upon technology in ways that were often novel to K-12 teachers (CDC.gov, 2022).

According to the United Nations Educational, Scientific, and Cultural Organization (UNESCO) (2020), over 1.5 billion students worldwide have been affected by school closings due to COVID-19. A major consideration with school closures on emergency notice was the readiness of teachers to utilize new technology in the pursuit of educating students during the pandemic (Unesco.org, 2022). Scherer et. al. (2021) found that levels of teacher readiness were not homogenous and there are, in fact, multi-faceted aspects and levels of readiness that all affected the ability of teachers to handle the emergency transition to online learning and its accompanying changes in the use of technology (Scherer et al., 2021).

In accordance with these findings, Dorn et al. (2020) found there were many different experiences and levels of learning that occurred in the period when schools were closed due to the pandemic. This study projected learning loss that occurred with average online instruction, below average online instruction, and no online instruction. Learning levels under the average online learning loss scenario were projected to result in the equivalent of three to four months of lost instruction. Learning levels under the poor online learning resulted in the equivalent of seven to eleven months of lost instruction. Learning levels under the no instruction scenario were projected to result in the equivalent of twelve to fourteen months of lost instruction (Dorn et al., 2020).

Some of the worst learning outcomes were seen in racial and ethnic minorities. Dorn et al. (2020) explained that learning levels were lowest among low-income black and Hispanic students. They reported that these students were less likely to have the material and support needed to engage in high quality online learning. Some of these materials, or educational resources, are quiet spaces where students can concentrate, devices that are dedicated to one student, internet infrastructure, and parental support. In their average online learning scenario, black students lost 10.3 months of instruction, Hispanic students lost 9.2 months of instruction, and low socioeconomic status students lost more than one year of instruction. The overall losses are estimated to worsen achievement gaps that already exist by fifteen to twenty percent (Dorn et al., 2020).

White et al., (2021) found similar outcomes for minorities and students living in poverty. They state that these students are at increased risk for poor academic outcomes because their parents may not be able to return to work, work remotely, or have flexible hours that allow academic supervision. Furthermore, the electronic devices that are in these homes may need to be shared or used for the parents' work.

Disparities in learning outcomes and learning experiences as described herein demonstrate the importance of high-quality online education during situations such as the forced lockdowns of the COVID-19 pandemic. Barbour (2018) attempted to quantify what high-quality online education consisted of by examining current research on the subject. He found that there is currently no gold standard for high-quality online education and that much research still needs to be completed before best practice standards can be constructed. Although unable to construct a definition of high-quality online education, Barbour was able to identify significant themes, to include that teachers should complete professional development, be engaged with their students, and project their presence online (Barbour, 2018).

As noted by Barbour, high-quality online education includes an environment in which students are engaged. Hartman et al. (2019) furthered this line of research by conducting a study on educators' perceptions of technology integration in the classroom. Approximately 86 percent of educators who were surveyed believed that technology contributes to success of children. The study also showed that 95 percent of educators valued the opportunities that technology integration assisted them with making pertinent lessons for students. The study shows only some of the benefits of technology integration and acceptance (Hartman et al., 2019).

Along the same lines as Hartman's study, Akram et al. (2022) completed a literature review on teachers' perceptions of technology integration in teaching and learning. The review found that integration of information, communication, and technology, along with its utilization or acceptance, promoted student and educator engagement. In fact, the integration encourages student engagement in the form of student-to-student communication. The study also found that learning management system (LMS) integration by teachers helps boost academic achievement. Teacher acceptance of an LMS helps students with easy access to reference materials, important announcements, and other relevant information. Student achievement is also boosted by the

LMS, enabling learners to fully engage with a lesson before its delivery by the teacher (Akram et al., 2022).

Furthering the point that student engagement, technology usage, and resulting learning outcomes can be affected by the technology acceptance of individual teachers, Songkram and Osuwan (2022) found that teacher attitudes towards technology are strong predictors of a teacher's behavioral intention to use a technology. Additionally, perceived usefulness and perceived ease of use (two main constructs of the technology acceptance model) are predictors of teacher attitudes towards technology. A logical conclusion is that teacher technology acceptance can be a determinant of teachers' engagement, online presence, professional development choices, and possibly student achievement if perceived usefulness and perceived ease of use directly affect the teachers' attitudes towards a technology and their intention to use the technology. (Songkram & Osuwan, 2022).

Although it has been shown that teacher integration and acceptance of technology, including LMS, can increase student engagement and achievement, there are also barriers that teachers face in adopting these instructional technologies. Akram et al. (2022) detailed lack of defined policy, lack of competency, and poor attitudes as barriers to instructional technology use.

Reid (2012) conducted a literature review, categorizing barriers for adoption of technology by educators into five categories. Barriers to technology adoption were defined as environmental or personal factors that impede a person's usage of a particular technology. The five categories identified were technology, process, administration, faculty, and environment. Technology barriers included accessibility, reliability, and complexity. The study discovered that accessibility barriers were shown through dissatisfaction about investments and distribution of technology products. Reliability barriers were explained through the resistance of faculty to use technology after finding that it did not work in their first attempt to use the technology. Complexity barriers included availability, purpose, and applicability that make technology feel intimidating (Reid, 2012).

The process barriers included implementation, project management, and support. Implementation barriers included choosing the technology and the way IT departments assisted in the technology's initial use. Project management barriers are described as narrow views of future use, poor comfort with present use of the technology, inadequate communication and information, and natural tendency to be uncooperative. Support barriers are explained as lack of support from other faculty, lack of technical support, lack of administrative support, and support that is not focused on educator needs. Administration barriers to technology adoption are identified as control, instructional support, and leadership, misunderstanding of required effort, and faculty compensation and time. Control barriers were purchasing decisions, access, and the use of technology. Instructional support and leadership barriers were described as lack of directives, poor examples, inconsistent adoption, and non-strategic placement of support staff. Misunderstanding of required effort was explained as leaders' ignorance of the time and effort necessary to adopt technology. Faculty compensation and time were described as lack of pay for extra time taken to adopt technology (Reid, 2012).

According to Reid, environment is the fourth category of barrier to adoption of technology. Environment is explained as changes, culture, and technology effectiveness. Reid explains that learning institutions constantly go through changes that can have negative effects on technology adoption. Culture barriers are described as environmental problems such as home environment, parental assistance, and tension between administration and educators. Technology effectiveness is described as the usefulness of the technology with regards to the courses educators are teaching. Faculty barriers to technology adoption are explained as the varied resistance to change, efficacy, and perception of effectiveness. Faculty resistance is explained as an inherent barrier that exists in each institution in different degrees. Efficacy is described as the different levels of skill and comfort in using technology. Perception of effectiveness is the level that educators believe a piece of technology will help them teach their students (Reid, 2012).

Much like the categories of barriers to technology adoption detailed by Reid, Butler and Sellbom (2002) identified several barriers to technology adoption in teaching and learning. Butler and Sellbom found reliability, perceived worthiness, learning to use, and institutional support to be four major barriers to technology adoption. Reliability barriers were explained as the most cited large problem by educators. Examples of reliability barriers included incompatible software, support service mistakes, perceived worthiness of technology, software malfunctions, and poor internet access. Perceived worthiness of technology was explained as concerns from faculty that adopted technology may not be useful for teaching and learning (Butler & Sellbom, 2002).

Learning to use technology was another barrier identified by Butler and Sellbom. Learning to use technology was detailed as the second most important concern for educators regarding technology adoption. Educators were primarily concerned with the time needed to fully implement a technology. Institutional support was the final barrier and is explained as a perception of inadequate support by the educational organization. The authors listed several recommendations that can improve teacher self-efficacy and increase student engagement. These recommendations are to improve quality control, raise reliability, simplification of learning to use technology, assistance in determination of worth, and improvement of institutional support (Butler & Sellbom, 2002).

Cardullo et al. (2021) furthered this point by conducting a study to determine the relationship between factors in the Technology Acceptance Model and teacher self-efficacy. The study found that teacher disadvantages with online teaching included personal levels of self-efficacy, lack of resources and support, and student motivation. The advantages noted in online learning were flexibility, differentiation, and a wealth of resources for teaching when in-person instruction is not viable. Cardullo et al. further detail that teachers need to feel their technological needs are met (perceived ease of use) and are focused on the needs of students (perceived usefulness) (Cardullo et al., 2021).

Perceptions and technology acceptance have inevitably changed as teachers become more familiar with technologies such as learning management systems (Inbal & Blau, 2021). Stone and Zheng (2014) define learning management systems (LMS) as key pieces of an organization's e-learning capabilities that track learning activities and provide for growth and development. The majority of the online learning that took place during the pandemic (and is still taking place now) is done using LMS. It is important to include functionality and usability when discussing LMS and technology acceptance. Functionality is defined as the degree to which a system contains functions that are needed to complete tasks. Functionality changes according to functions available and tasks that need completion. Usability is defined as the task that is required to be completed and also the competence of the user. A system must be compatible with user perception, action, and cognitive skills to be usable. Several points of research exist on perceived usability and technology, usability and technology acceptance, usability evaluation in selecting technology, and LMS usability. Holden and Rada (2011) examined influence of perceived usability and technology acceptance, Hussein (2015) researched usability evaluation in selecting technology, Alshira'H et al. (2021) studied learning technology and usability, and

Dimitrijevic and Devedzic (2020) researched LMS usability. To the best of this researcher's knowledge, there has been no comparative study between grade levels that examines the barriers faced by teachers in accepting an LMS through the lens of TAM, functionality and usability in the K-12 school setting during the pandemic. Given this widespread-shift to technology-based instruction that was forced upon teachers across all subjects, grade levels, and communities on an emergency basis, the perceptions of K-12 teachers through technology acceptance are an area worthy of research (Inbal & Blau, 2021; Stone & Zheng, 2014; Goodwin, 1987; Holden & Rada, 2011; Hussein, 2015l Alshira'H et al., 2021; Dimitrijevic & Devedzic, 2020).

Statement of the Problem

Several research studies on teacher perceptions of online learning were conducted throughout the early phases of the pandemic, including during school closings and the initiation of online learning. Initially, the problems that existed with online learning had to do with the abruptness of its implementation and the lack of training to prepare teachers for new technology use. Eadens et. al. (2022) explains that less than half (2.23 out of 5) of school teachers surveyed felt they had an instructional skill set applicable to online teaching prior to school closings. Even fewer (1.91 out of 5) had been personally observed by a school leader while they were delivering an online lesson. Notwithstanding, many teachers (4.09 out of 5) felt as if they would return to the traditional classroom setting with stronger instructional skills and knowledge (Eadens et al., 2022).

In their article on lessons learned from the COVID-19 pandemic in higher education, Dolenc et al. (2021) recommend that school leaders pay special attention to support teachers and courses with the goal to communicate more effectively. Their recommendation is based on teacher's perceptions on the forced move to new technologically-based learning platforms that present major challenges to all teachers. Such challenges noted by teachers were organizational support, interaction and communication, previous experience, hardware, and problems assessing students (Dolenc, et al., 2021). This study aims to examine the steps that school leaders can take to help facilitate teachers' success to use LMS in online teaching and learning and to identify specific school-level (elementary, middle, and high) barriers that hinder the usage of LMS. The study of teachers' post-pandemic technology acceptance in online teaching can be a valuable tool to help guide decisions, particularly in the area of professional development.

Research indicates that professional development and IT support could have positive effects on technology acceptance. Kelly (2014) found that the opportunity to explore and be educated on open educational resources such as LMS can improve the belief that these resources are easy to use. This belief, otherwise known as perceived ease of use, is a direct indicator of technology acceptance and would increase the likelihood of use in each technology. Education in the form of professional development opportunities can lead to increased perceived ease of use and higher rates of engagement with technologies. Teachers who are more actively engaged should be able to provide stronger online educational opportunities for their students (Kelly, 2014).

In March 2020, teachers had little choice in their emergency-based use of new technologies. The forced use of online instruction and the accompanying LMS may not have been accepted by every individual classroom teacher. Teachers' opinions about the use of LMS and other technological tools were never examined during the pandemic. According to Doyle et al. (2021), many public and private schools in states like Florida began reopening as early as August of 2020. Ioannides (2022) suggests that the pandemic phase of COVID-19 may have ended in some areas as early as 2021. Currently, most schools have returned to traditional learning, and technologies such as LMS that had been adopted during the pandemic have now been incorporated in more traditional environments (Ioannides, 2022).

The incorporation of LMS in the traditional classroom highlights the importance of quality IT support. In fact, it has been found that IT support can have an effect on the perceived usefulness and perceived ease of use of an LMS and the technology acceptance of an LMS. Zheng et al. (2018) reported that organizational support, in the form of IT support and self-efficacy, positively affects faculty perceived benefits. Essentially, increased IT support, along with teacher self-efficacy, can positively affect the way educators feel about LMS (Zheng et al., 2018).

Although LMS have proved to be beneficial in the realm of online learning, there were naturally issues that were identified through experience with their use. For example, online assessment security was identified as an area of concern. Nguyen et al. (2020) states that roughly 70 percent of online college students admitted to cheating during the course of their online classes. The cheating infractions ranged from copying homework answers to using search engines to find answers to online assessments. This academic dishonesty continued in spite of explicit instructions against these acts (Nguyen et al., 2020).

Considering the insights gained on teacher technology acceptance and the importance of IT support while using LMS, it is worthwhile to consider the technology acceptance of teachers, while also assessing their perceptions on barriers faced while using LMS and IT support. It is important to survey K-12 teachers on technology acceptance, the inevitable experiences gained with technology use, and the accompanying IT support after the pandemic. Such information will provide much needed information as leaders seek to help teachers improve the quality of their instruction now and in the future.

Purpose of Study

The central purpose of this study is to determine teacher perceptions of LMS usage in a post-COVID-19 environment, using the technology acceptance model. This study is needed given that teachers' use has evolved as a result of their experiences with and reliance upon the use of LMS and technological tools during the COVID-19 pandemic (Ioannidis, 2022). Technology acceptance may help measure the effectiveness of instruction and of professional development on LMS, such as Google Classroom. Teachers, who were forced to begin using technology in a way that they were not familiar with or educated on, may have gained new insight and attitudes on the use of LMS. Furthermore, these teachers may have also accepted or embraced the use of technology in their classrooms in ways that they may never have considered before the pandemic lockdowns. Information gathered from this study can be used to better support teachers in the present and to prepare for the future, by gauging their technology acceptance to LMS and the associated tools embedded within it to inform areas of professional development.

The secondary purpose of this study is to determine the implications teacher technology acceptance has for schools, the barriers faced in using LMS, and the schools' efforts to provide information technology (IT) support. This researcher believes it is highly likely that the information obtained from classroom teachers who experienced the pandemic lockdowns will carry important information that can be used to help better support teachers and their LMS usage across the state of Georgia. It is important for school leaders to better understand perceived technology acceptance among teachers who may carry some of the same feelings as the staff members that work in their buildings. Technology alone does nothing to enhance pedagogy. Appropriate use and technology acceptance take a concerted effort from teachers and schools. In this study, K-12 teachers' assessment of the IT support provided by their school and the barriers faced by them to use the Google Classroom LMS will be researched to determine the role of technology support in the acceptance and usage of this LMS (Keengwe & Kidd, 2010).

The tertiary purpose of this study is to understand the effect that functionality and usability of the LMS has on K-12 teachers' use and acceptance of technology. The effect of functionality and usability on K-12 teachers' use of the Google Classroom LMS will be assessed as a way to fulfill this purpose. Chen et al. (2023) defines usability as the quality of an interface and the different ways in which activities are performed in its system. They hold that usability should be examined through the lens of the K-12 teacher when applying it to an LMS (Chen et al., 2023).

The final purpose of this study is exploratory in nature. As noted by Garcia-Morales et al. (2021), teachers experienced several difficulties and barriers throughout the period of forced distance and online learning. This study seeks to obtain more information about the assessment problems and technological barriers in LMS that were encountered by K-12 teachers specifically. More information on this matter is important for K-12 educators and leaders because of the continued growth in online education and also in case of another period of quarantine. All four purposes of this study serve the goal of improving instruction through data collection and informed assistance.

Research Questions

The overarching research question: What are the perceptions of teachers when using the Google classroom LMS during the post COVID-1 9 era?

Additionally, the researcher will answer the following questions:

1. **How does perceived ease of use of the Google Classroom LMS in K-12 teachers influence their behavioral intention to use the Google Classroom system?**

   H_0: Perceived ease of use of the Google Classroom LMS does not influence K-12 teachers' behavioral intention to use it to a statistically significant degree.

   H_a: Perceived ease of use of the Google Classroom LMS positively influences K-12 teachers' behavioral intention to use it to a statistically significant degree.

2. **How does perceived usefulness of the Google Classroom LMS in K-12 teachers influence their behavioral intention to use the Google Classroom system?**

   H_0: Perceived usefulness of the Google Classroom LMS does not influence K-12 teachers' behavioral intention to use it to a statistically significant degree.

   H_a: Perceived usefulness of the Google Classroom LMS positively influences K-12 teachers' behavioral intention to use it to a statistically significant degree.

3. **How do the IT experiences of K-12 teachers influence their behavioral intention to use the Google Classroom system?**

   H_0: IT support experiences do not influence K-12 teachers' behavioral intention to use Google Classroom to a statistically significant degree.

   H_a: IT support experiences positively influence K-12 teachers' behavioral intention to use Google Classroom to a statistically significant degree.

4. **How does the functionality and usability of the Google Classroom LMS influence K-12 teachers' behavioral intention to use it?**

   H_0: Functionality and usability perceptions do not influence K-12 teachers' intention to use it to a statistically significant degree.

H_a: Functionality and usability perceptions positively influence K-12 teachers' intention to use it to a statistically significant degree.

5. **How does the perceived ease of use and perceived usefulness of the Google Classroom LMS in K-12 teachers influence their attitudes toward use?**

   H_0: Perceived ease of use and perceived usefulness do not influence K-12 teachers' attitudes towards use of the Google classroom LMS to a statistically significant degree.

   H_a: Perceived ease of use and perceived usefulness positive influence K-12 teachers' attitudes towards use of the Google Classroom LMS.

6. **How do K-12 teachers' attitudes toward use of the Google Classroom LMS influence their behavioral intention to use it?**

   H_0: Attitudes toward use of the Google Classroom LMS do not affect K-12 teachers' behavioral intention to use it.

   H_a: Attitudes toward use of the Google Classroom LMS have a positive effect on K-12 teachers' behavioral intention to use it.

7. **How does K-12 teachers' behavioral intention to use the Google Classroom LMS influence actual system usage of it?**

   H_0: K-12 teachers' behavioral intention to use the Google Classroom LMS does not influence actual system usage to a statistically significant degree.

   H_a: K-12 teachers' behavioral intention to use the Google Classroom LMS positively effects actual system usage to a statistically significant degree.

8. **What types of assessment problems did teachers face with online learning during the COVID-19 pandemic?**

9. **What are the different types of barriers (technology, process, administration, faculty, lack of training, and environment) teachers faced while using Google Classroom LMS during the pandemic?**

Conceptual Framework

The conceptual framework of this study is based on the Technology Acceptance Model (TAM) created by Fred Davis (1989). Davis created the TAM in 1989 to gauge determinants of computer usage, more specifically, electronic mail (email). Davis identified two distinct variables of perceived usefulness and perceived ease of use and created scales to measure each of these two variables. Both scales were tested and found to have robust psychometric properties and significant relationships with self-reported levels of technology usage. In his work, Davis states that perceived usefulness is affected by perceived ease of use. Thus, a specific piece of technology is seen as more useful if it is also seen as easy to use. Conversely, if a piece of technology is not seen as easy to use, it is more likely to be thought of as less useful (Davis, 1989).

Over the years the TAM became the most widely used theoretical framework in technology usage research. Venkatesh built upon the foundational TAM by incorporating more factors into perceived ease of use and perceived usefulness, finding that computer self-efficacy, facilitating conditions, intrinsic motivation, and computer anxiety also affect how people come to their perceived ease of use about new technologies. In fact, facilitating conditions were found to more strongly influence perceived ease of use than user practice (Venkatesh, 2000).

Perceived ease of use and perceived usefulness can have effects on behavioral intention to use. According to Brezavšček et al. (2016), behavioral intention to use can be defined as the degree that a person has created conscious plans to complete or not complete a certain behavior in the future. In other words, behavioral intention to use is if a person intends to use a technology. Furthermore, both perceived ease of use and perceived usefulness have an effect on behavioral intention to use. For the TAM's purposes, perceived ease of use and perceived usefulness make it more likely that someone will use a particular piece of technology (Brezavšček et al., 2016).

The framework for this research study takes the constructs of perceived ease of use and perceived usefulness from the TAM in order to test them, along with facilitating conditions and behavioral intention to use. This study will use IT support as a form of facilitating condition. Perceived ease of use, perceived usefulness, and the facilitating condition of IT support will be utilized in an attempt to form a more detailed picture of technology acceptance in the surveyed population of K-12 teachers. For example, facilitating conditions in the form of IT support along with high levels of functionality and usability may have an effect on perceived ease of use and eventually perceived usefulness.

Methodology Overview

This study will use a correlational research design in which participants are surveyed in order to determine their acceptance of technology in their professional teaching careers and their feelings about IT support at work. The participants of this study will be K-12 teachers in one of the larger counties in Georgia. Teachers to be surveyed are employed by a public school district located in a suburban county within the state of Georgia. The district serves approximately 32,000 students and employs approximately 2000 teachers who fill eighteen elementary schools, eight middle schools, and five high schools. According to the National Center for Educational Statistics (NCES) (2023), the sampled school district has a total of 1,811 teachers. Overall, there are 28 prekindergarten teachers, 104 kindergarten teachers, 723 elementary school teachers, 750 secondary teachers, and 205 ungraded teachers. The sampled school district maintains a student to teacher ratio of 16:1 (NCES, 2023).

The survey will be sent to teachers in five elementary schools, eight middle schools, and five high schools. Schools included in this study were recommended by district-level leadership. The survey will be sent electronically by way of email and will be anonymous. This email survey will be sent to every teacher in these 18 schools. Teachers who were not in the classroom during the COVID-19 pandemic will not be eligible for this study. This cross section of teachers from kindergarten to high school will result in the gathering of data that are more diverse and revealing than data collected by simply surveying a single grade level.

A modified version of the TAM survey will be used to suit the needs of current study. While the original TAM survey focused on electronic mail (Davis, 1989), this survey has been adapted to mention Google Classroom, which is the technological hub used by teachers at the study site to quickly access a wide variety of technology pieces. In the school district of the teachers surveyed in this study, Google Classroom is used by nearly every teacher. The Google Classroom LMS is used for notes, assignments, assessments, communication, and even grading. Teachers are expected to use the Google Classroom LMS, making the Google Classroom LMS the ideal conduit for gathering data on perceived ease of use, perceived usefulness, IT support, functionality and usability, as well as assessment and implementation issues encountered during the emergency transition to online learning during the COVID-19 pandemic.

In order to collect information about K-12 teachers' experiences with IT support at work, this study will also include a survey of IT support adapted from Yang et al. (2004). Finally, this study will include an adapted form of the usability survey used by Laugwitz et al., (2008). This survey was originally used to assess functionality and usability and will be adapted for the Google Classroom LMS. These modified surveys will be combined into one survey that will be created in Qualtrics. The survey will employ a six-point Likert scale, with responses ranging from strongly disagree to strongly agree. There will be no neutral choice to ensure that respondents provide either a positive or negative perception on the six-point Likert scale (Yang et al., 2004; Laugwitz et al., 2008).

The survey for this study will be sent to teachers in a link using each school's email list. Resulting data will be collected using Qualtrics. Data will be analyzed using the structural equation modeling technique. According to Ullman (2006), the structural equation model (SEM) is a statistical technique that make it possible to analyze a set of relationships between one or more independent constructs and one or more dependent constructs. Both the independent and dependent variables that are analyzed can be discrete or continuous. Fit indices are used to judge the quality of proposed SEM and its fit to the data. For this study, the researcher will analyze data at the construct level. This study will measure the relationship between perceived ease of use, perceived usefulness, LMS functionality and usability, information technology support, attitudes toward use, and the behavioral intention to use the Google Classroom learning management system. Additionally, data will be collected on the barriers teachers faced during the pandemic when using Google Classroom LMS and its associated technological tools. Likewise, data will be collected on the assessment issues in Google Classroom. (Ullman, 2006).

Delimitations

This study is intended to determine the technology acceptance that K-12 teachers have after the COVID-19 pandemic, for the software Google Classroom LMS, and it also includes a component regarding teacher perceptions of IT support. This study is solely focused on K-12 teachers and will be conducted in a large suburban county in Georgia. A second delimitation, common method bias, can occur as only one data collection tool (i.e., survey) will be used in the study. There will be a few open-ended questions in the survey that can alleviate the bias from arising from common method to some extent. Survey data will be collected at only one time point (cross-sectional). Hence, the teachers' perceptions of Google Classroom LMS usage over time cannot be measured. This would limit the researcher's ability to measure change in perspective towards technology acceptance and usage over time (Podsakoff et al. 2003).

Another delimitation is social desirability bias, which refers to the "tendency of research subjects to give socially desirable responses instead of choosing responses that are reflective of their true feelings." In the case of this study, the researcher is collecting data on several different variables that are all self-reported by the same people, the K-12 teachers. This will likely introduce social desirability bias which can incorrectly raise or lower the statistical relationships between variables. This study has worked to minimize social desirability bias by making responses anonymous (Grimm, 2010).

The final delimitation identified in this study is the lack of choice definitions in conjunction with the sliding scale questions. Choice definitions could have been provided for clarity and may have contributed to more consistent and meaningful responses. Future studies should include choice definitions in order to elicit improved responses.

Limitations

As is to be expected, this study has limitations, the foremost being that the study will be limited to one school district and, therefore, findings may not apply to wider areas, such as the entire state of Georgia, other states in the US, and other countries. This study is simply a small piece of an area of study that needs to be further explored. Further research would include replicating this study over a larger area and with more teachers. Additional variables with different variables, such as content areas, would provide a more complete picture into teacher perceptions of the use of technology in their classrooms through the TAM.

Another limitation of this study is that the survey questions are geared towards the Google Classroom platform and its accompanying applications. Google Classroom is not used in all school districts. Furthermore, the same quality of IT support is not available in all school districts. Future research in other school districts could be adapted to survey teachers in other types of LMS through the TAM. Response rate is also a limitation in this study. The researcher will send reminder emails to all teachers in the school district to complete the survey.

The final limitation currently attributed to this study is social desirability bias. Fisher (1993) explains that social desirability bias occurs when data becomes skewed due to respondents feeling compelled to choose what they think the correct response should be. In this study's case, respondents may feel compelled to answer positively about the Google Classroom LMS because it is embraced by and used heavily in their district. Steps to mitigate this are the researcher making responses anonymous, which will allow respondents to be more truthful without fear of retribution (Fisher, 1993).

Definition of Terms

Accessible Technology: Technology that is designed in a way that is accessible by a diverse and wide range of users and circumstances is considered accessible technology (wisc.edu, 2021).

Actual usage: Actual usage is a user's self-reported usage of a technology such as a learning management system (Davis, 1989).

Attitudes Towards Use: Attitudes towards use are measured levels of a user's desire to use a specific technology (Davis, 1989).

Barriers: Barriers towards use are environmental, or personal, factors that impede a person's usage of a particular technology (Reid, 2012).

Behavioral Intention to Use: Behavioral intention to use is the degree that a person has created conscious plans to complete or not complete a certain behavior in the future (Brezavšček et al., 2016).

Confirmatory Factor Analysis: Confirmatory Factor Analysis is a series of tests conducted to determine if a set of items define a construct. Confirmatory factor analysis is used for scale validity of the Modified Technology Acceptance Survey (Schumacker & Lomax, 2010).

Correlation Matrix: A correlation matrix is a technique that helps assess the relationship between two variables in a set of data (Ullman, 2006).

Covariance Matrix: A covariance is a measurement of the degree of linear relationships between two variables and a matrix is an array of numbers used to represent mathematical properties. In this case, a covariance matrix is used to displace the linear relationships of multiple variables (Ullman, 2006).

COVID-19: COVID-19 is a respiratory disease caused by the SARS-CoV-2 virus that started a pandemic in 2019 (CDC.gov, 2019).

Direct Effect: Direct effect is the direct influence of one variable to another. For example, the direct influence of attitude towards use on behavioral intention to use (Schumacker & Lomax, 2010).

Elementary School: Any school containing grades 1 through 5 can be considered an elementary school (nces.ed.gov, 2023).

Endogenous Variable or Factor: Otherwise known as a dependent variable or factor, endogenous variables are directly affected by exogenous variables (Schumacker & Lomax, 2010).

Exogeneous Variable or Factor: Otherwise known as an independent variable or factor, exogenous variables directly affect endogenous or dependent variables (Schumacker & Lomax, 2010).

External Variables: Influences such as demographics, attitudes towards targets, personality traits, and other individual differences that effect behavior and beliefs (upenn.edu, 2023).

Functionality: The degree to which a system contains functions that are needed to complete tasks. Functionality changes according to functions available and tasks that need completion (Goodwin, 1987).

High School: Any school that offers more of higher grades, typically 9-12, can be considered a high school (nces.ed.gov, 2023).

Information Technology (IT): Any equipment, or system, that is used in the acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency can be considered information technology (CSRC.NIST.gov, 2023).

Indicator Variable: Otherwise known as the measured, manifest, or observed variables, indicator variables are used to indicate whether data belongs to a specific category using the numbers zero and one. For example, is a survey respondent male or female (Weston, 2006).

Indirect Effect: The indirect influence of one variable to another. For example, the effect of IT support on behavioral intention to use (Schumacker & Lomax, 2010).

IT Support: IT support is a combination of the reliability, responsiveness, competence, and security of information technology (Yang et al., 2004).

Latent Error: The measurement error, or difference between expected and obtained data, associated with the latent variable or construct which cannot be directly measured (Weston, 2006).

Latent Factor: Another term for a latent variable. Latent can be described as unobserved or not directly observed. In variable form, a latent variable can only be measured through observed variables (Weston, 2006).

Learning Management System/Systems: LMS are integrated suites, or tools, that facilitate online transfer of instructional content, class interaction, group interaction, and administrative supervisory features (Rhode et al., 2017).

Manifest Error: The measurement error associated with the observed variable which can be directly measured and represent the attributes of the latent construct (Ullman, 2006).

Manifest Variable: Another term for an indicator, measured, or observed variable, a manifest variable is a type of variable that can be directly measured (Weston, 2006).

Measurement Error: Unreliable variable measurements due to a difference between the true value and measured value (Schumacker & Lomax, 2010).

Measurement Model: A confirmatory factor model used to define the relationships between the latent variables and the observed variables (Schumacker & Lomax, 2010).

Middle School: Any school that offers more of grades 5 through 8 than higher or lower grades can be considered a middle school (nces.ed.gov, 2023).

Online Learning: Education that takes place when students are physically away from their teachers and is completed using internet resources is considered online learning (UH.org, 2023).

Parsimonious Model: Model indices that are arranged from complex to simple. A more parsimonious model will have less interconnections between constructs. For example, the TAM is more parsimonious than the Modified TAM (Schumacker & Lomax, 2010).

Path Analysis: Solving a set of simultaneous regression equations that theoretically establish the relationship among the observed variables in a path model (Schumacker & Lomax, 2010).

Perceived Ease of Use: The extent to which one believes using a form of technology will be free of effort (Davis, 1989).

Perceived Usefulness: The extent to which one believes a form of technology will make their job easier (Davis, 1989).

Structural Equation Model: The various types of models used to depict relationships among observed variables, with the same basic goal of providing a quantitative test of a theoretical model hypothesized by the researcher. The structural equation model is typically created after confirmatory factor analysis, a series of construct validity tests, is completed (Schumacker & Lomax, 2010).

Structural Model: A model used to indicate how latent variables are related (Schumacker & Lomax, 2010).

Technology Acceptance: The extent to which one accepts or rejects a form of technology. Technology acceptance is made up of two components, perceived ease of use and perceived usefulness (Davis, 1989).

Theory of Reasoned Action: Precursor theory to the Technology Acceptance Model in which one's actions are believed to be determined by one's beliefs, attitudes, and intentions (Ajzen & Fishbein, 1975).

Theory of Planned Behavior: Theory where attitudes toward behavior, norms associated with the behavior, and perceived control over the behavior can exert a strong influence over intention to perform a behavior (Ajzen, 1991)

Usability: Usability is affected by the task needing to be completed and also the competence of the user. To be usable, a system must be compatible with user perception, action, and cognitive skills (Goodwin, 1987).

Significance of Study

This study is significant for several reasons. First, a dearth of research exists on the technology acceptance of K-12 teachers in the years since the COVID-19 pandemic. Many studies, such as those conducted by Joo et al. (2018), Hussein (2016), and Nafsaniath et al. (2015), were conducted in the years before the COVID-19 pandemic and considered technology acceptance of teachers. To the best of researcher's knowledge, no study has considered teacher technology acceptance in the wake of the COVID-19 pandemic, specifically in relation to teachers' perceptions at different grade levels with regards to the role of IT support in LMS usage and the different types of barriers that exist in its usage. This study is intended to help fill this gap in research (Joo et al., 2018; Hussein, 2016).

The second significance of this study is that it examines IT support and the effects that IT support, or lack thereof, can have on teacher technology perceptions. Studies such as Ruggiero and Mong (2015) and Francom (2016) emphasize the important effects that IT support can have on perceived ease of use, perceived usefulness, and intention to use. Teachers who report active, and ongoing, IT support show a stronger inclination to use technology. It would appear that IT support can have a material effect on technology acceptance (Ruggiero & Mong, 2015; Francom, 2016).

The third significance of this study is that, along with technology acceptance of K-12 teachers and IT support, it also explores the role of functionality and usability and their relationship with K-12 teachers' technology acceptance of the LMS Google Classroom in conjunction with IT support. According to Alshira'h et al. (2021), usability is effectiveness, efficiency, and satisfaction with a piece of technology, specifically with its ease of use. In regards to an LMS, Alshira'h explains that usability shows ease of understanding, ease of comprehension, speed of navigation, and the ability of users to control their progress. It is possible that usability, perceived ease of use, perceived usefulness, and behavioral intention to use are correlated with each other and explain the intention to use an LMS (Alshira'h et al., 2021).

Functionality of an LMS is defined by Ghosh et al. (2019) as the communication tools, student to student interaction abilities, student to instructor interaction capabilities, and additional requirements that differ between learning institutions. Essentially, the functionality of an LMS will be different based on the diverse needs of the many elementary schools, middle schools, high schools, and universities that utilize them. Much like usability, functionality may also correlate with perceived ease of use, perceived usefulness, and behavioral intention to use. These constructs may all factor into a K-12 teacher making use of a particular LMS like Google Classroom (Ghosh et al., 2019).

The fourth significance of this study is that it seeks to gain more insight into problems that occurred with online assessment and testing during the pandemic. As noted by Davidson-Shivers and Reese (2014), K-12 teachers experienced several problems with online learning. These problems ranged from academic dishonesty, to data security, to operational problems with assessments. This study will explore the influence of IT support on teachers' experiences with assessment and testing that is conducted within Google Classroom LMS (Davidson-Shivers & Reese, 2014).

The fifth significance of this study is that it delineates perceptions between elementary (K-5), middle (6-8), and high school (9-12) teachers. As noted previously, the functionality of an LMS can change based on the learning institution that makes use of it. With that in mind, different grade level clusters will likely not have the same thoughts about the Google Classroom LMS. Furthermore, the significance of the grade level in which the teachers operate may also affect their feelings about perceived ease of use, perceived usefulness, and behavioral intention to use the Google Classroom LMS.

The sixth significance of this study is that there is limited research on specific barriers experienced by K-12 teachers in using technology in their classroom. The studies conducted in the past to explore teachers' perceptions of technology acceptance during the pandemic have limitations with regards to diversity in teachers' characteristics, assessment of only the TAM perceptions in isolation, and without considering the role of level variables like school size, school type, and availability of IT support. Furthermore, a systematic review conducted by Chun and Yunus (2023), showed that all studies conducted during the pandemic on teachers' perceptions and the TAM were in schools outside of the US.

This dissertation further contributes to the research literature by identifying the barriers teachers face from a TAM perspective and steps that IT support, from schools and districts, can implement to reduce the barriers towards implementation of technology in K-12 classrooms. For all of these reasons, this study is significant and will add to the body of research about technology acceptance of LMS (Chun & Yunus, 2023).

Summary

The need for this study is justified after the COVID-19 pandemic and its aftermath. As detailed in the UNESCO (2020) article, more than one billion students, and teachers, have been affected by the COVID-19 pandemic and its resulting shutdowns of schools. In the move to emergency online learning, teachers and students alike were forced to interact using technology, such as LMS and other applications, that neither group were familiar with. The problems were multiplied for teachers, in that they were forced to use new programs and LMS to teach students even though the teachers themselves were not trained to use these types of technologies (UNESCO, 2020).

Due to the emergency reliance upon online education, technologies such as LMS became much more wide-spread in their usage (Inbal & Blau, 2021). The higher self-efficacy associated with increased usage could be associated with higher rates of technology acceptance of these increasingly used applications such as Google Classroom (Dindar et al., 2021). These same teachers whose usage of technology dramatically increased during the COVID-19 lockdowns may also have unique insights on the different aspects of IT, such as support and needs for IT improvement in schools.

Findings in this study can help prepare teachers and leaders for future professional development and IT support. Alongside documented instances of perceived ease of use, perceived usefulness, functionality, and usability affecting technology use, Philipsen (2018) explains the role of how institutional support, in the form of professional development and IT support, can help influence teachers' dispositions about online learning and possibly affect their behavioral intention to use LMS based technologies. Findings in this study can also help inform school leaders on teacher feelings and needs to better prepare schools for future scenarios requiring sustained online learning (Philipsen, 2018).

Chapter II: Literature Review

The Technology Acceptance Model (TAM) is the natural evolution of the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB). This study takes the major constructs of the TAM (perceived ease of use, perceived usefulness, attitudes towards use, and behavioral intention to use) and combines them with the information technology (IT) support constructs (reliability, responsiveness, competence, security, and product portfolio), along with functionality constructs (novelty, stimulating) and usability constructs (perspicuity, efficiency) to create the modified TAM framework (Azjen & Fishbein, 1975; Azjen, 1985; Davis, 1989; Mlekus et al. 2020).

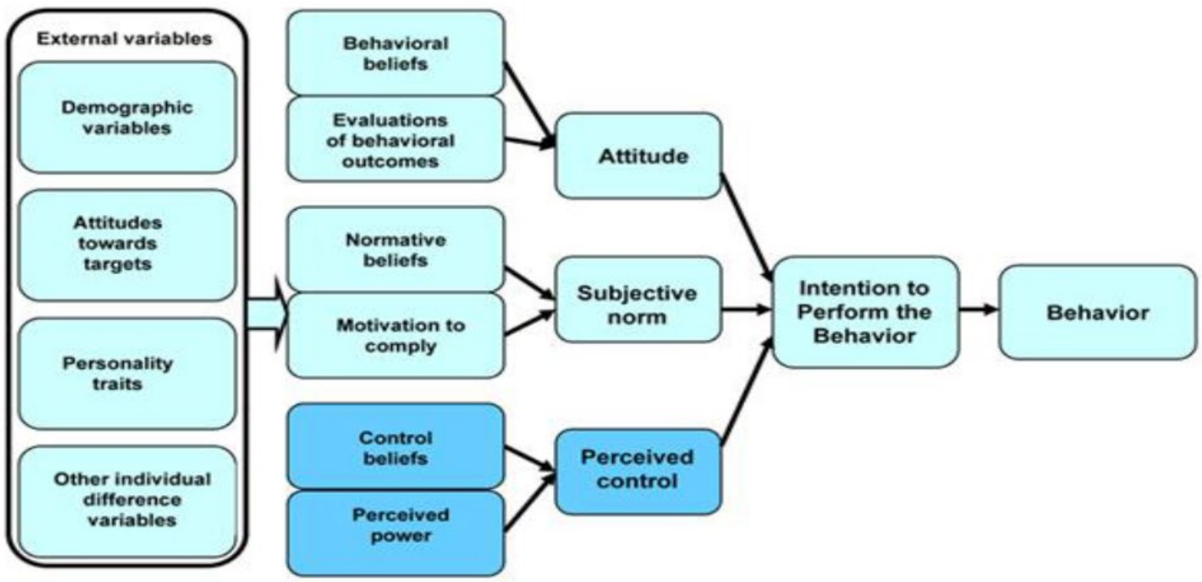
The major topics of this chapter are the application of the TAM to understand the acceptance of an LMS, barriers to online teaching during the COVID-19 pandemic, assessment issues with online learning, IT support, functionality, usability, and gaps in literature. This study helps to reduce a gap in literature because it focuses on K-12 teachers. This study also incorporates IT support, functionality, and usability into the TAM. To this researcher's knowledge, these features make this study unique.

Technology Acceptance Theoretical Framework

Knowledge of the history and development of the TAM is essential to fully understand this study's conceptual framework. Fishbein and Azjen (1975) developed The Theory of Reasoned Action (TRA) in an attempt to understand why people take certain actions and what factors influence decision making. Fishbein and Ajzen determined that the foundation of actions starts with beliefs. They explained that beliefs affect attitudes and an individual's attitude towards a certain action is heavily influenced by the person's beliefs about the action. Furthermore, a person's intentions toward an action are strongly affected by the individual's attitude toward that action. Fishbein and Azjen determined that proper assessment of a person's intentions is the main determinant of the person's overt behavior. Figure 1 represents the two combined theories (Azjen & Fishbein, 1975).

Figure 1

Combined Theory of Reasoned Action and Theory of Planned Behavior



Note: Theory of Reasoned Action (light blue) and Theory of Planned Behavior (dark blue) flow chart. Adapted from Health Behavior and Health Education. Upenn.edu. Retrieved October 11, 2023, from https://www.med.upenn.edu/hbhe4/part2-ch4-theory-of-reasoned-action.shtml.

The identification of beliefs, attitudes, intentions, and behaviors, along with their effects on each other, were Fishbein and Azjen's best attempt at developing a conceptual framework on attitudes (Azjen, & Fishbein, 1975). However, their research in the field of behaviors and actions did not end with the TRA. Azjen (1985) continued this line of research when he developed the Theory of Planned Behavior (TBH). The TBH builds on the TRA by modifying beliefs and attitudes with attitude toward the behavior, subjective norm, and perceived behavioral control (Azjen, 1985).

Azjen's TRA details how positive performance of social behaviors is reliant upon the amount of control the performer has on factors that can inhibit the completion of the behavior. The two factors identified are internal and external factors. Internal factors include individual differences related to an individual's ability to decide his or her own behavior, information, skill, ability, will-power, emotions, and compulsion. External factors are grouped under the two main categories of time and opportunity, and dependence on others (Azjen, 1985).

Azjen explains that the decision to take an action rest completely on the individual's desire to execute the action if internal and external factors are irrelevant or weak. The TRA is intended to be applied to these desired behaviors. Azjen categorizes these behaviors as being under volitional control where the person is not strongly influenced by internal or external factors. Azjen sums up the TRA by explaining that a person's decision to attempt a behavior is contingent on the perceived benefits of success, the perceived consequences of failure, and the pressures exerted upon the person to complete the action (Azjen, 1985).

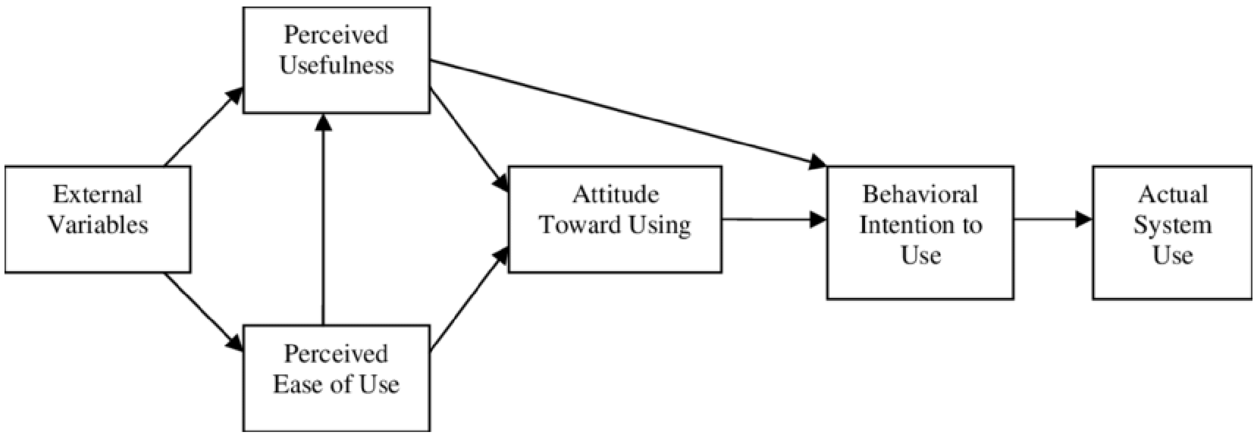
Following in the footsteps of Fishbein and Azjen, Fred Davis adapted the behavioral foundations laid by the TBA and the TRA for technology acceptance. The two distinct factors of perceived ease of use and perceived usefulness strongly affect technology acceptance. Perceived ease of use can be defined as the degree to which someone believes that using something will be free of effort. The technology is more likely to be accepted than when the technology requires effort if the use of some technology does not require effort (Davis, 1989).

Along with perceived ease of use, perceived usefulness has a noted effect on technology acceptance. Perceived usefulness is defined by Davis as the degree that someone thinks that using a certain technology will enhance his or her job performance. If a person decides that a technology will help him or her perform duties in a more effective manner, the person will be more likely to accept that type of technology. Likewise, if a person decides that a technology will not enhance his or her job performance, or that it may even hurt performance, the person will be less likely to accept that technology (Davis, 1989).

Although Davis found that perceived usefulness and perceived ease of use are both strongly correlated with behavioral intention to use, he also determined that they do not make a similar impact on behavioral intention to use. Davis defined behavioral intention to use as someone's attitude toward using a technology. Behavioral intention to use may be thought of as if someone is planning to use a technology. In the context of this research, behavioral intention to use will be the K-12 teacher's intention to use the Google Classroom LMS. In the two original studies conducted on TAM, Davis discovered that perceived usefulness had a much stronger effect on behavioral intention to use than perceived ease of use. The fact that perceived usefulness has a significantly larger effect on behavioral intention to use indicates that most people who were surveyed cared more about the effectiveness of a technology than its difficulty of use (Davis, 1989). Figure two shows the original TAM that is used as the basis for the Modified TAM used in this study.

Figure 2

Technology Acceptance Model



Note: Technology Acceptance Model flow chart. Adapted from "A Model of the Antecedents of Perceived Ease of Use: Development and Test," by V. Venkatesh and F. D. Davis, 1996, *Decision Sciences, 27*(3), p. 453. Copyright 1996 by John Wiley & Sons, Inc.

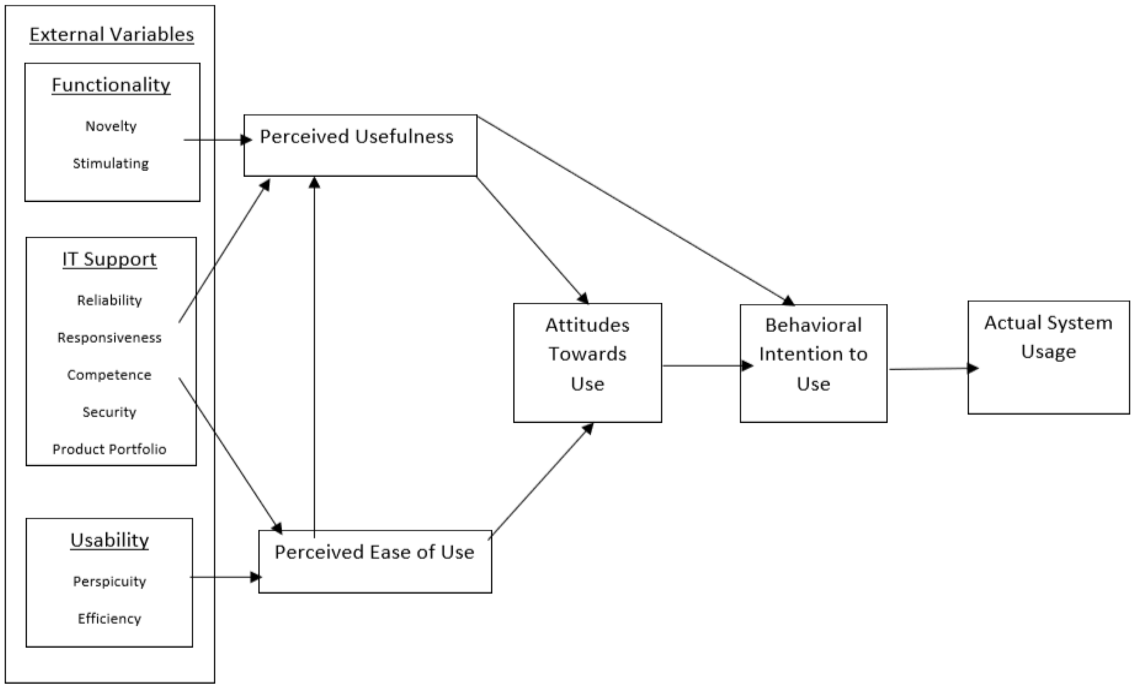
Davis (1989) developed the TAM because there were no psychometrically tested survey scales to measure technology acceptance. Therefore, he sought to develop a scale to measure technology acceptance. The research question was, "What causes people to accept or reject information technology?" There were two main factors which determined whether a user will accept or reject a given technology. These factors are perceived ease of use and perceived usefulness. Davis found that increased perceived ease of use and perceived usefulness correlated with increased usage of a technology (Davis, 1989).

The research design included three steps. The first step was to use research to develop two scales, one for perceived usefulness and one for perceived ease of use. The next step was to test the reliability of the perceived ease of use scale. The final step was to test the reliability of the perceived usefulness scale. The results found that both scales were significantly reliable. The perceived usefulness scale was determined to have a Cronbach alpha of .97 for two types of technology, electronic mail and XEDIT (technological tool used in the study). Conversely, the perceived ease of use scale scored .86 for electronic mail and .93 for XEDIT. Both the scales for perceived ease of use and perceived usefulness were validated to be used by Davis (Davis, 1989). Many future researchers built upon the TAM such as Venkatesh (2000) and Azjen (1991) (Venkatesh, 2000; Azjen, 1991).

This study's conceptual framework builds upon the TRA, TPB, TAM and considers the influence of institutional technical support (ITS), functionality, usability, and barriers to implementation on technology acceptance. Alenezi et al. (2011) asserted that technical support provided by institutions is another important factor that influences technology acceptance by organization members. The Alenezi et al. study describes the direct effect of ITS on perceived ease of use and perceived effectiveness on a given technology. Mlekus et al. (2020) showed that functionality effected perceived usefulness and usability effected perceived ease of use. This author has incorporated this finding into the current study. An et al. (2021) showed how barriers to online learning can affect teacher feelings and attitude toward online learning. This author has incorporated barriers to online learning and reflected these barrier's effects on attitude towards technology. Figure 3 shows the Modified TAM that is used as the theoretical model for this study and adds three constructs to the original TAM (An et al., 2021; Alenezi et al., 2011, Mlekus et al. 2020)

Figure 3

Modified Technology Acceptance Model



Note. Arrow directions show direction of relationship between variables.

The determinants of perceived ease of use, perceived usefulness, institutional technical support, functionality, usability, and barriers round out the conceptual framework of this study. This study functions in an atmosphere where perceived ease of use and perceived usefulness are both directly impacted by IT support. Functionality directly effects perceived usefulness and usability directly effects perceived ease of use. Perceived ease of use affects perceived usefulness. However, perceived usefulness does not affect perceived ease of use. Barriers, Perceived usefulness, and perceived ease of use all affect attitudes towards use. Attitudes towards use affects intention to use and intention to use affects actual usage.

Application of the TAM to Understand the Acceptance of LMS

Over the years, the TAM has been applied to many areas within the field of education. Students and teachers from multiple areas of education having been surveyed by using the TAM as a base. For example, Nafsaniath et al. (2015) used the TAM to look at faculty use of LMS in higher education. The study had two primary reasons for study. The study explored the factors that influenced faculty members to use LMS and investigated the underlying relationships between the factors. The study investigated that system quality of LMS had a significant positive effect on the perceived usefulness. The study also hypothesized that system quality has a significant positive effect on faculty members' attitudes toward using LMS. The last hypothesis stated that system quality of LMS had a significant positive effect on faculty members' behavioral intention of using LMS. (Nafsaniath et al., 2015).

A study was conducted through a survey involving two public universities in the United States. The survey was anonymous and completed online. The survey results revealed that system quality, perceived self-efficacy, and facilitating conditions all had significant effects on faculty attitudes of LMS. Furthermore, system quality, perceived self-efficacy, and facilitating conditions were determined to be significant causes of perceived ease of use, perceived usefulness, attitude towards using, behavioral intention to use, and actual use which aligned with the TAM (Nafsaniath et al., 2015).

Another study was conducted in US by Fathema et al. (2015) in which faculty members from two American public universities were surveyed. The quantitative study utilized an adapted version of the original technology acceptance survey. The online survey was completed by 560 American public university faculty members. These surveys were sent in an attempt to help understand if system quality, perceived self-efficacy, and facilitating conditions affected perceived ease of use and perceived usefulness of Canvas LMS. Data from the completed surveys was analyzed using SPSS factor analysis (Fathema et al., 2015).

Results indicated that all three variables, system quality, perceived self-efficacy, and facilitating conditions significantly affected perceived ease of use and perceived usefulness. System quality was found to have the regression coefficients (β= .432, p<.001) for each effect. System quality was found to have a significant effect on both perceived ease of use (β= .184, p<.001) and perceived usefulness (β= .131, p<.001). Perceived self-efficacy was also found to have a significant effect on perceived ease of use (β= .239, p<.001) and perceived usefulness (β= .53, p<.001). The facilitating condition was not found to have significant influence on perceived ease of use (β= .062, p >.05) or perceived usefulness (β= .53, p>.05). The study shows that there are variables that can alter perceived ease of use and perceived usefulness, thereby indicating that the factors making up the TAM may be more complex than initially thought.

A study was conducted in a non-US setting by Husein (2016) to explore the role of attitude in relation to e-learning. The researcher gathered data on user's acceptance to a technology based on the attitude from 151 Malaysian university students in the age range of 20 to 40 years. A 10-minute presentation was provided about the e-learning platform to the participants by the researchers. The presentation was conducted to ensure that the participants understood the e-learning platform and that it represented the technology that was in the survey. Users were then given fifteen minutes to complete the survey (Hussein, 2016).

Results demonstrated that attitude was significantly correlated with the intention to use e-learning ($R2$ = .431, p < .01). Interestingly, the perceived ease of use and perceived usefulness did not correlate significantly with e-learning use. However, the researcher argues that this can be explained because the majority of participants in this study were already well informed about e-learning technology, which decreased the score of perceived usefulness. It can also be noted that perceived ease of use and perceived usefulness can both be applied as part of one's attitude towards a certain technology. Hussein concluded the study by explaining that it is crucial for educators to ensure e-learning will help in improving learning outcomes and contribute to better educational techniques that allow for higher student success (Hussein, 2016).

Joo et al., (2018) studied factors influencing future teachers' intention to use technology. The research took place in South Korea, under conditions of rapid technological development and increased need for technology use in education. The study was conducted using a survey of 300 university students enrolled in teacher preparation courses that were designed to prepare them for future positions and included four hypotheses. The first hypothesis tested the positive impact of teacher's technology-based pedagogy and content knowledge (TPACK) on their self-efficacy. The second hypothesis tested if TPACK positively influenced perceived ease on using technology. The third hypothesis examined the positive influence of teacher's TPACK and perceived ease of use on perceived usefulness of technology. The fourth hypothesis tested teacher's PACK, teacher self-efficacy, perceived ease of use, and perceived usefulness on intention to use technology. Data was collected through a survey which was administered to the students by their professors. (Joo et al., 2018).

The first three hypotheses were not supported by survey results. The study found that TPACK did not significantly affect self-efficacy, TPACK did not significantly influence perceived ease of use, and that TPACK and perceived ease of use did not significantly affect perceived usefulness of technology. The fourth hypothesis was confirmed in that the influence of self-efficacy, perceived ease of use, and perceived usefulness were statistically significant, but the TPACK's effect on intention to use technology was not significant. This study is important to validate the effectiveness of the TAM, because it demonstrates that perceived usefulness and perceived ease of use are still significant and reliable measures of technology acceptance (Joo et al., 2018).

Another study that looks at TPACK in conjunction with the TAM was conducted by Zou et al. (2022) in China. The study focused on how online classes in English as a foreign language were conducted during the COVID-19 and how teachers perceived the effectiveness of online teaching during the pandemic. Researchers used a mixed-methods study design in which a questionnaire and semi-structured interviews were used. The Likert-style questionnaire, incorporating concepts from TPACK, was completed by 132 English teachers from twelve provinces in China (Zou et al., 2022).

The results showed that 30 percent of classes were conducted without synchronous or asynchronous meetings, roughly 44 percent used synchronous classes, just over five percent used asynchronous, and 18 percent conducted synchronous and asynchronous meetings. Therefore, a majority of students experienced synchronous learning. Results on teacher perceived effectiveness of online teaching showed that roughly 34 percent of teachers strongly disagreed on the effectiveness of online teaching. Additionally, 23 percent disagreed on the effectiveness of online teaching. A little over 12 percent agreed that online teaching is effective, around five percent strongly agreed, and 24 percent had a neutral response. These results indicate that, overall, teachers had negative perspectives on the effectiveness of online teaching (Zou et al., 2022).

Results related to TPACK showed that teachers' perceptions of online learning were associated with each of the eight concepts (integration, coordination, evaluation, usage of platform, combination, teaching style, resources, and training methods) of TPACK to a statistically significant degree. This further shows that teachers' self-efficacy had an impact on their engagement and technology acceptance based on their ratings on their own technical, pedagogical, and content knowledge. This aligns with the findings of the original TAM study which showed that teachers who are confident, or feel that using a certain technology is easy, are more likely to have positive attitudes about that technology. Zou's study was a snapshot of teacher perceptions of online learning in the COVID-19 pandemic, in a time full of changes and challenges associated with the move to online learning (Davis, 1989; Zou et al., 2022).

Lobos-Peña et al. (2021) explained that teachers had to quickly adapt their educational practices in order to use alternate technologies to accommodate remote learning During COVID-19. The study postulated four hypotheses. The first hypothesis speculated that teachers with higher levels of technology acceptance would spend more time in Canvas LMS during the pandemic. The second hypothesis stated a positive relationship between teachers' level of technology acceptance and their time spent on the Canvas LMS. The third hypothesis examined the positive relationship between a teachers' level of technology acceptance and the percentage of resources viewed by their students in Canvas LMS. The fourth hypothesis examined the positive relationship between teachers' level of technology acceptance and their student's academic performance. The timeframe for this study was at the end of the emergency remote teaching semester (Lobos-Peña et al., 2021).

The Lobos-Peña study used a Spanish version of the original TAM to survey teachers working in a public university in Chile. A total of 251 teachers responded to the survey. Results showed that teachers with higher levels of technology acceptance did spend more time in Canvas LMS ($F = 3.23$, $p < 0.05$) and higher perceived ease of use resulted in more time spent on the Canvas LMS ($r = 0.30$, $p < 0.001$). Furthermore, a moderate positive correlation was found between perceived ease of use by teachers and materials viewed by students ($r = 0.26$, $p <$

0.001). Perceived usefulness also had a small positive correlation with the academic success of students ($r = 0.18$. $p < 0.01$) (Lobos-Peña et al., 2021).

Furthering the body of research on technology acceptance in education, Dindar et al. (2020) conducted a study comparing technology acceptance of K-12 teachers with and without prior experience of LMS. This study was conducted during the height of the COVID-19 pandemic and involved an online survey that was sent to 192 Finnish K-12 teachers. The survey had questions on behavioral intention, satisfaction, performance expectancy, effort expectancy, self-efficacy, social influence, and facilitating conditions. Technology acceptance was measured through these seven items (Dindar et al., 2020).

The results showed that there was no difference between experienced and inexperienced teachers on effort expectancy, performance expectancy, self-efficacy, or satisfaction. Conversely, experienced teachers were found to have higher perceived support ($M = 4.16$) than inexperienced teachers ($M = 3.91$). Experienced teachers also had higher behavioral intention to use LMS ($M = 4.70$) than inexperienced teachers ($M = 4.37$). Finally, experienced teachers reported higher levels of self-efficacy ($M = 3.42$) than inexperienced teachers ($M = 3.20$) (Dindar et al., 2020).

Dincher and Wagner (2021) further studied technology acceptance and technology use on a broader scale, after receiving permission to survey each public school in 12 out of 16 federal states in Germany. Consequently, about 76 percent of public-school teachers were surveyed online. The survey results were used to discover the variables that determined teachers' adaptation to increased use of technology, including LMS, during COVID-19 lockdowns. There were no hypotheses, as this was an exploratory study (Dincher & Wagner, 2021).

Overall, 3,673 teachers responded to the Dincher and Wagner survey, and data from 2,610 teachers were used for analysis. The researchers found that higher levels of technical affinity, perceived learning effectiveness of digital technologies, and extraversion significantly increased the chances that teachers would use web-based technology in their instruction. Technical affinity (*SD*= .053, p = <.01) had the strongest correlation towards usage of web-based technology for instruction, with perceived learning effectiveness having the second strongest correlation (*SD*= .032, p = <.01). Furthermore, almost 68 percent of teachers reported using more than one web-based technology platform during the COVID-19 lockdowns. This study further indicates that the TAM provides the foundation for the majority of contemporary research conducted on perceived ease of use and perceived usefulness, which are the determinants of technology acceptance and LMS usage (Dincher & Wagner, 2021).

Another non-US based study that applied the TAM towards LMS usage was conducted by Alharbi and Drew (2014). This quantitative study examined university faculty's intention to use LMS in their teaching, by using an adapted version of the original TAM survey to collect data from participants in a university located in Saudi Arabia. Participants were 59 university faculty members who volunteered to take the survey. These faculty members were from multiple colleges within Shaqri University. The survey questions focused on the perceived ease of use of LMS, perceived usefulness of LMS, and their effects on attitude towards use of LMS (Alhari & Drew, 2014).

Results found that 49 percent of respondents had never used an LMS before. Furthermore, 16.9 percent of respondents had been using an LMS for less than one year. Results showed a statistically significant correlation between perceived ease of use and perceived usefulness (r = .576, p =.000). Additionally, results showed that there was a statistically significant relationship between perceived usefulness and intent to use an LMS (r = .691, p = .000). Also, there was a statistically significant correlation between perceived ease of use and intent to use an LMS (r =.376, p = .000). This study, like others, demonstrates the role of perceived ease of use and perceived usefulness that can help illuminate the technology acceptance of LMS in education (Alhari & Drew, 2014).

Barriers to Online Teaching in K-12 Schools During COVID-19 Pandemic

Seabra et al. (2021) conducted research in Portugal during the pandemic to further understand the difficulties teachers experienced during the sudden transition to online learning. A mixed-methods study design was used that included a combination of open and closed ended questions. The researchers' questionnaire was validated in a previous study and was adapted for the needs of their research. The researchers made sure to note that this study was more heavily tilted towards a qualitative study even though the results of the study were quantified (Seabra et al., 2021).

The authors used MaxQda coding software to collect the data and identify themes in the open-ended results. The teachers who responded to the survey reported that their main difficulties in transitioning to online learning were work, conditions, and time management. There were 118, 133, and 110 teachers respectively who noted difficulties with work, conditions, and time management respectively with time management. The work category consisted of difficulties with overload, or too much work, (n = 37), changing expectations (n = 35), lack of coordination (n = 30), evaluation and feedback (n = 29), adaptation (n = 10), support from colleagues (n = 9), being rushed (n = 8), little learning opportunity (n = 4), and laboratory practices (n = 1). The conditions category consisted of difficulties related to tools and platform (n = 64), equipment (n = 31), internet (n = 25), digital self-efficacy (n = 23), training opportunities (n = 23), lack of knowledge about distance learning (n = 6), data protection (n = 3), and total amount of students in class (n = 2). The time management category consisted of difficulties with the time available (n = 93), home life balance (n = 33), and amount of time available to students (n = 8). Overall, a majority of the problems detailed in this study were related to the novelty of online teaching and its associated technologies (Seabra et al., 2021).

An et al. (2021) conducted a study of K-12 teachers' experiences, feelings, and perspectives about online teaching during the COVID-19 lockdowns. Researchers used a mixed-methods design in which participants were selected and asked to complete a Likert survey scale. The researchers conducted follow-up interviews with a sub-set of teacher participants. Overall, 107 teachers in 25 American states completed the survey. Additionally, 13 teachers representing 10 states were chosen for post-survey interviews. The emphasis of the survey and follow-up interviews was primarily on online teaching experiences, challenges, issues, and required support. The initial survey data was collected through Google forms, in order to discover how online teaching during the pandemic worked out and what could be done to enhance online teaching in the future. Follow-up interviews were recorded by using video conferencing software. The interviews were then transcribed and coded into themes (An et al., 2021).

The survey results showed that approximately 80 percent of respondents felt they had the necessary skills and knowledge to be successful at online teaching with a mean of 4.07. Approximately 66 percent reported that they wished to have more opportunity to learn about online teaching, with a mean of 3.66. Conversely, 22 percent of respondents said that they struggled throughout online teaching, with a mean of 2.46, and nearly 60 percent stated that online teaching caused stress to them. Follow-up interviews discovered that the main issues with online teaching were related to struggles with student participation, lack of student technology, student well-being, lack of in-person communication with students, work-life imbalance, and struggles of working with new technology. These problems with online learning are among the most common that teachers experienced in online teaching during the pandemic (An et al., 2021).

Furthering the documentation of the issues with online learning experienced by teachers during the pandemic, Ragpala (2022) conducted a qualitative study in which teachers were asked to share their experiences using emergency online learning during the COVID-19 pandemic. A total of 17 K-12 private school teachers in the Philippines were interviewed in an online semi-structured format. The semi-structured nature of the study allowed the participants more freedom of expression and also made it easier for the researcher to ask follow-up questions. The qualitative data was analyzed using thematic analysis which included transcribing, reading with familiarization, coding, seeking, reviewing themes, defining themes, and ending analysis. One of the major themes that was identified was challenges in online teaching (Ragpala, 2022).

Participants stated that some of the challenges they experienced were internet connectivity issues, unresponsive students, late submissions, checking outputs online, and online teaching in the K-12 setting. Participants noted that internet connection problems, including unstable connections, caused students to miss important information and sometimes led to teachers' inability to appropriately teach their lessons. Participants also explained that unresponsive students negatively affected their ability to communicate with other students. There were long wait times for responses from students. This gap in communication caused teachers to struggle in the online learning environment. Late submissions were also mentioned as a problem because teachers struggled with holding students accountable, while also maintaining fairness towards them. Checking outputs online, such as assignment submissions, was also problematic for the teachers. Teachers stated that they spent an inordinate amount of time checking online for completion of assignments. Finally, participants explained that they felt students missed out on valuable learning experiences due to the online learning format. More specifically, hands-on activities such as labs were shut down and teachers felt this caused learning deficits. This study is important because it illuminates many of the problems encountered by teachers during the COVID-19 pandemic (Ragpala, 2022).

The study conducted by Sari (2022) had themes similar to Ragpala's (2022) study. A qualitative case study design was used to explore primary school teacher perceptions of online learning during the COVID-19 pandemic. Participants consisted of 12 primary school teachers from different villages and districts in Turkey. All participants taught a mixture of mathematics, science, and social studies online during the COVID-19 pandemic. Data were collected by using semi-structured online interviews. The qualitative data collected were analyzed using content analysis where the audio was transcribed, coded, grouped into themes, and finally interpreted using quotes to bolster findings (Sari, 2022).

Findings were grouped into the four main categories of guidance and support, planning and teaching, technical issues, and the use of technological tools. Teacher participants stated that they perceived a lack of guidance and also a lack of parental support for online teaching. They explained that professional learning sessions were offered by schools and that these sessions were helpful. Respondents explained that they learned the majority of information about online teaching through lesson planning. However, they stated that they had trouble teaching the online lessons because parents would often undermine them in the process. An example that was used was parents giving answers for their students. Technical issues ranged from microphone problems, phone problems, user ineptitude, screen size, and also software errors. Finally, the use of technological tools was only a problem at the onset. Teacher respondents stated that there were no further problems using necessary technological tools in online learning after working through initial problems (Sari, 2022).

Francom et al. (2021) conducted a mixed-methods study which had results similar to the Sari (2022) study. A survey was emailed to 15,341 teachers in Mississippi and South Dakota. Overall, 388 responses with all thirteen questions about distance learning experiences, strategies used during distance learning, and problems encountered during online learning were received. Quantitative elements of the study asked respondents about the types of LMS that were used and qualitative elements questioned respondents about the experiences and difficulties they encountered (Francom et al., 2021).

The quantitative results showed that Google Classroom was by far the most utilized LMS with 171 respondents stating that they used this LMS. Canvas and Schoology were the next most popular LMS, with Canvas being used by 40 respondents and Schoology being used by 22 participants. The remaining respondents were split between numerous other LMS. The qualitative results found the following five major areas of difficulty: students, remote teaching, technology, parental and home environments, and school administration. The student issues that were discovered included contact and communication difficulties, participation and engagement deficits, and accountability. Teachers found interactions with students to be more difficult using online learning. Remote teaching problems included trouble finding and creating online resources and providing instructional support (Francom et al., 2021).

The third problematic area was internet and computer access. Participants found that computer access, and the resulting technology disparity, to be a great challenge. One respondent explained that some students had to drive to alternate locations for class because their connections did not work at home. Another teacher was forced to create online and paper packets due to these issues. Parent lack of support and involvement was the fourth problem area noted by teachers. Teachers found that parents were inadequately prepared to support their children in online learning and unhelpful when they were asked to assist the teachers. One teacher mentioned a parent stating that she could not make the student do the work because it did not count anyway. The final problem was centered on school administration. The teachers felt that they were not given sufficient instructions, guidance, or support during remote learning. One teacher specifically mentioned that there was a lack of guidance by administration and the school staff did not even meet before their school closed. These studies highlight the need to examine the role of IT support to alleviate the internet and computer-based issues that were encountered by PK-12 teachers during the pandemic (Francom, et al., 2021).

Assessment Issues with Online Learning

Among the many issues about online learning that have been detailed herein, notably, assessment struggles are some that have not been widely reported. Previous studies detailed in this literature review report teachers feeling unprepared to teach online courses. Part of the preparedness gap naturally includes issues with assessment. Garcia-Morales et al. (2021) compiled several data sets from qualitative studies to investigate the challenges in an online learning environment. One of the foremost topics brought up in this study was assessment challenges (Garcia-Morales et al., 2021).

The study explains the challenges that teachers faced with student assessments when using new technologies after being forced into online classrooms during the lockdown. Some of these assessment types were diagnostic evaluations, evaluations with video tags, peer evaluations, and final evaluations. Along with evaluation issues, results of the study revealed that

IT issues made it nearly impossible for teachers to fully embrace and complete online learning (Garcia-Morales et al., 2021).

Along with problems about specific assessment types, research has revealed that teachers also experienced procedural issues related to assessing students in an online environment. Davidson-Shivers and Reese (2014) listed challenges with assessment security, student cheating, accommodating students with special needs, and other factors like technology disparities between students. This study also acknowledged that assessment security is something that is not entirely novel to online learning. For example, teachers in traditional classrooms must be vigilant about test security and worry about students taking or copying test materials from other students. However, they also noted that online assessment comes with its own challenges that are rather new. Student privacy laws are guarded primarily by the Family Educational Rights and Privacy Act (FERPA). This law requires that all student records need to be maintained in a safe environment that does not allow unauthorized access to outside entities. Online learning information, and the assessment data, may be at risk even when using an LMS. Student information can be illegally accessed or stolen by hacking techniques such as spyware, a malicious code that is used to gather information on users, and phishing, a technique in which an individual or website attempts to gain user information such as passcodes through deceit (Davidson-Shivers & Reese, 2014).

Additionally, teachers in the online environment also need to be cognizant of the risk that student cheating creates. K-12 teachers have reported that incidents of plagiarism and unauthorized internet searching are two of the most common forms of cheating that they encounter. Organizations have begun to require online proctoring tools for assessments to combat these types of cheating. Teachers also must respect student accommodations and special needs while assessing their students, when navigating student privacy, and with academic honesty in the online setting. K-12 teachers must often call upon particular colleagues for guidance in this area, because accommodations vary from student to student (Davidson-Shivers & Reese, 2014).

Just as special accommodations vary by student, so does access to and quality of the technological devices needed to participate in online learning and assessment. For example, some students may only have access to a cell phone or a shared computer. These students can be at a disadvantage compared to their peers who have a higher level of access to technology and its advantages. Fortunately, the majority of the typical accommodations for students with special needs, such as extended time or no time limit, can help offset technological disparities and allow for a more equitable online assessment environment for all students (Davidson-Shivers & Reese, 2014).

Another significant issue with online learning is students becoming isolated and developing feelings of despair. Morrison and Jacobsen (2023) explain that this is due to limited interaction and ineffective feedback. Feedback needs to be timely and personalized to be effective. Their study details that timely and personalized feedback can lead to positive rapport between instructors and students, which is necessary to create a learning and assessment environment in which students feel engaged and supported (Morrison & Jacobsen, 2023).

Online learning assessments are still a work in progress. Much like how students can become isolated, disconnected, and begin to despair, students in online courses have been shown to perform more poorly on assessments than students who are in traditional classes. Ni (2013) completed a quantitative study that compared student assessment results in six research methods classes taught at California State University. Three of the six classes were online courses and the other three were traditional courses. The assessment scores were analyzed in two classrooms, online and traditional, after which qualitative data was also collected (Ni, 2013).

The quantitative results found that students taking the online research methods course performed more poorly than the students who took the same course face to face. Overall, students taking the online course failed eight percent of the time, while students in the traditional course failed three percent of the time. These results indicate that students were less successful in taking online assessments than they were when taking face to face assessments. These results are likely due to a mixture of assessment suitability and knowledge transfer. Assessments and teaching methods may need to be differentiated based on online or traditional courses. Online assessment continues to be an area that is changing and improving (Ni, 2013).

Information Technology Support

IT support, or lack thereof, can affect technology use by educators. Ruggiero and Mong (2015) detailed that external barriers, such as professional IT support and access to materials, have been found to decrease technology integration and usage. The study defines professional IT support as teacher training on new technology, school administrative support, and technological support provided by trained IT professionals. Access to materials is defined as hardware and software such as technology devices including computers, tablets, and other devices along with programs that are used, such as LMS and assessment software (Ruggiero & Mong, 2015).

Exploring different types of technology integration in the classroom, this study was conducted in a school district located in mid-west US and surveyed 1,048 teachers working in public K-12 schools. The research question for the study was, “What technology do teachers use and how do they use that technology to support student learning?” To answer this question, the researchers utilized a survey with follow up interviews. Approximately 10 percent of teachers were selected for a follow-up interview after the initial survey. Overall, 111 teachers participated in the post-survey interviews (Ruggiero & Mong, 2015).

The quantitative results of the study revealed that more than 90 percent of middle and high school teachers used video as a primary means of technology integration in their classrooms. In elementary schools, 48 percent of teachers reported that the majority of technology usage occurred through games played with their students. The follow-up interview data were audio-taped and revealed that 45 percent of teachers referred to in-house and virtual supports in the form of trained professional and administrator assistance in IT as extremely important to their success in integrating technology in their classrooms. Furthermore, they claimed that IT support in the form of a knowledgeable team of fellow teachers was integral to their successful technology integration and use (Ruggiero & Mong, 2015).

Building from previous study, Francom (2016) identified two types of barriers to technology use. The researcher described first order barriers, such as access, resources, and support, and second order barriers that were more personal, such as confidence and beliefs about the type of technology they thought to use. A mixed methods descriptive research was conducted to determine the barriers that obstructed learning in K-12 public education classrooms, differences in barriers to technology due to size, and other factors that inhibit technology integration. The study was initiated by administering an online survey to 1,185 K-12 public school teachers in a setting described by the researcher as a rural, north midwestern state. A total of 1,079 teachers' responses were considered to be valid. Follow-up interviews were conducted by selecting 11 respondents from these 1,079 teachers (Francom, 2016).

Cronbach's alpha of the survey was 0.792. The quantitative results indicated that the main barriers to technology integration were administrative support (67.38%), technology training and support (65.10%), lack of access (63.05%), and time to prepare (40.48%). Other factors that influenced barriers to technology integration were derived from the qualitative interviews. These factors were class size, grade level, age, and years of experience (Francom, 2016).

Furthering the study of IT support and technology integration or acceptance, Zheng et al. (2018) examined the impact of organizational support, technical support, and self-efficacy on faculty perceived benefits of using an LMS. Zheng et al. explains that technical support can enhance an employee's use of technology. A Likert style survey with a five-point scale was utilized to survey faculty members in four medium-sized universities located in the mid-west. In total, 379 faculty members were surveyed on topics related to organizational support, technical support, self-efficacy for LMS usage, and faculty perceived benefits (Zheng et al., 2018).

The quantitative results showed that LMS self-efficacy had a mean of 3.98 out of 5.0. Organizational support and technical support had a mean of 3.83 out of 5.0. Faculty perceived benefits had a mean of 3.78 out of 5.0. These results indicate that LMS support and technical support can influence the perceived benefits of faculty members and extensive support in LMS and information technology seem to have a positive effect on faculty acceptance and use of LMS (Zheng et al., 2018).

Adequate IT support can also help facilitate student acquisition of knowledge. The study explained that IT support consists of information and technological components that are connected both functionally and structurally, and it is directed to fulfill the purpose of educational process. The study further divided information technology support into these four components: methodology, forms of educational process, technology, and tutorials (Veronika, 2023).

The Veronika study describes methodology as the base that all training processes are built on. The study states that methodology is created by teachers as they learn different ways to support their students and the role of IT support. Along with methodology and forms of educational processes, there are different types of pedagogical communication between teachers and students. In other words, forms of educational processes are the different types of instructional strategies and other ways that teachers provide IT support. Technology and tutorials are the two most self-explanatory parts of IT support described in the study. Technology is described as the actual technology, such as LMS in which the training is completed. Tutorials are an important methodological tool in which teachers get trained in information technology (Veronika, 2023).

Functionality and Usability

Along with perceived ease of use, perceived usefulness, behavioral intention to use, and IT support, functionality and usability are both able to influence the usage of LMS and the different technologies embedded within it. Godwin (1987) defined usability as a construct that is affected by the task which needs to be completed and the user's competence. In order to be usable, a system must be compatible with user perception, action, and cognitive skills. Functionality was defined by Godwin as something that changes depending on the functions available and the tasks that need to be completed. These two constructs are often used together in order to evaluate a specific item or piece of technology (Godwin, 1987).

Although LMS are relatively new in the grand scheme of educational research, there is a body of literature on functionality and usability of LMS. Chen et al. (2023) wrote a research paper on the usability of LMS from the instructor's viewpoint. The study was conducted on Canvas LMS. The researcher prefaced the study by stating that LMS are becoming complex in terms of functionality, including interactions between instructors and students. This increasing complexity of LMS and their functions brings to question the usability of the Canvas LMS (Chen et al., 2023).

The Chen study used pre- and post-test interviews to understand problems associated with online learning, before and after IT support in the form of system training. Participants for this study included 17 instructors from Poland and 18 instructors from Norway. Overall, 31 participants had prior experience using the Canvas LMS, while only four did not. Overall, the study identified 10 problems associated with the usability of Canvas LMS. These problems were visibility of system status, the match between the system and the real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency use, aesthetic and minimalist design, help recognizing, diagnosing, and recovering from errors, and help with documentation. The final discussion point was that usability issues are some of the greatest factors that lowered the adoption and use of the Canvas LMS (Chen et al., 2023).

A mixed-methods study focusing on functionality and usability of an LMS was conducted by Thuseethan et al. (2014). The study defined usability as a construct that is based on four major aspects. These aspects are effectiveness, learning ability, flexibility, and attitude. Effectiveness is defined as the level of performance in completing tasks by users within the LMS. Learning ability is explained as the amount of learning that it takes for a user to complete these tasks. The study also notes that learning encompasses the amount of time that it takes users to learn, and re-learn, the LMS. Flexibility is defined as the ability to adapt to changes in tasks and the different types of environments that are available in the LMS. Attitude is described as user satisfaction with the LMS and if the user plans to continue to use the LMS (Thuseethan et al., 2014).

The Thuseethan study used two types of methodologies to test the usability of the Moodle LMS. In the first approach, over two hundred students in seven Sri Lankan universities were surveyed using a five-point Likert type scale. Survey question topics included LMS design, LMS functionality, ease of use, learnability, satisfaction, intention to re-use, and LMS usefulness. The second approach created a set of tasks for participants to complete in order to test the usability of the Moodle LMS. These tasks were based on the four aspects of usability detailed previously. Users would then complete a different survey than the first group, after completing the tasks. (Thuseethan et al., 2014).

Survey results indicated that students found the Moodle LMS easy to use and that its functionality was well suited for their needs. It was noted, however, that there were still some inconsistencies and problems when using the Moodle LMS. This was expected, because LMS are always evolving to better suit the needs of educators and students. Results of the task and survey approach were much like that of the first approach. Users found the Moodle LMS relatively easy to use and its functionality appeared to support their usage patterns in Moodle. However, users in the second survey approach indicated that there were several large problems that inhibited their successful use of Moodle. These problems were malfunctions in the search feature, the organization of discussion posts and forums, and inconsistencies downloading course materials. Final analysis of the study showed that Moodle LMS was rated relatively high for functionality and usability, even though users still believed that there were issues with the LMS (Thuseethan et al., 2014).

An experimental study that was focused on functionality and usability analyzed a destination recommendation system named DieToRecs, a prototype system that recommends destinations for potential travelers and contains some of the same aspects as an LMS. For example, DieToRecs is interactive, it allows for navigation within the platform, and it updates according to user feedback. Usability was defined as the extent to which a product can be used by specific users to achieve desired goals with effectiveness and satisfaction. Usability was further explained as being made up of objective and subjective aspects. The objective aspects were described as task completion time, number of questions, and error rate. Subjective usability was taken exclusively from user responses (Zins et al., 2011).

The Zins study used experimental design where three different versions of the application were created. The study had 47 participants who completed tasks in the application. After completing the tasks, the users were given a survey that included design, functionality, ease of use, learnability, satisfaction, future use, and system reliability. Results showed that the more intelligent, or refined, system recommendations were, the more they were accepted by the users. Final analysis of the study indicated that user acceptance of this system was based on these three main aspects: ease of use, effectiveness, and reliability. It can be argued that many aspects of functionality and usability can also affect technology acceptance (Zins et al., 2011).

Along the lines of the Zins et al., 2011 study, Holden and Rada (2011) conducted a study about perceived usability and technology self-efficacy with regards to their effect on technology acceptance. The hypotheses in this study were two-fold. The first hypothesis stated that the addition of perceived usability to the TAM would explain more variance in perceived usefulness and behavioral intention to use. The second hypothesis stated that teachers' technological self-efficacy would be more influential to technology acceptance than computer self-efficacy. This quantitative study was conducted by administering a Likert-style survey to 378 teachers working in a rural school district in Virginia who had varying experience levels using technology in the classroom, teaching styles, grade levels, and subjects (Holden & Rada, 2011).

For the first hypothesis, the adjusted R-squared results showed that perceived ease of use with the addition of usability accounted for 53 percent of the differences in teachers' attitude toward technology and 35 percent of the differences in perceived usefulness of a technology. In fact, perceived ease of use combined with perceived usability accounted for 77 percent of differences in behavioral intention to use, while perceived usefulness and perceived ease of use combined for only 63 percent. For second hypothesis, neither computer self-efficacy nor technology self-efficacy had a significant effect on perceived ease of use and perceived usability. These results show that the addition of functionality and usability have a large impact on technology acceptance that could potentially be more significant than the original TAM constructs of perceived ease of use and perceived usefulness (Holden & Rada, 2011).

Furthering the line of research showing the importance of usability in technology acceptance, Dimitrijevic and Devedzic (2020) created a literature review on evaluating usability in selecting educational technology. The aim of their literature review was to analyze usability methods and attributes in relation to selection of educational technology in higher education. The study analyzed pedagogical criteria, considered learner and educator approaches, and identified future areas of research. The compiled studies were composed of roughly 35 percent comparative studies, 33 percent methodology proposals, 15 percent technology selection, nine percent model proposals, and seven percent criterion investigations (Dimitrijevic & Devedzic, 2020).

In the area of usability methods, the researchers found that expert assessments are most common, followed by mixed approach, user testing, questionnaires, heuristic evaluation, checklist evaluation, and surveys. In regards to pedagogical criteria, only two studies were found to have fully incorporated usability. However, over half of the studies on selection of educational technology partially incorporated usability. It was noted that end-user perspective, or that of the learner, is important to consider along with teacher perspective, when considering educator and learner approaches. Future areas of research included the need for a simple and effective tool to help with the process of selecting educational technology. The researchers also noted that additional research on usability should take place (Dimitrijevic and Devedzic, 2020).

A study by Mayes and Fowler (1999) that investigated usability debated that learning outcomes should be included. Furthermore, the authors state that usability and effectiveness of learning technology should include prior learning. The assessment of usability related to educational software requires awareness of user's prior knowledge and the learning environment. Addressing specifically the usability of educational technology, the authors posit that there are three types of courseware that have varied definitions of usability: primary courseware, secondary courseware, and tertiary courseware (Mayes & Fowler, 1999).

Primary software is defined as the conceptualization stage and is the balance between pre-existing knowledge and available learning materials. It is most important in regards to usability. This addition of pre-existing knowledge to usability is interesting and also innovative in the context of primary software. Secondary software is defined as the construction stage and is the area where most of the orthodox components of usability are relevant. Consistency, memorability, learnability, and satisfaction are specifically stated. Tertiary software is defined as technology aimed at communication and is unique. The authors state that we do not currently know enough about tertiary software to determine what makes it usable (Mayes & Fowler, 1999).

Along with choosing educational technology, the usability of a piece of technology can be critical to teaching and learning. For example, Jamir Williams (2023) states that usability can be defined as ease of use and quality of user experience with a tool. The study further explains that usability is made up of learnability, efficiency, memorability, reducing errors, and user satisfaction. Williams specifically equates this to LMS usability. Williams explains that usability can affect the LMS learning experience by managing time, focusing on instruction, supporting accessibility and digital equity, and creates channels of communication and collaboration. Several concepts are explained in the study which are reminiscent of the TAM and its offshoots (Williams, 2023).

Gaps in Literature

This study is intended to fill gaps in the body of literature on the topic of technology acceptance. This author notes relative gaps in literature on K-12 technology acceptance of an LMS. This study has detailed many studies relating to technology acceptance of an LMS, such as Nafsaniath et al., 2015, Hussein, 2016, Joo et al., 2018, Zou et al., 2022, Lobos-Peña et al., 2021, Dindar et al., 2020, among others. These studies take place in either one grade level, such as elementary school, or are centered in higher learning environments. This author has found no single study that researches technology acceptance of an LMS across the entire K-12 spectrum (Dindar et al., 2020; Hussein, 2016; Joo et al., 2018; Lobos-Peña et al., 2021; Nafsaniath et al., 2015; Zou et al., 2022).

Along with the scope that encompasses K-12 educators, this study also incorporates several constructs that together form a gap in literature. To this author's knowledge, no single study has combined barriers to implementation of an LMS, assessment issues in online learning, IT support, perceived ease of use, perceived usefulness, along with functionality and usability.

The need for this researcher's study is not only supported by these gaps in literature, but also it is amplified by the negative impacts of such an absence of study and resulting information.

Furthermore, the holistic nature of this study is not common in the current body of literature. In the case of another pandemic, school leaders would be forced to identify independent studies that cover each of the major aspects contained in this study. Such searches would take extra time away from planning for student success. This study aims to fill multiple gaps in the literature by researching the important areas of barriers to implementation, assessment problems, perceived ease of use, perceived usefulness, along with functionality and usability. These areas will make this study more impactful in the case of future emergency school closures.

Summary

The use of technology has impacted teachers in their effort to help students learn to their potential, particularly during the COVID-19 pandemic. Teacher technology acceptance, often in the form of perceived ease of use and perceived usefulness, is an important indicator that can help predict if a teacher is going to use a certain LMS with success. Even with practice, there are problems that can occur with online teaching, such as technology disparities, student and parent apathy, assessment issues, and multiple barriers to LMS usage. Additionally, IT support can have a material effect on technology acceptance which has the possibility to lead to increased usage and comfort in the usage of LMS such as Google Classroom, used heavily by teachers participating in the present study. Finally, functionality and usability contribute to the perceptions of technology and behavioral intention to use in TAM constructs. (Davidson-Shivers & Reese, 2014; Fathima et al., 2015; Francom et al., 2021; Ruggiero & Mong, 2015; Holden & Roya, 2011).

Chapter III: Methodology

Schools were forced into online learning when the COVID-19 pandemic hit the United States. Beginning in March 2020, all United States public school systems were forced to transition to emergency online learning for various lengths of time (CDC.gov, 2022). A majority of teachers did not feel prepared to teach their students in the online format due to the nature of the emergency transition to online learning. According to Eadens et al. (2022), less than 50 percent (2.23 out of 5) of teachers felt prepared to teach their classes online. It was necessary for teachers to adapt their teaching practices into an entirely online style and attempt to teach students as best they could. Teachers worked to become pedagogically stronger in the online setting throughout the emergency online learning period. The Centers for Disease Control and Prevention (CDC) reports that more than 80 percent (4.09 out of 5) of teachers would return to the traditional classroom setting with stronger instructional skills and higher knowledge (CDC.gov, 2022; Eadens et al., 2022).

One of the more common avenues that teachers took to conduct online learning during the COVID-19 pandemic was through the use of LMS. According to Dolenc et al. (2022), the details and intricacies of online learning platforms caused challenges with navigating through these systems. The most common challenges faced by teachers were communication with students, implementation of classroom activities in a virtual setting, setting (e.g., assignments and quizzes), and tracking student's conduct (e.g., cheating) during testing sessions. This sudden shift to online learning negatively impacted teachers' perceptions of online learning and associated LMS with regards to perceived ease of use and perceived usefulness which, in turn, significantly influenced the acceptance and usage of technology in teaching. However, IT support can have a positive influence on technology acceptance and result in higher engagement with technology. An increase in highly engaged teachers can help create better online learning opportunities for their students (Dolenc et al., 2022; Kelly, 2014).

This study seeks to determine the technology acceptance of teachers in the post COVID-19 era. From the lens of the TAM, this study will look at perceived ease of use, perceived usefulness, behavioral intention to use, IT support experiences, along with functionality and usability beliefs associated with the Google Classroom LMS. Data will be collected on problems teachers faced with using an LMS for online teaching. This study seeks to determine important perceptions of teachers now that the dust has settled from the emergency online learning associated with COVID-19 and schools have returned to more traditional settings. The procedures for data collection will include research questions, research design, population sampling, sampling plan, instrumentation, procedures, methods of data analysis, evaluation of research method, organization of reporting and results, and chapter summary.

This study consists of seven quantitative research questions and two qualitative research questions. The justification and application of the correlational research design and its application in the current study is explained. A visual of the research design and a description of the constructs being studied are also discussed. The population and sampling section describes the characteristics of elementary, middle, and high school teachers who will be the study participants. This section also provides information on the minimum number of participants needed to conduct inferential analysis. The instrumentation section discusses the content of Likert-based survey items which measure the attributes of TAM constructs, IT support experiences, along with functionality and usability beliefs associated with the Google Classroom LMS. The survey will be the primary data collection instrument in the study. A discussion on validity and reliability of survey items that measure the constructs of interest is also provided.

The steps implemented for survey data collection from K-12 teachers and IRB approval from the school district and Columbus State University is described. The data analysis section explains the process of examining and interpreting the survey data and also describes the layout of results in Chapter IV. Finally, the methodology section will conclude with a summary of this entire chapter.

Research Questions

The overarching research question: What are the perceptions of teachers when using the Google classroom LMS during the post COVID-1 9 era?

Additionally, the researcher will answer the following questions:

1. How does perceived ease of use of the Google Classroom LMS in K-12 teachers influence their behavioral intention to use the Google Classroom system?

   H_0: Perceived ease of use of the Google Classroom LMS does not influence K-12 teachers' behavioral intention to use it to a statistically significant degree.

   H_a: Perceived ease of use of the Google Classroom LMS positively influences K-12 teachers' behavioral intention to use it to a statistically significant degree.

2. How does perceived usefulness of the Google Classroom LMS in K-12 teachers influence their behavioral intention to use the Google Classroom system?

   H_0: Perceived usefulness of the Google Classroom LMS does not influence K-12 teachers' behavioral intention to use it to a statistically significant degree.

   H_a: Perceived usefulness of the Google Classroom LMS influences K-12 teachers' behavioral intention to use it to a statistically significant degree.

3. How do the IT experiences of K-12 teachers influence their behavioral intention to use the Google Classroom system?

H_0: IT support experiences do not influence K-12 teachers' behavioral intention to use Google Classroom to a statistically significant degree.

H_a: IT support experiences positively influence K-12 teachers' behavioral intention to use Google Classroom to a statistically significant degree.

4. How does the functionality and usability of the Google Classroom LMS influence K-12 teachers' behavioral intention to use it?

   H_0: Functionality and usability perceptions do not influence K-12 teachers' intention to use it to a statistically significant degree.

   H_a: Functionality and usability perceptions positively influence K-12 teachers' intention to use it to a statistically significant degree.

5. How does the perceived ease of use and perceived usefulness of the Google Classroom LMS in K-12 teachers influence their attitudes toward use?

   $H_{0:}$ Perceived ease of use and perceived usefulness do not influence K-12 teachers' attitudes towards use of the Google classroom LMS to a statistically significant degree.

   $H_{a:}$ Perceived ease of use and perceived usefulness influence K-12 teachers' attitudes towards use of the Google Classroom LMS.

6. How do K-12 teachers' attitudes toward use of the Google Classroom LMS influence their behavioral intention to use it?

   $H_{0:}$ Attitudes toward use of the Google Classroom LMS do not affect K-12 teachers' behavioral intention to use it.

   $H_{a:}$ Attitudes toward use of the Google Classroom LMS have a positive effect on K-12 teachers' behavioral intention to use it.

7. How does K-12 teachers' behavioral intention to use the Google Classroom LMS influence actual system usage of it?

   $H_{0:}$ K-12 teachers' behavioral intention to use the Google Classroom LMS does not influence actual system usage to a statistically significant degree.

   $H_{a:}$ K-12 teachers' behavioral intention to use the Google Classroom LMS influence actual system usage to a statistically significant degree.

8. What types of assessment problems did teachers face with online learning during the COVID-19 pandemic?
9. What are the different types of barriers (technology, process, administration, faculty, lack of training, and environment) teachers faced while using Google Classroom LMS during the pandemic?

The two qualitative questions seek to gather first-hand information from educators about their experiences with online learning and the Google Classroom LMS. The qualitative question on assessment issues during the pandemic seeks to further illuminate the problems in implementing assignments and quizzes, as well as in monitoring student conduct in a virtual testing environment. The qualitative question on barriers teachers faced in using the Google Classroom LMS seeks to gather valuable information about teacher experiences in navigating and working with Google Classroom LMS. These qualitative research questions, combined with the seven quantitative questions, should provide a detailed picture of K-12 teacher technology acceptance along with valuable information about the issues faced during the pandemic. This information will allow school leaders to determine teacher perceptions and also provide valuable insight in case of another event resulting in emergency online learning.

Research Design

This study will use a correlational research design in which the researcher attempts to determine the relationship patterns between two or more variables. Typically, correlational research involves independent and dependent variables. The researcher seeks to determine the relationships between observed variables that measure the traits of the TAM, IT support, functionality, and usability constructs. In correlational research design, quantitative data is analyzed to explain the phenomena of K-12 teachers' acceptance and usage of classroom LMS (Asamoah, 2014).

Furthering Asamoah's point, Brink and Wood (1994) detail that correlational research designs are most often used when a researcher suspects that relationships exist between certain variables. Brink and Wood also explain that the conceptual framework can be created in an attempt to explain the hypothesized relationships and provide justification for the study. These researchers are careful to add that correlational studies are used to describe the relationship between variables, yet can be used to support a theory or perspective. The theories and frameworks created have huge disparities between their strengths (Brink & Wood, 1994). The theoretical framework for this study is partially established due to the TAM already being an established model. This correlational research study will seek to determine the relationships between the new variables of IT support, functionality, and usability.

According to Longe (2023), surveys are the most common type of data collection tool for correlational research designs. Surveys are self-reported measures in which study participants provide responses to Likert-based survey items that are direct measures of the constructs under investigation. The survey method is described as extremely flexible and desirable because the researcher is able to reach out to a large number of teachers in the district (Longe, 2023).

Research Design Rationale

Several studies on the TAM in the past have utilized correlational research design. Holden and Rada (2011) conducted a correlational study about perceived usability and technology self-efficacy with regards to their effect on technology acceptance. Another correlational study was conducted in the US by Fathema et al. (2015) in which faculty members from two American public universities were surveyed. These surveys were created to help discover if system quality, perceived self-efficacy, and facilitating conditions affected perceived ease of use and perceived usefulness of Canvas LMS. In a third correlational study, Zheng et al. (2018) examined the relationship of organizational support, technical support, and self-efficacy on faculty perceived benefits of using an LMS. All three of these studies utilized the correlational research design and are quite similar to this author's study (Holden & Ra, 2011; Fathema et al., 2015; Zheng et al., 2018).

Experimental and quasi-experimental designs would be inappropriate for this study. An experimental research design is used to test for causal differences between groups where random assignment is used to form the groups. This study is simply seeking to determine the relationship between the TAM, IT support, functionality, and usability constructs. A descriptive research design is not appropriate for this study because the researcher does not seek to gather data in order to explore the underlying participant characteristics. Due to these reasons, a correlational research design is most applicable and appropriate for this research study.

Link to Theoretical Framework

The Likert-based items in the survey are directly measuring the constructs of conceptual framework as described in Chapter II. This study builds upon the TAM by further exploring the external variables of IT support, functionality and usability that have been shown to influence the user's perceptions of LMS usage. To the best of this researcher's knowledge, these constructs are being examined for the first time from the perspective of PK-12 teachers at all grade levels during and after the pandemic. The correlational research design has been used in previous TAM studies to investigate users' perceptions related to a technological platform, system or tool. Hence, this study's research design is correlational.

Data Collection Measures

The survey will consist of the following constructs that will be measured through the Likert items.

1. Technology acceptance is defined as the extent to which one accepts or rejects a form of technology. Technology acceptance is the main latent variable that is made up of behavioral intention to use, perceived ease of use, and perceived usefulness (Davis, 1989).

2. Perceived usefulness is the extent to which one believes a form of technology will make the person's job easier. Actual system usage is a user's self-reported usage of a technology (Davis, 1989).

3. Perceived ease of use in the TAM is the extent to which one believes a form of technology will make the person's job easier (Davis, 1989).

4. Attitudes towards use is the extent to which one believes using a form of technology will be free of effort (Davis, 1989).

5. Behavioral intention to use is defined as the degree that a person has created conscious plans to complete or not complete a certain behavior in the future (Brezavšček et al., 2016; Davis, 1989).

The attitudes towards use are directly influenced by barriers to implementation, defined as any perceived barrier to LMS usage. Perceived ease of use is influenced by usability and IT support. Usability is defined as user perception, action, and cognitive skills (Godwin, 1987). IT support is defined as assistance with equipment or systems that are used in the acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, reception of data or information by the executive agency (Godwin, 1987; CSRC.NIST.gov 2023).

Perceived usefulness is influenced by functionality and IT support. Functionality is defined as the degree to which a system contains functions that are needed to complete tasks. Functionality changes according to functions available and tasks that need completion. Functionality is made up of efficiency and output quality (Godwin, 1987). Efficiency is a user's ability to solve their tasks without unnecessary effort and if it can react quickly. Output quality is defined as the value of the product of a technology. Usability is made up of perspicuity and dependability. Perspicuity is defined as the ease of becoming familiar with a technology and learning how to use it. Dependability is defined as the user feeling in control of the technology and if the technology is secure and predictable (Mlekus et la., 2020).

Population

Teachers to be surveyed are employed by a public school district located in a suburban county within the state of Georgia. The district serves approximately 32,000 students and employs approximately 2,000 teachers who fill eighteen elementary schools, eight middle schools, and five high schools. The school district maintains a student to teacher ratio of 16:1. The average teaching experience of those surveyed is 14.7 years of experience, and the certified employee retention rate for the district is 93.13%. The average teacher daily attendance is 95.6%, which indicates a high degree of teacher dedication (NCES, 2023).

The majority of teachers are White (84.8%), followed by Black (10.6%), and Hispanic (1.96%). The percent of multi-racial. Asian and Native American or Alaskan are 1.33%, 1.03% and 0.2% respectively. Electronic surveys will be sent to five high schools, eight middle schools, and five elementary schools, which would approximate to about 1,800 teachers.

Sampling Plan

This study will utilize purposive sampling. According to Rai and Thapa (2015), purposive sampling is a kind of non-probability sampling design in which the choices on which individuals will be included in the study are decided by the researcher. The decision of who to include in the study can be made due to myriad reasons, such as specialist knowledge of the research problem or willingness to participate. The specific type of purposive sampling that will be used is maximum variation sampling. Maximum variation purposive sampling is a technique that is used to select participants with a diverse range of characteristics and perspectives that is related to the topic of research. In other words, maximum variation purposive sampling is used to include PK-12 teachers with diverse demographic characteristics who have varying levels of experience with LMS usage (Rai and Thapa, 2015).

The researcher has selected this school district because the district engaged in an emergency shift to online learning during the COVID-19 pandemic. Furthermore, the researcher is aware that teachers in this school district have been expected to use the Google Classroom LMS for online teaching before, during, and after the COVID-19 pandemic. The researcher selected three different types of schools which would allow teachers at different levels to be included in the sample. Hence, a broader and more diverse sample is obtained.

The researcher has ensured that the Google Classroom LMS (primary vehicle of research), is widely used and understood by potential respondents. Due to the exclusion factors associated with the sampling plan, it is important for the researcher to maximize the credibility and knowledge of the potential respondents who do qualify to complete the modified TAM survey. This is especially important considering the use of the structural equation model and the need for a robust respondent pool.

The researcher aims to include teachers from all grade levels to obtain a representative sample of the school. This is important because the diverse perspectives of teachers need to be captured in the survey responses. Approximately 1,400 teachers will receive the electronic surveys. Out of these 1,400 teachers, approximately 600, 500, and 300 teachers will be from high school (9-12), middle school (6-8) and elementary (K-5) grade levels respectively. The inclusion criteria for this study to select teachers will have two conditions. The first condition is that teachers should have actively taught in the K-12 setting during the COVID-19 pandemic. The second condition is that participants must have experience using the Google Classroom LMS. This qualifying group of teachers will constitute the potential participants of this study.

According to Ullman (2006), the sample size can be calculated by using the equation $(p(p+1))/2$, where p represents the number of observed indicator variables. There are 51 survey items. Based on this equation, the sample size required for structural equation model should be approximately 1,326 participants.

Instrumentation: Data Collection Measure

The survey for this study consists of 51 Likert-based items that will measure the attributes of the TAM, IT support, functionality and usability constructs. The survey used in this study will be a combination of surveys that measure these constructs. The researchers who created the surveys are acknowledged and cited. The first section in the survey consists of items that measure the TAM constructs perceived usefulness, perceived ease of use, attitude towards usage, behavioral intentions to use, and actual system. The survey will have Likert items that have been adapted from the original TAM survey. The Likert scale ranges from 1 to 5, with one representing strongly disagree and five representing strongly agree (Davis, 1989). The second section of the survey contains Likert items that have been taken form the Online Service Quality Scale by Yang et al. (2004). The Likert items in this survey will be used to measure IT support construct and ranges from 1 to 5, with one representing strongly disagree and five representing strongly agree (Yang et al., 2004).

The third section consists of Likert items from the Individual Differences and Usage Behavior: Revisiting a Technology Acceptance Model Assumption survey. This instrument will be used to collect data on usage frequency, usage volume, and behavioral intention to use and ranges from 1 to 5, with one representing strongly disagree and five representing strongly agree (Burton-Jones & Hubona, 2005; Venkatesh & Davis, 2000). The fourth section of the survey will have sliding scaled items from User Experience Questionnaire which was created by Laugwitz et al. (2008). The survey items will collect data on the functionality and usability constructs. Written permission was granted through email by Theo Held. Dr. Held who is one of the primary authors of this survey (Laugwitz et al., 2008).

The fifth section of the survey is a user input section where users input the number of hours spent in the Google Classroom LMS. The sixth section of the Modified TAM survey is exploratory in nature. Both questions were created by this author and need no permission from other authors. The first question is about assessment issues during the COVID-19 pandemic. The second question is about implementation issues during the COVID-19 pandemic. The two qualitative questions would allow teachers to provide subjective responses on the assessment issues that they faced during the pandemic and specific types of barriers experienced when using Class Link LMS.

These modified surveys will be combined into one survey that will be created in Qualtrics. The survey uses a six-point Likert scale, with responses ranging from strongly disagree to strongly agree. There will be no neutral choice to ensure that respondents provide either a positive or negative perception on the six-point Likert scale (Yang et al., 2004; Laugwitz et al., 2008). Exploratory data will be gathered from two qualitative questions which will focus on assessment and barriers with online teaching in Class Link LMS that teachers faced during the COVID-19 pandemic.

Validity and Reliability

Validity and reliability testing were performed for each of the quantitative constructs in the survey. According to Davis (1989), a detailed process was used to develop initial items for perceived ease of use and perceived usefulness based on their conceptual definitions. Davis then conducted pre-test interviews in order to make sure the semantic content of the items was appropriate. The items that best fitted the definition for perceived ease of use and perceived usefulness were kept and ten items were retained for each construct. A field study was conducted to test for construct validity. Finally, six items were retained for both perceived ease of use and perceived usefulness. The perceived ease of use and perceived usefulness items were conducted using a 5-point Likert scale based on agreement ranging from 1 to 5(strongly disagree to strongly agree). Cronbach alpha was .98 for perceived usefulness and .94 for perceived ease of use (Davis, 1989). Construct validity for attitudes toward use was not conducted in the original TAM survey. However, these items were validated in the study by Weng et al. (2018). Cronbach alpha was .891 for attitudes towards use (Weng et al., 2018).

Burton-Jones and Hubona (2002) used a modified version of the TAM survey for behavioral intention to use. Cronbach's Alpha was not conducted. However, the authors used PLS-GRAPH version 3.00 to test for validity. Usage frequency and usage volume each had a PLS-Graph score of 1.0. A PLS-GRAPH score greater than .7 indicates a reliable scale. Behavioral intention to use scale items was taken from Venkatesh and Davis (2000). Venkatesh and Davis used adapted scales from Davis (1989). They tested the validity of these scale items across four different and diverse studies. Cronbach's Alpha for behavioral intention to use ranged from .82-.92. across multiple studies and time periods (Burton-Jones & Hubona, 2002; Venkatesh & Davis, 2000).

An exploratory study was conducted to identify the critical dimensions of IT support through a content analysis of consumer reviews. Results of the exploratory study came up with 17 items for online service quality. These 20 items represented the attributes of reliability, responsiveness, competence, ease of use, security, and product portfolio (PP). These items were merged into the online service quality survey. Next, a pre-test was conducted to assess the content validity of the measurement scales. The content validity was reviewed by a group of judges which included five academicians and four professors who were specialists in online service and marketing. A 5-point Likert scale was used. A total of 17 items were used to measure the five dimensions of IT support, strongly disagree to strongly agree (Yang et al., 2004).

Reliability tests were performed on each set of survey items representing IT support. The Cronbach alphas for responsiveness, competence, ease-of-use, product portfolio and security were 0.86, 0.76, 0.83, 0.80, 0.75 and 0.83 respectively. The *t*-values of each indicator all surpassed the critical value of 2.78 at the .01 significance level. The surpassing of this critical value means that each indicator was likely acceptable and pertinent. The chi-square was also statistically significant (χ^2 =158:07; df = 126, p < 0:03). The value of the Root Mean Square Residual Error (RMSRE) was .05 (Yang et al., 2004).

The user acceptance questionnaire was used to measure functionality and usability. It was first created by Laugwitz et al. (2008). The authors conducted two brainstorming sessions with 15 usability experts. The authors asked the experts to come up with terms that they thought were characteristics of user experience assessment. Experts were then allowed to veto terms they did not like and terms that received more than one veto were taken out. Eventually the item pool was reduced to perspicuity, efficiency, attractiveness, dependability, stimulation, and novelty. Perspicuity can be defined as easy to get familiar with the product and to learn how to use it. Efficiency can be defined as solving tasks without unnecessary effort and a quick reaction time. Attractiveness can be defined as the overall impression of the product and if users like or dislike the product. Dependability can be described as the user feeling in control of the product along with the product being secure and predictable. Stimulation can be described as exciting, motivating, and fun to use. Novelty can be defined as creative and able to catch the interest of users. Cronbach alpha for perspicuity, efficiency, attractiveness, dependability, stimulation and novelty was 0.71, 0.79, 0.86, 0.69, 0.88, and 0.84 respectively (Laugwitz et al., 2008).

Due to the exploratory nature of the qualitative research questions in this study, validity tests are not necessary. These research questions are not directly connected to any constructs and are therefore not involved in the modified TAM survey. However, they are still important in nature and will provide valuable information about teacher experiences during the emergency shift to online learning due to the COVID-19 pandemic. These two questions may eventually give rise to future constructs in future studies. However, they remain exploratory in this study.

Validity and Reliability Scales

Modified Technology Acceptance Model Scale and Reliability

Perceived Ease of Use (Cronbach's α = .94)

Learning to operate the Google Classroom LMS is easy for me.
I find the Google Classroom LMS to be flexible to interact with.
My interaction with the Google Classroom LMS is clear and understandable.
I find it easy to get the Google Classroom LMS to do what I want it to do.
It would be easy for me to become skilled at using the Google Classroom LMS.
I find the Google Classroom LMS easy to use.

Perceived Usefulness (Cronbach's α = .98)

The use of the Google Classroom LMS in my job enables me to accomplish tasks more quickly.
The use of the Google Classroom LMS improves my job performance.
The use of the Google Classroom LMS increased my productivity.
The use of the Google Classroom LMS enhances my effectiveness on the job.
The use of the Google Classroom LMS application makes it easier to do my job.
Overall, I find the Google Classroom LMS application useful in my job.

IT Support: (reliability, responsiveness, competence, security, product portfolio) (Cronbach's α = .82)

Reliability (Cronbach's α = .86)

My organization's IT support performs services correctly the first time.
My online IT support transactions are always accurate.
My organization keeps my records accurately.

Responsiveness (Cronbach's α = .76)

I receive prompt responses to my requests by email or other means from my organization's IT department.
My organization quickly resolves IT problems I encounter.

My organization's IT department gives me prompt service.

Competence (Cronbach's α = .83)

My organization's IT department has the knowledge to answer my questions.
My organization's IT department properly handles any problems that arise.
My organization's IT department complies with my requests.

Security (Cronbach's α = .83)

My organization's IT department will not misuse my personal information.
I feel safe with my organization's online applications.
I feel safe in providing sensitive information online to my organization.
I feel the risk associated with my organization's online transactions is low.

Product Portfolio (Cronbach's α = .75)

All my service needs are included in the Google Classroom LMS menu options.
The Google Classroom LMS provides wide ranges of product packages.
The Google Classroom LMS provides services with the features I want.
The Google Classroom LMS provides most of the service functions that I need.

Attitudes Toward Use: (Cronbach's α = .89)

Using Google Classroom in my class is good.
My using Google Classroom in my class is favorable.
It is a positive influence for me to use Google Classroom in my class.
I think it is valuable to use Google Classroom in my class.
I think it is a trend to use Google Classroom in class.

Behavioral Intention to Use (Cronbach's α = .91)

I intend to use the Google Classroom LMS assuming I have access to the system.
I predict that I will use Google Classroom LMS given that I have access to the system.
The easy availability of the Google Classroom LMS will help me to use it.

Functionality: (novelty, stimulation) (Cronbach's α = .85)

Novelty (Cronbach's α = .82)

conventional ------- inventive
usual ------- leading edge

Stimulation (Cronbach's α = .88)

boring ------- exciting
not interesting ------- interesting

Usability: (perspicuity, efficiency) (Cronbach's α = .75)

Perspicuity (Cronbach's α = .71)

confusing ------- clear
complicated ------- easy

Efficiency (Cronbach's α = .79)

inefficient ------- efficient
obstructive ------- supportive

Actual System Usage: (self-report)

How often do you use the Google Classroom LMS?

Burton-Jones, A., & Hubona, D. (2002). Individual differences and usage behavior: Revisiting a technology acceptance model assumption. The Data base for Advances in Information Systems, 36(2), 58-77.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319. https://doi.org/10.2307/249008

Laugwitz, B., Schrepp, M. & Held, T. (2008). Construction and evaluation of a user experience questionnaire. European Journal of Clinical Investigation. 52(6), 1-12. http://dx.doi.org/10.1007/978-3-540-89350-9_6

Venkatesh, V., & Davis, F. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science, 46(2), 186-204. https://www.jstor.org/stable/2634758?seq=1&cid=pdf-reference#references_tab_contents

Weng, F., Yang, R., Ho, H., Su, H. (2018). A TAM-based study of the attitudes towards use intention of multimedia among school teachers. Applied System Innovation, 1(3), 1-9. https://doi.org/10.3390/asi1030036

Yang, Z., Jun, M., Peterson, R. (2004). Measuring customer perceived online service quality: Scale development and managerial implications. International Journal of Production and Production Management. 24(11), 1149-1174. DOI 10.1108/01443570410563278

Ethical Considerations and Data Collection Procedures

Institutional Review Board (IRB) approval was sought at two different levels for this study. The first step was to obtain permission to conduct research from the district in which this research study takes place. IRB approval from the school district, seen in Appendix A, was obtained by the researcher by filling out a form that indicated the name of the study, the topic of the study, the instrument being used in the study, any risk associated with the study, and potential benefits to the teachers, and administrators of the school district. The next step in the process was to submit the research request to the associate superintendent of curriculum. Eventually, the research request was approved by the associate superintendent, and this study was authorized to survey five high schools, eight middle schools, and five elementary schools.

The next step was to complete the paperwork from Columbus State University (CSU) IRB. The information in IRB application at CSU, seen in Appendix B, that was added included participant recruitment procedures, process of obtaining informed consent, procedures for deidentifying the data and maintaining the confidentiality of participant responses. The final application was signed by the principal investigator and co-principal investigator.

IRB approval from the school district and CSU will be taken prior to the survey administration. The survey will be electronically sent, via email seen in Appendix C, to teachers in five high schools, eight middle schools, and five elementary schools. The survey, seen in Appendix D, will be administered through the Qualtrics platform which is a secure method to collect data. The survey link will be emailed to teachers in the 18 schools. The email will also contain the informed consent form.

The informed consent for this study is located on the first page of the online Qualtrics survey. The first page of the web-based survey includes the following information on the informed consent form: an explanation of the research project along with its purpose, a description of the minimal risks and possible benefits of the research project, a statement of explanation on the maintenance of confidential records, and a statement explaining the procedures for withdrawal. The participants must select the appropriate option within the web-based survey as to whether they agree or disagree to participate in the study after reading the informed consent form. The survey will conclude if they choose not to participate and the response will be recorded. If they choose to participate, the participants will respond to each survey item. The survey response data will be stored on the primary researcher's password protected computer and only shared with the co-principal investigator. Unsigned copies of any IRB documents will remain with the primary researcher on a password protected computer.

While the original TAM survey focused on electronic mail (Davis, 1989), the survey has been adapted for this study to mention Google Classroom, which is the technological hub that is used by teachers at the study site and provides quick access to a wealth of technology pieces. Google Classroom is used by nearly every teacher in the school district from which the teachers for this study have been identified. The Google Classroom LMS is used for notes, assignments, assessments, communication, and grading. Teachers are expected to use the Google Classroom LMS, making it the ideal conduit to gather data on TMS constructs, IT support, functionality and usability, as well as assessment and implementation issues encountered in online teaching during the COVID-19 pandemic (Davis, 1989).

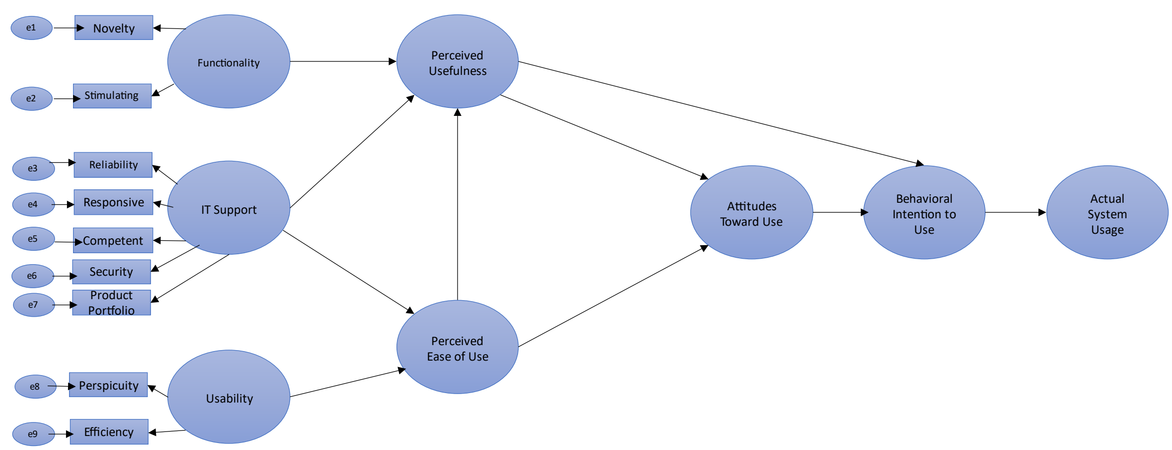
Quantitative Data Analysis

The descriptive statistical analysis will include computation of means, standard deviations, variances, kurtosis, and outliers. Reliability analysis will include computation of Cronbach alpha to measure the internal consistency of the survey items. Cronbach alpha values of 0.7 or higher indicate good internal consistency between the survey items that are supposed to measure attributes of a construct. According to Allison (2009), missing data is a problem in statistical analysis because statistical analysis software assumes that all variables in a tested model are measured in all cases. Furthermore, missing data can negatively cause bias in the results. The issue of missing data can be alleviated by using appropriate imputation procedures (single or multiple) based on the pattern of missing data (missing at random and missing not at random). The type of imputation method will be useful to resolve the issue of missing data and retain the maximum number of complete cases for the inferential statistical analysis (Cheema, 2014).

Structural equation modeling (SEM) is the primary data analysis technique that will be implemented in this study. SEM is based on regression analysis where causal relationships can be modeled between the constructs of interest, which are if they choose to participate the TAM (perceived usefulness, perceived ease of use, attitude towards use, behavioral intentions to use and actual system usage), IT support (reliability, responsiveness, competence, security, and product portfolio), functionality (novelty and stimulation), and usability (perspicuity and efficiency). According to Ullman (2006), when SEM is used to examine the relationships between factors, the factors are free of measurement error. Measurement error, or unreliable variable measurements, are estimated and removed through SEM. Freedom from measurement error is an important positive aspect of SEM. SEM is the marriage between path analysis and confirmatory factor analysis. Both are multivariate statistical procedures. Path analysis is used to run several linear regression equations simultaneously. Confirmatory factor analysis (CFA) is used to test the fit between the observed data and the proposed conceptual model. The model consists of latent constructs that are measured through indicator variables. These variables represent the attributes or traits of a specific latent construct (Schumaker & Lomax, 2010). The primary difference between path analysis and CFA model is that the former contains only observed variables whereas the latter contains both indicator variables and constructs. The endogenous and exogeneous variables in path analysis are the independent and dependent variables respectively. The endogenous variables cannot be influenced by any other variable that is specified in the model. An exogeneous variable can be influenced by an independent variable. The same terminology is used for CFA models. An endogenous variable or construct can become exogeneous in both path analysis and CFA model. For example, perceived ease of use is endogenous construct as it is influenced by usability and IT support (exogeneous constructs). It becomes exogenous when it influences perceived usefulness as shown in Figure 4. Perceived usefulness is also both endogenous and exogenous because it is influenced by functionality, IT support, and perceived ease of use, while influencing attitudes toward use and behavioral intention to use. CFA models are conducted in this study in order to determine if constructs of interest are defined by their factors, which are the TAM (perceived usefulness, perceived ease of use, attitude towards use, behavioral intentions to use and actual system usage), IT support (reliability, responsiveness, competence, security, and product portfolio), functionality (novelty and stimulation), and usability (perspicuity and efficiency).

Figure 4

Hypothesized Model



Note. Hypothesized structural model of the impact of perceived usefulness, perceived ease of use, functionality, IT support, and usability on behavioral intention to use.

In SEM, these variables become constructs (endogenous or exogeneous) because the relationships are now depicted at the construct-level. SEM consists of two separate models. The measurement model consists of the relationships between latent constructs, represented by ovals, and the corresponding indicator variable, (represented by squares. The measurement model is tested and validated through the CFA statistical procedure, the structural model that defines the hypothesized causal relationships between latent constructs. The main advantage of SEM is that it can model measurement error through the CFA model. It is the degree to which indicator variables are accurate and true representation of a specific construct under investigation. The CFA model is used to test and validate the accuracy of indicator variables before the SEM can be specified. The CFA model removes those indicator variables that lead to poor model fit. Hence, the final version of CFA model consists of only those indicator variables that are valid indicators of a construct. That is why CFA is also used for construct validity. Hence, the SEM or structural model that is estimated has low measurement error because the indicator variables have already been rectified to be the accurate attributes of a construct. Through the removal of indicator variables that lead to poor model fit, CFA allows the structural model created to have low measurement error. SEM further reduces measurement error because it allows for modifications of the structural model in order to find the model that best fits the gathered data. The combination of CFA and SEM serves to greatly reduce measurement error (Schumaker & Lomax, 2010).

Outliers can influence SEM parameter estimates and increase error variance. According to Schumaker and Lomax (2010), the use of an adequate sample size can help to create reasonable and stable parameter estimates. Another suggestion is to have at least four indicators per latent variable. According to Yaro et al. (2023), univariate outliers are detected through a z-score greater than 3.0 and subsequently removed. For multivariate outliers, a Mahalanobis chi-square test will be performed at a significance level of $p = .001$. According to Ghorbani (2019), the Mahalanobis distance measures the number of standard deviations that an observation, or data point, is from the mean of a distribution. The Mahalanobis chi-square statistic was determined by taking the number of observed variables in each model and using them as degrees of freedom. This study considers responses to be multivariate outliers if they are greater than the chi-square critical value and had a Mahalanobis distance that is much greater than other distances in the distribution. Any such responses will be subsequently removed (Yaro et al., 2023; Ghorbani, 2019).

According to Shumaker and Lomax (2010), SEM is a based-on covariance matrix which shows the differences between the indicator variable scores and depicts the direction and magnitude of multivariate data. Covariance between two variables is the product of correlation times the product of indicator variable's standard deviations. Covariance always exists between two variables. SEM can be negatively impacted by missing data, outliers, nonlinearity, and nonnormality. Weston (2006) explains that most statistics used in SEM assume normality and that violating this assumption will affect the accuracy of statistical tests. The maximum likelihood (ML) estimation procedure assumes that the indicator variables follow a multivariate normal distribution. The ML estimation assumes that the covariance matrix is positive definite, meaning that the eigenvalues (amount of variance in the indicator variables that is explained by each latent construct) in CFA model are positive. ML provides unbiased model parameter estimated if the data follows a multivariate normal distribution and if the model specification is correct. ML estimates are robust to violations of normality (Curran, West & Finch, 1996; Muthén & Muthén, 2002; West, Finch, & Curran, 1995). However, severe non-normality will result in inflated Type I error rate when $\chi 2$ is used as model fit. An increase in sample size results in the estimates approximate a normal distribution. ML estimates provide a statistical test to assess the overall model fit for over-identified models. Another advantage of ML is that it is scale invariant, that is, change in the range of scale scores (e.g., 5-point scale to 7-point Likert scale) of indicator variables does not influence ML estimation. Data that is skewed will influence variance and co-variance between variables. Shumaker and Lomax (2010) also state that kurtosis impacts SEM with leptokurtotic and platykurtic data both being detectable through univariate and multivariate tests. All univariate distributions for indicator survey items will be assessed for normality, skewness and kurtosis through histograms (Shumaker & Lomax, 2010; Weston, 2006).

According to Weston (2006), skewness absolute values greater than |3| are extreme. For Kurtosis, absolute values greater than |10| are problematic, and Kurtosis absolute values greater than |20| are considered extreme. Ryu (2011) explains that maximum likelihood can be used as a general framework for data analysis and should be used with skewness $\leq |2|$ and a kurtosis of $\leq |7|$. Ryu (2011) states that the anything more in skewness and kurtosis causes problems. For this study, skewness of |2| and kurtosis of |7| will be used as general limits to be able to use maximum likelihood estimations. Weston (2006) suggests the Anderson and Gerbing (1998) approach of estimation that uses confirmatory factor analysis to test the measurement model before estimating the full structural model. Appropriate changes to the model are necessary after model estimation is completed (Weston, 2006; Ryu, 2011).

The extent to which the SEM aligns to the empirical data under investigation is assessed through model fit indices. There are several fit index measures used in SEM. The $\chi 2$ statistic is used to test the fit between the model covariance matrix ($\Sigma(\theta)$) and the population covariance matrix (Σ). A higher value of $\chi 2$ statistic indicates a greater difference between model and population covariance matrix, which shows poor model fit. The $\chi 2$ statistic is influenced by non-normality. Its value is lower for more complex models than simpler models because the degrees of freedom of the former is reduced. Sample size increases $\chi 2$ statistic with increase in degrees of freedom. The $\chi 2$ difference test is used to select the best-fitting model across all the competing models. The test assesses the two models. The first model is the restricted version of the second model. It is nested within the second model and has more degrees of freedom and less free parameters. The second model is less restricted and contains more free parameters and less degrees of freedom. If the $\chi2$ difference test is statistically significant, then the second model is retained. If the test is not significant, then the fit of first model is not worse than second model to a statistically significant degree. The $\chi2$ goodness-of-fit value of .90 is considered to be acceptable fit and a value of .95 is regarded as good fit (Bentler & Bonett, 1980).

Normed Fit Index (NFI) fit index values range from 0 to 1. The rule of thumb is to have an NFI value of at least .90 (Kaplan, 2000, p. 107) as acceptable model fit and 0.95 or greater as good model fit (Schumacker & Lomax, 1996). The Non-Normed Fit Index (NNFI) is robust to changes in sample size (unlike NFI). A higher NNFI value (.95 for acceptable fit and .97 for good fit) indicates better fit (Jöreskog & Sörbom, 1993, p. 12). The Root Mean Square Error of Approximation (RMSEA) is used as index of approximate model fit to the data. A value that is less than .05 indicates close fit. A value less than or equal to .05 is regarded as close fit, whereas values between .05 and .08 are considered good fit (Browne & Cudeck, 1993). RMSEA value that is less than .06 is the cut-off criterion (Hu & Bentler, 1999). The advantage of RMSEA is that it can differentiate between two types of error. The first type is error of approximation (lack of fit between the CFA model or SEM to the population covariance matrix Σ). The second type is error of estimation (differences between fitted model and the matrix). Root Mean Square Residual (RMR) is based on residual or error terms of the model. The closer RMR value to zero, better is the fit (Jöreskog & Sörbom, 1981, p. 41). The Standardized Root Mean Square Residual (SRMR) is robust to changes in the variable scale scores (unlike RMR). A rule of thumb for SRMR is that it should be less than .05 for a good fit (Hu & Bentler, 1999). The comparative fit index (CFI) is used to assess under-estimation of models. It ranges from 0 to 1. Values greater than 0.95 indicate acceptable fit whereas 0.97 or more is regarded as good fit (McDonald & Marsh, 1990). Goodness-of-Fit Index (GFI) is used to test the extent to which a hypothesized model fits when compared to a null model (all parameters are fixed to zero). GFI ranges from 0 to 1 with values of .95 indicative of good fit and .90 indicative of acceptable fit ((Jöreskog & Sörbom, 1989). The Akaike Information Criterion (AIC) is used to test competing models and select the model that best fits the data. The AIC values are lower for parsimonious models. It is not a statistical significance test. All these fit indices will be used to assess the quality of theoretical model fit to the covariance matrix derived from the survey data.

Both the measurement and structural model are specified, identified, estimated, tested, and re-specified based on fit indices. All the analyses related to SEM will be conducted in Statistical Analysis Software (SAS). The first step in the analyses is **model specification**. The primary objective of this step is to create a theoretical model which has all the relevant constructs and corresponding indicator variables based on prior empirical research and relevant theory. In this step, every relationship and parameters that needs to be estimated is specified in the model. A model is said to be properly specified when the hypothesized theoretical model can reproduce the sample covariance matrix (derived from empirical data). The main goal is to assess the degree to which the true model that is generated from the data deviates from the proposed theoretical model. In the hypothesized structural model, there are five latent constructs related to the TAM (perceived usefulness, perceived ease of use, attitudes toward use, behavioral intention to use, and actual system usage). There are three higher-level constructs (IT support, functionality, and usability). The higher-level constructs consist of multiple dimensions which have indicator variables that are measured through Likert survey items. As shown in Figure 3, IT support has four dimensions (reliability, responsiveness, competence, and security). Functionality consists of two dimensions (novelty and stimulation). Usability has two aspects (perspicuity and efficiency). Specification errors may arise when relevant or irrelevant variables are included which results in mis-specified model. The specification error leads to misalignment between the true model and hypothesized structural model.

The next step is **model identification**. The SEM models can be under-identified (all the parameters cannot be estimated), just-identified/saturated (model having zero degrees of freedom, number of free parameters is equal to the number of known parameter values) or over-identified (all the parameters are identified and there is unavailability of additional free parameters) based on the fit indices. In this step, the goal is to compute unique parameter estimates for the regression equation. The sample variance-covariance matrix is used to derive these parameter estimates from every free parameter that is available. The number of unique values in the matrix equals the number of parameters to be estimated. The next step is **model estimation,** where the model parameters are estimated. The standardized regression beta coefficient weights for the exogeneous (independent) variables are estimated to predict the endogenous (dependent) variables. CFA (along with exploratory factor analysis) is the most common statistical approach that is used in this step to develop the measurement model where the relationships between the constructs and their corresponding indicator variables are estimated. The construct validity and reliability are also assessed in this step. Variables (in the form of Likert-based survey items) that are legitimate indicators of each construct are assessed based on the beta coefficient weights (also known as the path coefficient). The literature reports several criteria to establish the required number of indicators depending on sample size. In CFA model, six to 12 indicator variables per latent construct is required with a sample size of $N = 50$. However, three to four indicators per construct is sufficient when the sample size increases to $N = 100$ (Marsh, Hau, Balla & Grayson, 1998). Hoyle (2012) suggests having at least three indicators per construct. Larger sample size is required when the number of indicator variables per construct is less (Schermelleh-Engel, Moosbrugger & Miiler, 2003). In accordance with this recommendation, each latent variable that was added to the theoretical model has at least two indicator variables per latent construct.

The next step is **model testing** where the fit of the theoretical model is assessed with respect to the variance-covariance matrix that has been derived from the survey data. The fit indices described previously will be used to assess the model fit to the data. The cut-off scores of fit indices are consulted to determine the model fit. In addition, competing models are tested by using the $\chi 2$ difference test and AIC indices. These fit indices help the researcher to select the theoretical model that best fits the variance-covariance matrix. Sample size and the number of indicator variables per construct also have a major role in selecting the best model. The last step is bold. Chi-square tests, parameter estimates, and goodness of fit testing are conducted in this step. Shumaker and Lomax (1996) explain that a statistically non-significant chi-square test, $\leq$ .05, is considered acceptable for model fit criteria. Path coefficients are calculated by dividing the parameter estimates by their associated standards of error. These estimates, or *t*-values, are usually compared to the critical values at *p*-value of .05 for statistical significance testing. The positive and negative sign of path coefficients will be used to evaluate each indicator variable in relation to the attributes of a specific dimension within a higher-level construct that it represents (Schumaker & Lomax, 2010). For example, the three survey items representing the reliability dimension of IT support construct will be assessed based on the path coefficients. In the proposed theoretical model, functionality and IT support are the exogenous variables for perceived usefulness. Usability and IT support are the exogenous variables for perceived ease of use. Attitudes towards use is predicted by perceived usefulness and perceived ease of use.

Behavioral intention to use is predicted by attitudes towards use. The final endogenous variable in this model is actual system usage which is explained by behavioral intentions to use.

The last step is **model modification**. In this step, the theoretical justification, fit indices, standardized regression path coefficients, error terms, addition (introduce free parameters) or deletion (reduce free parameters) of constraints and statistical tests are used to revise the initially specified theoretical model. Chou and Bentler (1990) state that the adding or reducing constraints is a commonly used approach in model modification when the theoretical model is not a good fit to the variance-covariance matrix. The addition or removal of free parameters is similar to the forward and backward procedures followed in stepwise regression models. The non-significant parameter estimates of Wald statistical test is used to remove indicator variables (e.g., statistically non-significant path coefficients and factor loadings-correlation between the indicator variable and latent construct) in CFA model, add or delete pathways in the structural model or to constrain specific parameters that were initially freely estimated. A non-significant Wald test would show that removal of a freely estimated parameter will not improve model fit. Shumaker and Lomax (2010) note the problem of multicollinearity and explain that interaction factors will be correlated at a high level with the observed variables that are used to construct them. Multicollinearity or high correlation between the exogeneous variable can be problematic as it can result in inflated standard errors, and increase in Type II error (Schumaker & Lomax, 2010; Weston, 2006). According to Weston (2006), a bivariate correlation coefficient that is greater than .85 is potentially problematic. Factor scores for functionality, usability, IT support, perceived usefulness, perceived ease of use, and behavioral intention to use will be used to estimate bivariate correlations. The conceptual relationships that have been described in research literature between the constructs and their corresponding variables should be also considered when modifying the model.

Qualitative Data Analysis

Although this study is more heavily quantitative than qualitative, there are two open-ended research questions in the survey which will allow teachers to subjectively express their opinions and perspectives on the challenges they faced when using the Google Classroom LMS for online teaching. The responses received from open-ended questions will be coded to derive themes. According to Saldaña (2009), a code is a word, or phrase, that symbolically assigns a summative attribute for a section of language-based or visual data. In the case of this study, the data would be language-based. Saldaña further explains that coding takes place in more than one cycle and that first cycle coding can use anywhere from one word, one sentence, to an entire page of text. Saldaña describes the second cycle coding as being able to compile into same size pieces, longer passages than the first cycle, or even reconfigurations of the codes that were developed in the first cycle. While coding is not summarization, Saldaña explains that it is heuristic. Essentially, coding is an exploratory technique that does not have a specific formula. Coding is designed to take information from being a data set to ideas. This transformation is made through the mechanics of coding (Saldaña, 2009).

Data in this study will be pre-coded by separating text into paragraph lengths with lines between topics (Saldaña, 2009). Pre-coding includes highlighting significant quotes, words, or passages that appear to be "codable moments." This can be done in specific programs to pick out the same items across large amounts of written data. Saldaña (2009) advises the researcher to thoroughly read all data and write complete words, for potential codes, throughout the written margins. Computer assisted qualitative data analysis software (CAQDAS) such as MaxQDA will be used. Data will be analyzed and broken down into specific codes by using structural coding. According to Saldaña (2009), structural coding applies to content-based phrase representing a topic of inquiry to a segment of data that is connected to a specific research question. For this study, the structural coding would be connected to the research questions regarding assessment issues and implementation issues with online learning. Saldaña (2009) further details that structural coding is especially appropriate for exploratory investigations. Structural coding can be kept at the basic level by applying it as a categorization technique in order to eventually conduct more qualitative research (Saldaña, 2009). The two qualitative research questions in this study are exploratory in nature and will be structurally coded into major categories. After categorization is completed, the categories will be evaluated into themes. "Themeing" data will be done at the manifest level (observable level) or the latent level (underlying level). After data collection and organization, themeing will be done at the manifest, latent, or both levels as appropriate. Subsequent themes will be analyzed and explained in the data reporting section of this study (Saldaña, 2009).

Results Reporting

Chapter IV results will be laid out starting with demographics. Demographic data will be disaggregated by school level, experience, and frequency. This disaggregation is important because there may be differing levels of Google Classroom LMS usage based on school level and experience. After demographic data, testing of assumptions will be completed. Missing data will be addressed through appropriate imputation techniques. Skewness and kurtosis will be addressed. Finally, the five steps of SEM, model specification, model identification, parameter estimation, model evaluation, and model modification, will take place. According to these results, the four quantitative research questions will be answered. Following the quantitative research, the qualitative research questions will be coded according to structural coding with themes identified.

Summary

According to the CDC, in 2020, the COVID-19 pandemic resulted in all public-school systems in the US being forced to move to emergency online learning. During this time, many students and teachers began using LMS as avenues for instruction (CDC.gov, 2022). Teachers experienced various issues involved with the emergency transition to online learning and subsequent LMS usage (Dolenc et al., 2022). This study seeks to assess the technology acceptance of teachers in the years after the COVID-19 pandemic, while adding functionality, usability, and IT support to the traditional TAM. Along with the quantitative portion of this study, there is also a qualitative portion that seeks to determine the problems with implementation of online learning and also assessment issues associated with online learning in Google Classroom LMS. This study will use a correlational research design. Correlational research is a type of associational research in which the researcher attempts to study what relationships, if any, exist among two or more variables (Asamoah 2014). Although correlational research studies are most often quantitative studies, this specific study adds two qualitative questions that result in this study being a mixed methods survey-based inquiry (Longe, 2023). This study's theoretical framework, research design, and purpose are all extensions of the TAM study. For these reasons, this study has correctly chosen its correlational research design, survey instrument, and research questions.

This study utilizes correlational research design where survey data is collected on the constructs of interest. The survey will be sent out to PK-12 teachers in five high schools, eight middle schools, and five elementary schools. Validity and reliability testing were performed for each of the quantitative items in the survey. SEM is used to determine the causal relationships between these constructs under investigation. Model specification, model identification, parameter estimation, model evaluation, and model modification will be conducted in SAS to answer the quantitative research questions. Qualitative data will be structurally coded with the intention to create themes. Results will be disaggregated according to demographic attributes.

CHAPTER IV: RESULTS

The purpose of this quantitative research was to examine the state of K-12 teacher technology acceptance in the years after the COVID-19 pandemic using the Modified TAM as a framework. Technology acceptance will be measured through behavioral intention to use and actual usage through the Modified TAM Survey. The survey consists of Likert-based items which measure the attributes of the following constructs: behavioral intention to use, attitude towards use, perceived usefulness, IT support, functionality, and usability.

The research was guided by the following seven research questions:

1. How does perceived ease of use of the Google Classroom LMS in K-12 teachers influence their behavioral intention to use the Google Classroom system?
2. How does perceived usefulness of the Google Classroom LMS in K-12 teachers influence their behavioral intention to use the Google Classroom system?
3. How do the IT experiences of K-12 teachers influence their behavioral intention to use the Google Classroom system?
4. How does the functionality and usability of the Google Classroom LMS influence K-12 teachers' behavioral intention to use it?
5. How does the perceived ease of use and perceived usefulness of the Google Classroom LMS in K-12 teachers influence their attitudes toward use?
6. How do K-12 teachers' attitudes toward use of the Google Classroom LMS influence their behavioral intention to use it?
7. How does K-12 teachers' behavioral intention to use the Google Classroom LMS influence actual system usage of it?

Data Screening

The raw survey response scores were exported from the Qualtrics platform into excel. There were 199 respondents who reported that they did not experience online learning during the COVID-19 pandemic. These 199 responses were deleted. There were nine surveys which had incomplete responses, and they were deleted. There were 348 surveys that were kept for the descriptive and inferential data analysis. The response rate was calculated by dividing 348 by 1601. The response rate was 21.7%.

Demographic Characteristics

The majority of respondents (97.4%) identified as non-Hispanic (*n* = 339). The remaining nine participants (2.6%) were Hispanic (*n* = 9). Table 1 shows that the majority of the participants were White (*n* = 309), followed by Black or African American (*n* = 26), Asian (*n* = 4) and American Indian or Alaskan Native (*n* = 3). There were six respondents who did not indicate their race.

Table 1

Race

	Frequency	Percent	Cumulative Percent
American Indian or Alaskan Native	3	.9	.9
Asian	4	1.1	2
Black or African American	26	7.5	9.5
White	309	88.8	98.3
Other	6	1.7	100
Total	348	100	100

Note. Cumulative percent race table for Modified TAM Survey respondents.

Table 1 shows the racial statistics and categories for all Modified TAM Survey respondents. The majority of respondents (75.3%) identified as female (*n* = 262). The next largest group (24.1%) identified as male (*n* = 84). The remaining respondents (.6%) stated that they preferred not to disclose their gender for this study (*n* = 2). Table 2 shows the school level statistics and categories for Modified TAM Survey respondents.

Table 2

School Level

	Frequency	Percent	Cumulative Percent
Elementary School	82	23.6	23.6
Middle School	141	40.5	64.1
High School	125	35.9	100
Total	348	100	100

Note. Cumulative school level statistics table for Modified TAM Survey respondents.

The majority of respondents (40.5%) are middle school teachers (*n* = 141). The next highest category of respondents (35.9%) are high school teachers (*n* = 125). The remaining respondents (23.6%) are elementary school teachers (*n* = 82). Table 3 shows LMS experience disaggregated by school type. Respondents were asked if they had LMS experience prior to the COVID-19 pandemic.

Table 3

Teacher LMS Experience by School Type

LMS Experience	Elementary School	Middle School	High School	Total
Yes	25 (7.2%)	50 (14.4%)	52 (14.9%)	127 (36.5%)
No	57 (16.4%)	91 (26.1%)	73 (21.0%)	252 (63.5%)
Total	82 (23.6%)	141 (40.5%)	125 (35.9%)	348 (100.0%)

Note. The number of teachers with LMS experience by school type with percentages for each in parentheses.

Overall, 127 respondents had prior LMS experience, while 252 did not have prior LMS experience. LMS experience was most prevalent (14.9%) in high school respondents (*n* = 52). LMS experience was nearly as common (14.4%) in middle school respondents (*n* = 50). LMS experience was much less common (7.2%) in elementary school respondents (*n* = 25). Table 4 shows that there were 96 (27.6%) teachers who indicated having had past training with other LMS. There were 252 (72.4%) teachers who did not have past training with other LMS.

Table 4

Prior LMS Training by School Type

Experience with LMS	Elementary School	Middle School	High School	Total
Yes	18 (5.2)	45 (12.9)	33 (9.5)	96 (27.6)
No	64 (18.4)	96 (27.6)	92 (26.4)	252 (72.4)
Total	82 (23.6)	141 (40.5)	125 (35.9)	348 (100)

Note. The number of teachers with prior LMS training by school type with percentages for each in parentheses.

Elementary teachers (5.2%) had the lowest training experience with other LMS when compared to middle school teachers (12.9%) and high school (9.5%) teachers. Table 5 represents a visual of the Modified TAM Survey respondents' years of experience with the Google Classroom LMS, other LMS, and also training received on other LMS.

Table 5

Frequency Table Showing Respondent LMS Experience in Years

Years Experience (N = 347)	Google Classroom Use (N = 116)	Other LMS Use (N = 96)	Other LMS Training
0 – 1	8 (5.2)	7 (6.0)	2 (2.1)
2	8 (2.3)	26 (22.4)	41 (42.7)
3	23 (6.6)	20 (17.2)	4 (4.2)
4	34 (9.8)	13 (11.2)	1 (1.0)
5	79 (22.8)	22 (19.0)	48 (50.0)
6	67 (19.3)	5 (4.3)	0 (0.0)
7	36 (10.4)	3 (2.6)	0 (0.0)
8	4 (9.8)	4 (3.4)	0 (0.0)
9	9 (2.6)	1 (.8)	0 (0.0)
10	28 (8.1)	7 (6.0)	0 (0.0)
>10	11 (3.2)	11 (9.5)	0 (0.0)

Note. Frequency table for Google Classroom use, other LMS use, and other LMS training. Percentages are shown in parentheses.

Teachers in the district that was surveyed did not receive training on the Google Classroom LMS and were only able to report on their years of experience using Google Classroom. The highest frequencies of Google Classroom LMS experience were five years of experience (*n* = 79) at 22.8% of respondents and six years of experience (*n* = 67) at 19.3% of respondents. The highest frequences of other LMS use were two years of experience (*n* = 26) at 22.4% and five years of experience (*n* = 22) at 19.0%. The highest frequencies of other LMS training were five years of experience (*n* = 48) at 50.0% of respondents and two years of experience (*n* = 41) at 42.7% of respondents. As shown in Table 6, respondents had a wide range in years of experience, age, years using the Google Classroom LMS, years using other LMS, and years training on other LMS.

Descriptive Statistics

Table 6

Experience Teaching and Using LMS

	Years Experience	Age	Google Classroom Years	Other LMS Years	Other LMS training
Total	348	348	347	116	96
Missing	0	0	1	232	252
Mean	17.19	45.47	5.93	4.95	4.09
Std. Dev	7.65	8.98	2.67	4.16	5.50
Range	35	45	20	25	5
Maximum	38	70	20	25	6
Minimum	3	5	0	0	1

Note. Reported age and years of experience for Modified TAM Survey respondents.

The mean years of experience was just over 17 and the average age was 45 years. It is important to note that years of experience encompasses combined work experience in the field of education. The average years of Google Classroom LMS experience was just under six while the average years of other LMS usage was just under five. The average years of training on other LMS was slightly above four. The Google Classroom LMS was more widely used than other reported LMS and it also was used for a longer duration. While respondents were not trained on Google Classroom LMS usage, the data reported shows most respondents are quite familiar with the Google Classroom LMS. Forty-eight respondents named a specific LMS on which they had received training, with the most widely reported being Blackboard LMS that was listed by 26 (54.1%) respondents. Table 7 combines statistics reported in Tables 4 and 5 with school level and actual Google Classroom LMS weekly usage. While close, within 1.5 years of the other levels, elementary school teachers were the most experienced (M = 17.8).

Table 7

Descriptive Statistics for Teaching Experience and LMS Usage (Years) by Type of School

Descriptive Statistic	Elementary School	Middle School	High School
Teaching Experience			
Mean	17.8	16.34	16.84
SD	7.39	7.81	6.6
Range	30(5, 35)	300(4, 34)	27(4, 31)
Skewness	.206	.206	-.029
Kurtosis	-.709	-.709	-.479
GC LMS Usage			
Mean	5.55	5.94	6.12
SD	3.70	2.735	2.81
Range	14(0, 14)	13(1,14	12(1, 13)
Skewness	.379	.320	.361
Kurtosis	-.342	.811	.000
Other LMS Usage			
Mean	6.18	4.38	4.89
SD	6.01	4.38	4.89
Range	25(0, 25)	10(0, 10)	19(20, 1)
Skewness	2.07	.813	2.25
Kurtosis	4.08	-0.42	5.45
Training Other LMS			
Mean	3.72	4.24	4.09
SD	2.11	1.97	1.97
Range	5(1, 6)	5(1, 6)	4(2, 6)
Skewness	0.20	-.302	-0.11
Kurtosis	-2.13	-1.88	0.79
Hours per Week LMS Usage			
Mean	5.00	6.44	8.03
SD	5.39	7.97	8.80
Range	20(0, 20)	(0, 40)	50(0, 50)
Skewness	1.36	2.577	2.68
Kurtosis	1.53	7.93	9.71

Note. Numbers in parentheses represent the minimum value followed by maximum value of range.

High school teachers had the most experience using the Google Classroom LMS (*M* = 6.12), while elementary school teachers had the least (*M* = 5.55). Elementary school teachers tend to have had the most experience with other LMS (*M* = 6.18), while middle school teachers tend to have had the least experience with other LMS (*M* = 4.38). While middle school teachers tend to have had the least experience with other LMS, they actually had the greatest amount of training with other LMS (*M* = 4.24), while elementary school teachers had the least (*M* = 3.72). This suggests that there was a component of self-teaching occurring with teachers and different types of LMS. Actual usage of the Google Classroom LMS increased as level of school increased. Elementary school teachers reported spending 5.0 hours per week on the Google Classroom LMS, while middle school teachers reported 6.44 hours and high school teachers reported spending 8.03 hours per week. This data suggests that the Google Classroom LMS may be more applicable with older students and that teachers who have received more training on LMS usage are more likely to use an LMS.

For the purposes of this study, usability is broken down into efficiency and perspicuity, while functionality is broken down into stimulating and novelty. Initial survey items for usability and functionality were presented on a seven-point sliding scale. For the purposes of this study, any score below 3.5 was considered a negative response and any score above 3.5 was considered a positive response. Using the SPSS program, the data were re-coded to identify negative scores with a “1” and positive scores with a “2.” Table 8 shows the frequencies for the functionality and usability constructs disaggregated by school level positive and negative responses. The parenthesized percentages next to each term are the overall percent of teachers from each school level that indicated a positive or negative response. The parenthesized numbers in the “total” category represent the percentage of teachers reporting positive or negative responses in the functionality and usability categories by school level.

Table 8

Respondent Usability and Functionality Perceptions by School Level

Dimension	Elementary School		Middle School		High School	
	1	2	1	2	1	2
Usability						
Efficiency: Supportive	20 (5.7)	62 (17.8)	27 (7.6)	114 (32.8)	35 (10.1)	90 (25.9)
Perspicuity: Easy	22 (6.3)	60 (17.2)	32 (9.2)	109 (31.3)	39 (11.2)	86 (24.7)
Efficiency: Efficient	26 (7.5)	56 (16.1)	32 (9.2)	109 (31.3)	33 (9.5)	92 (26.4)
Perspicuity: Clear	23 (6.6)	59 (17.0)	37 (10.6)	104 (29.9)	30 (8.6)	95 (27.3)
Total	91 (27.8)	237 (72.3)	128 (22.7)	436 (77.3)	137 (27.4)	363 (72.6)
Functionality						
Stimulation: Exciting	35 (10.1)	47 (13.5)	74 (21.3)	67 (19.3)	70 (20.1)	55 (15.8)
Stimulation: Interesting	34 (9.8)	48 (13.8)	63 (18.1)	78 (22.4)	65 (18.7)	60 (17.2)
Novelty: Inventive	35 (10.1)	47 (13.5)	71 (20.4)	70 (20.4)	62 (17.8)	63 (18.1)
Novelty: Leading Edge	34 (9.7)	48 (13.8)	68 (19.5)	73 (21.0)	61 (17.5)	64 (18.4)
Total	138 (42.1)	190 (57.9)	276 (48.9)	288 (51.1)	258 (51.6)	242 (48.4)

Note. Numbers in parentheses represent percentages.

For the usability construct, elementary and high school teachers are nearly even with 72.3% and 72.6% of teachers respectively viewing the Google Classroom LMS as usable. Likewise, 27.8% of elementary school teachers and 27.4% of high school teachers viewed the Google Classroom LMS as not usable. Middle school teachers viewed the usability of the Google Classroom LMS most favorably, with 77.3% of respondents and 22.7% of respondents reporting usable and unusable respectively.

For the functionality construct, elementary and middle school teachers reported that the Google Classroom LMS was functional, with 57.9 and 51.9% respectively. Likewise, 42.1% of elementary school teachers and 48.9% of middle school teachers viewed the Google Classroom as less functional. High school respondents viewed the Google Classroom LMS as least functional, with 51.6% of respondents answering negatively and 48.4% of respondents answering positively. Elementary and middle school teachers appear to have more consistently positive functionality and usability beliefs about the Google Classroom LMS than high school teachers.

The survey items that represented the five constructs (perceived ease of use, perceived usefulness, IT support, attitude towards use, and behavioral intention to use) were measured on a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree). The composite average score was computed for each participant by each construct. This resulted in each participant having five composite scores. The composite scores for perceived ease of use were disaggregated by ethnicity, race, gender, and school level, as shown in Table 9 (elementary schools), Table 10 (middle schools), and Table 11 (high schools).

Table 9

Descriptive Statistics for Perceived Ease of Use Perceptions for Elementary Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	44.28	8.60	73.91	0.01	-0.63
Gender					
Female	4.16	0.79	0.62	-0.93	0.32
Male	5.00	0.00	0.00	-	-
Ethnicity					
Hispanic	4.58	0.59	0.35	-	-
Non-Hispanic	4.18	0.79	0.63	-0.94	0.29
Race					
Asian	4.00	1.41	2.00	-	-
Black/African-American	4.00	1.41	2.00	-	-
White	4.22	0.74	0.55	-0.98	0.59
Other	2.00	-	-	-	-

Note. Totals reported are representative of all elementary school respondents (*n* = 82).

Table 9 shows the descriptive statistics for perceived ease of use perceptions by demographic variables for elementary school teachers. The mean age was 44 years. Males (M = 5.00) had a higher perception of perceived ease of use (PEU) than females (M = 4.16). Hispanics (M = 4.58) had higher perceptions of PEU than non-Hispanics (M = 4.18). The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of PEU scores. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values as well as Q-Q plots show that the PEU scores did have an approximate normal distribution, as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval). Similar trends can be seen in the distribution of PEU scores for middle and high school teachers. Table 10 shows the descriptive statistics for perceived ease of use perceptions by demographic variables for middle school teachers.

Table 10

Descriptive Statistics for Perceived Ease of Use Perceptions for Middle Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	45.40	9.24	85.3	-0.33	-0.13
Gender					
Female	4.38	.070	0.49	-1.62	3.03
Male	4.11	0.65	0.42	-0.56	0.07
Prefer not to Answer	3.00	0.00	0.00	-	-
Ethnicity					
Hispanic	3.93	1.36	1.86	-1.52	2.52
Non-Hispanic	4.32	0.67	0.45	-1.11	1.06
Race					
Asian	4.16	1.18	1.39	-	-
Black/African-American	4.17	0.86	0.73	-1.36	1.62
White	4.32	0.69	0.48	-1.29	1.89
American Indian or Alaskan Native	3.83	-	-	-	-
Other	4.67	0.58	0.33	-1.73	-

Note. Totals reported are representative of all middle school respondents (*n* = 141).

The mean age was 44 years. Females (*M* = 4.38) had a higher perception for PEU than males (*M* = 4.11). Hispanics had higher (*M* = 4.32) perceptions of PEU than non-Hispanics (*M*

= 3.93). The measures of dispersion (SD, variance, skewness and kurtosis) do indicate a negative skew (some PEU scores greater than the mean) in the distribution of PEU scores. The kurtosis values are not very large (less than ± 2) which suggests that heavy tails on either side of the distribution is not a major issue that needs further investigation. Table 11 shows the correlation coefficients for perceived ease of use perceptions by demographic variables for high school teachers.

Table 11

Descriptive Statistics for Perceived Ease of Use Perceptions for High Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	46.33	8.90	79.25	-.253	-.637
Gender					
Female	4.15	.820	.673	-1.414	2.098
Male	4.03	.711	.507	-.743	.775
Prefer not to Answer	4.00	0.00	0.00	-	-
Ethnicity					
Hispanic	5.00	.000	.000	-	-
Non-Hispanic	3.76	.971	.942	-.742	.070
Race					
Asian	4.08	1.06	1.12	-	-
Black/African- American	4.06	.818	.668	-1.82	5.19
White	4.11	.783	.613	-1.17	1.478
American Indian or Alaskan Native	3.67	.471	.222	-	-
Other	5.00	5.00	5.00	-	-

Note. Totals reported are representative of all high school respondents (*n* = 125).

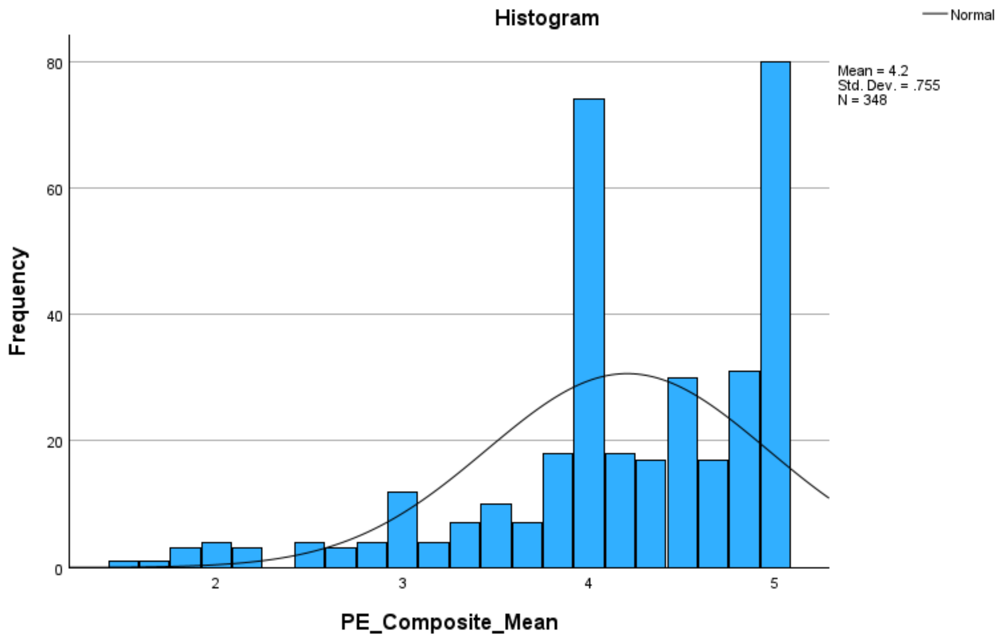
The mean age was 45 years. Females (*M* = 4.15) had a higher perception of PEU than males (*M* = 4.03). Hispanics (M = 5.00) had higher perception PEU than non-Hispanics (*M* = 3.76). The measures of dispersion (SD, variance, skewness, and kurtosis) do indicate a negative skew (some PEU scores greater than the mean) in the distribution of PEU scores. The kurtosis values are not very large (less than ± 2), which suggests that heavy tails on either side of the distribution is not a major issue that needs further investigation.

Overall, middle school respondents appeared to have a higher perception of the perceived ease of use of the Google Classroom LMS (*M* = 4.30), followed by elementary school respondents (*M* = 4.18) and high school respondents (*M* = 4.10). Across the grade levels, female respondents consistently had higher perceptions of perceived ease of use for Google Classroom LMS when compared to male respondents. Hispanic respondents reported higher scores (except middle school) across elementary and high school. Racially, minority respondents consistently had lower perceptions of the perceived ease of use of the Google Classroom LMS than white respondents. Black and Asian respondents had similar perceptions across the grade levels. American Indians or Alaskan Natives rated perceived ease of use the lowest in each grade level that they represented. These results show the differences of opinion amongst a diverse group of respondents and also highlight the differences between race and ethnicity. Figure seven shows the frequency of composite means for each respondent.

Figure 5 shows the overall composite mean for perceived ease of use (*M* = 4.20) is influenced by several outliers that create a negative skew. The histogram shows that the normal curve has shifted towards the right and is negatively skewed, which indicates that teachers have an overall positive perception for PEU for Google LMS usage.

Figure 5

Perceived Ease of Use Composite Mean Frequency Graph

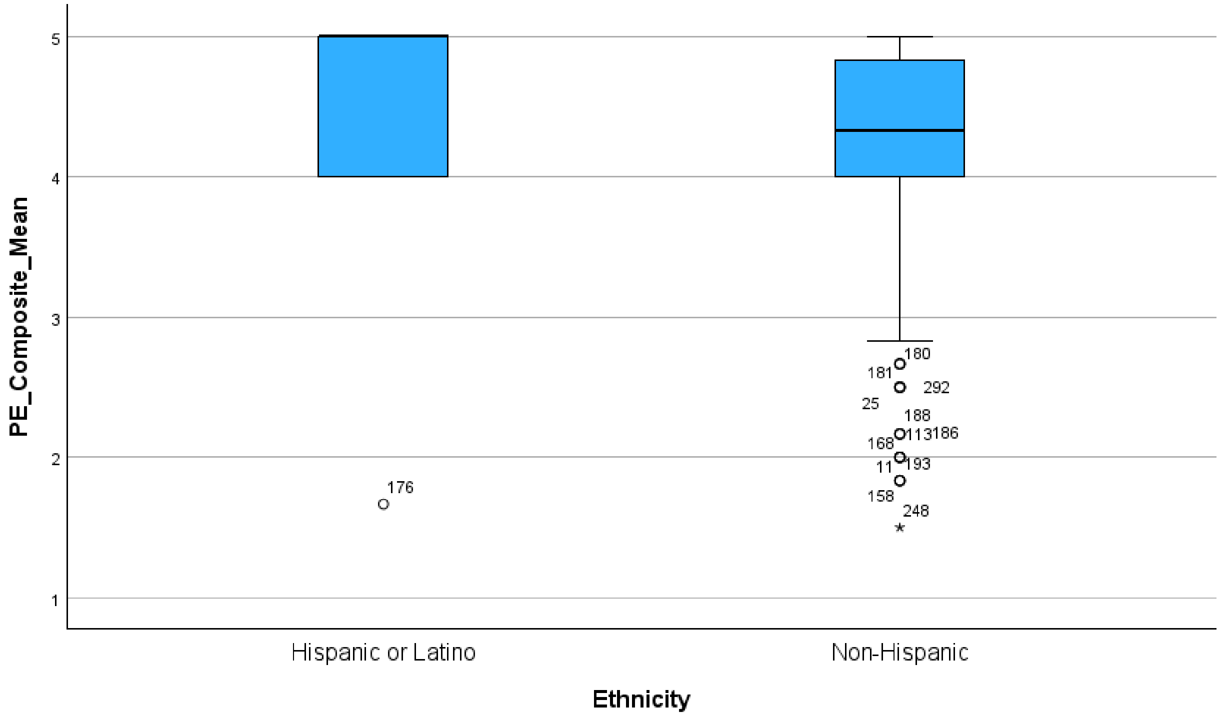


Note. Histogram with normal distribution curve for overall perceived ease of use composite mean scores. PE stands for perceived ease of use.

Figure 6 shows the distribution of PEU perception by ethnicity. The horizontal line inside the boxes shows the median value for that group (Hispanic or Non-Hispanic). The horizontal lines at the top and bottom of each box plot show the spread of PEU scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their PEU score is far away from the mean PEU score (usually ± 2 standard deviations from the mean).

Figure 6

Perceived Ease of Use Composite Mean by Ethnicity

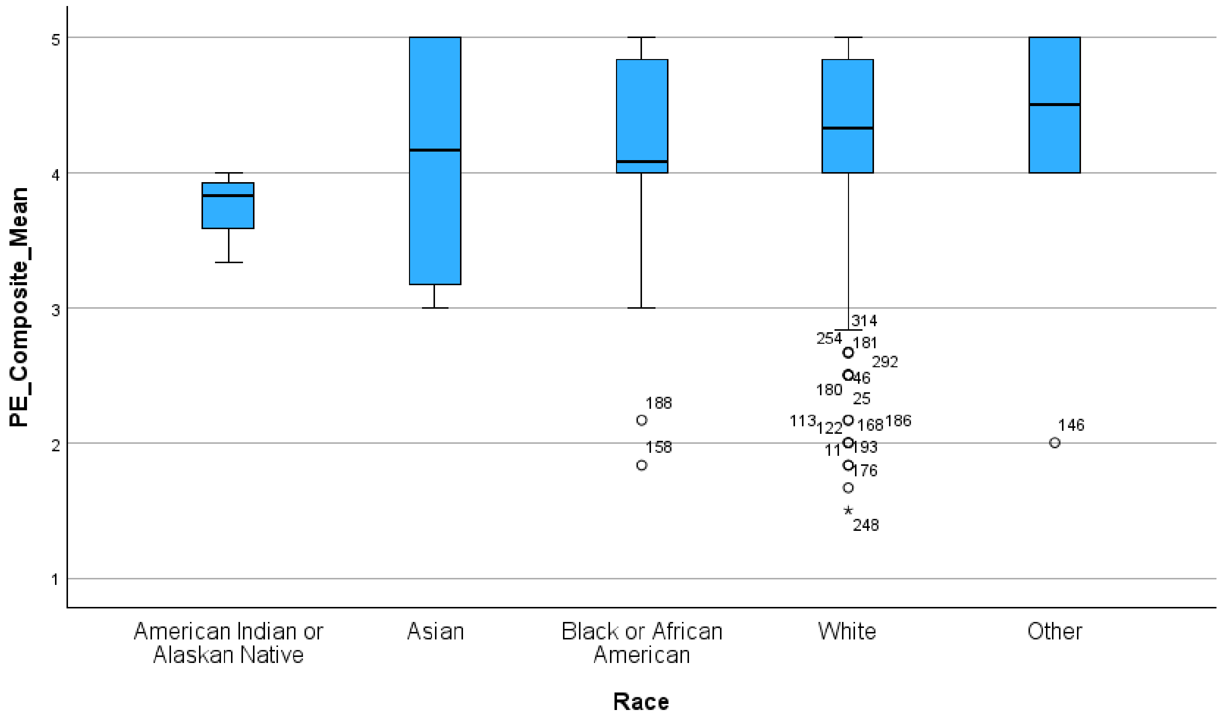


Note. Box plot with outliers for perceived ease of use composite means by ethnicity. PE stands for perceived ease of use.

The non-Hispanic group had only one extreme outlier, while the non-Hispanic group had 11 outliers, which are less than the median value. These case numbers are 11, 25, 113, 158, 168, 180, 181, 186, 188, 193, and 292. There were no outlier values which were greater than the median value. Figure 7 shows the distribution of PEU perception by race. The horizontal line inside the boxes shows the median value for that group (American Indian or Alaskan Native, Asian, Black or African American, White, or Other).

Figure 7

Perceived Ease of Use Composite Mean by Race



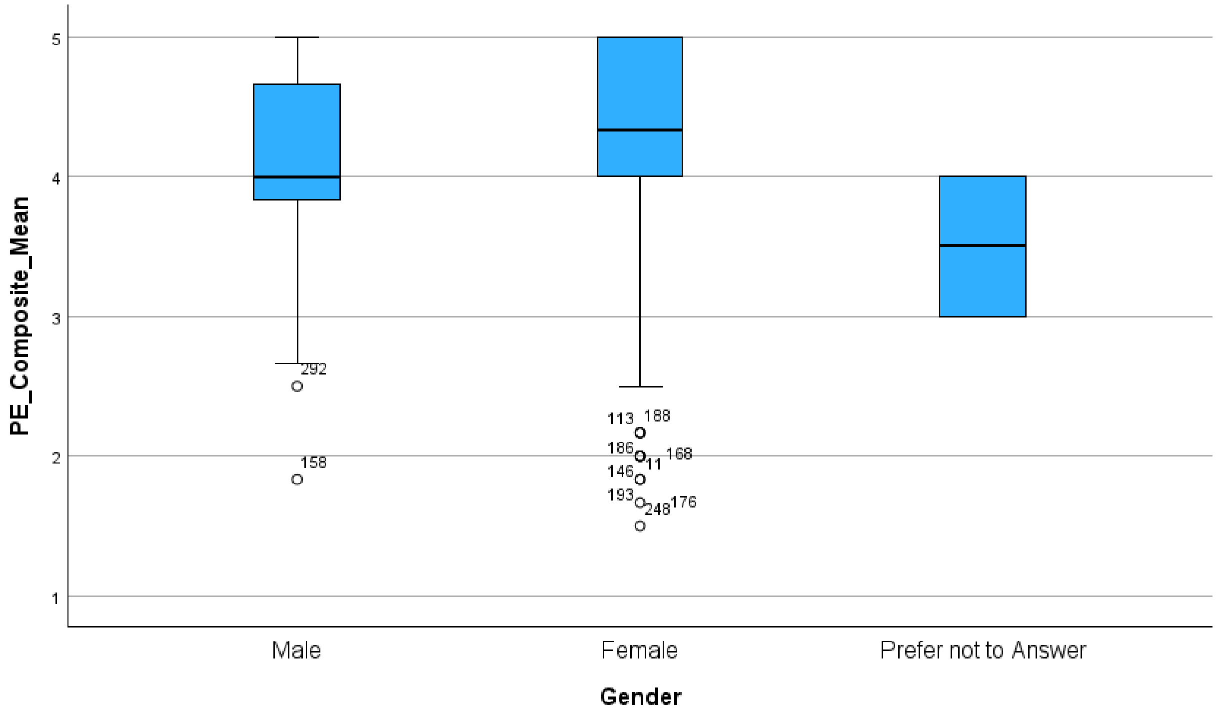
Note. Box plot with outliers for perceived ease of use composite means by race. PE stands for perceived ease of use.

The horizontal lines at the top and bottom of each box plot show the spread of PEU scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their PEU score is far away from the mean PEU score (usually ± 2 standard deviations from the mean). The White group had one extreme outlier and 14 total outliers which were less than the median value. These case numbers were 11, 24, 25, 46, 113, 122, 168, 176, 180, 181, 186, 193, 254, 292, and 315. The Black group had two outliers which were less than the median value. These case numbers were 158 and 188. The Other group had one outlier that was less than the median value. This case number was 146. There were no outliers which were greater than the median value.

Figure 8 shows the distribution of PEU perception by gender. The horizontal line inside the boxes shows the median value for that group (male, female, and prefer not to answer). The long tails on either side of the box plot show the spread of PEU scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their PEU score is far away from the mean PEU score (usually ± 2 standard deviations from the mean).

Figure 8

Perceived Ease of Use Composite Mean by Gender

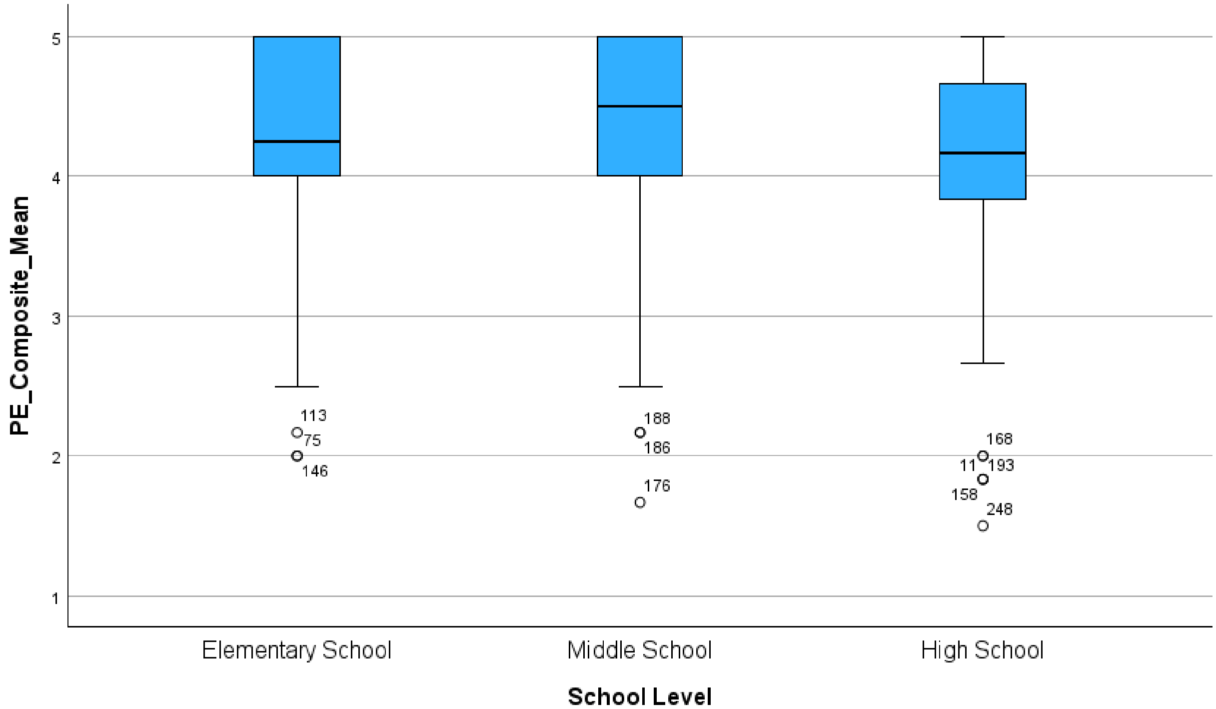


Note. Box plot with outliers for perceived ease of use composite means by gender. PE stands for perceived ease of use.

It can be seen that females had 14 total outliers which were less than the median value. These case numbers were 11, 113, 146, 168, 176, 186, 188, 193, and 248. The male group had two outliers which were less than the median value. These case numbers were 158 and 292. The prefer not to answer group had no outliers. There were no outliers which were greater than the median value. Figure 9 shows the distribution of PEU perception by school level. The horizontal line inside the boxes shows the median value for that group (elementary school, middle school, and high school).

Figure 9

Perceived Ease of Use Composite Mean by School Level



Note. Box plot with outliers for perceived ease of use composite means by school level. PE stands for perceived ease of use.

The long tails on either side of the box plot show the spread of PEU scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their PEU score is far away from the mean PEU score (usually ± 2 standard deviations from the mean). It can be seen that high school teachers had five total outliers which were less than the median value. These case numbers were 11, 158, 168, 193, and 248. The middle school group had three outliers which were less than the median value. These case numbers were 176, 186, and 188. The elementary school group had three outliers which were less than the median value. These case numbers were 75, 113, and 146. There were no outliers which were greater than the median value.

Table 12 shows the four different levels of correlation of the perceived ease of use composite mean with the composite mean of behavioral intention to use in elementary, middle, high school, and all respondents. Elementary school teachers (.715) perceived ease of use correlates most strongly with behavioral intention to use followed by high school (.679) and middle school (.654) teachers. Overall perceived ease of use correlation with behavioral intention to use (.680) is also statistically significant. This data highlights the statistically significant effect of perceived ease of use on behavioral intention to use.

Table 12

Perceived Ease of Use Correlation with Behavioral Intention to Use

	Correlation with Behavioral Intention to Use	Significance Test
Elementary School	.715	< .001
Middle School	.654	< .001
High School	.679	< .001
Overall	.680	< .001

Note. Perceived ease of use correlation with behavioral intention to use disaggregated by school level.

Perceived ease of use composite means for the Google Classroom LMS were calculated and disaggregated by ethnicity, race, gender, and school level. Hispanic respondents were found to have reported higher PEU perceptions than their non-Hispanic counterparts. PEU perceptions of White respondents were highest, while racial minorities, especially American Indians or native Alaskans and Black teachers, reported lower perceptions of perceived ease of use. Female respondents reported markedly higher perceived ease of use perceptions than male teachers. Middle school teachers perceived ease of use perceptions were followed by elementary and high school respectively. Finally, elementary school teacher perceived ease of use correlated more highly with behavioral intention to use than middle or high school respondents. Nevertheless, each school level's perceived ease of use showed a statistically significant correlation with behavioral intention to use as computed through bivariate correlation in SPSS.

Reported perceived ease of use data show that perceived ease of use has a positive correlation with behavioral intention to use. Perceived ease of use perceptions are influenced by demographic variables such as ethnicity, race, gender, and school level. It stands to reason that behavioral intention to use may also be affected by these variables. Perceived ease of use and behavioral intention to use are both complex constructs that have multiple factors able to influence them. While more variables can be studied in the future, the perceived ease of use of the Google Classroom LMS is directly correlated with behavioral intention to use the Google Classroom LMS.

The composite scores for perceived ease of usefulness (PU) were disaggregated by the ethnicity, race, gender, age, and school level as shown in Tables 13 (elementary schools), 14 (middle schools), and 15 (high schools). Table 13 shows the descriptive statistics for PU perceptions by demographic variables for elementary school teachers. The mean age was 44 years. Males (M = 5.00) had a higher perception of perceived ease of use (PU) than females (M = 4.05). Hispanics had higher (M = 4.42) perceptions of PU than non-Hispanics (M = 4.06). The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of PU scores. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values as well as Q-Q plots show that the PU scores did have an approximate normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval). Similar trends can be seen in the distribution of PU scores for middle and high school teachers.

Table 13

Descriptive Statistics for Perceived Usefulness Perceptions for Elementary Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	44.28	8.60	73.91	0.01	-0.63
Gender					
Female	4.05	0.81	0.66	-0.87	1.13
Male	5.00	0.00	0.00	-	-
Ethnicity					
Hispanic	4.42	0.82	0.68	-	-
Non-Hispanic	4.06	0.82	0.67	-0.89	1.01
Race					
Asian	4.33	0.47	0.22	-	-
Black/African- American	3.42	0.12	0.01	-	-
White	4.10	0.82	0.67	-1.00	1.36
Other	2.83	-	-	-	-

Note. Totals reported are representative of all elementary school respondents (n = 82).

Table 14 shows the descriptive statistics for PU perceptions by demographic variables for middle school teachers. The mean age was 45 years. Females (M = 4.02) had a higher perception for PU than males (M = 3.90). Non-Hispanics had higher (M = 3.99) perceptions of PU than Hispanics (M = 3.67). The measures of dispersion (SD, variance, skewness and kurtosis) do indicate a negative skew (some PU scores greater than the mean) in the distribution of PU scores. The kurtosis values are not very large (less than ± 2) which suggests that heavy tails on either side of the distribution is not a major issue that needs further investigation.

Table 14

Descriptive Statistics for Perceived Usefulness Perceptions for Middle Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	45.40	9.24	85.3	-0.33	-0.13
Gender					
Female	4.02	.85	0.72	-0.85	0.75
Male	3.90	0.76	0.58	-0.56	0.41
Prefer not to Answer	3.00	0.00	0.00	-	-
Ethnicity					
Hispanic	3.67	1.61	2.61	-0.86	-1.19
Non-Hispanic	3.99	0.79	0.63	-0.64	0.35
Race					
Asian	4.08	1.06	1.13	-	-
Black/African- American	3.71	0.92	0.85	-0.18	-0.97
White	4.00	0.80	0.64	-0.82	1.05
American Indian or Alaskan Native	2.17	-	-	-	-
Other	5.00	0.00	0.00	-	-

Note. Totals are representative of all middle school respondents (*n* = 141).

Table 15 shows the descriptive statistics for PU perceptions by demographic variables for high school teachers. The mean age was 46 years. Females (*M* = 3.79) had a slightly higher perception of PU than males (*M* = 3.77). Hispanics (*M*= 4.75) had a higher perception of PU than non-Hispanics (*M* = 3.78). The measures of dispersion (SD, variance, skewness, and kurtosis) do indicate a negative skew (some PEU scores greater than the mean) in the distribution of PEU scores. The kurtosis values are not very large (less than ± 2) which suggests that heavy tails on either side of the distribution is not a major issue that needs further investigation.

Table 15

Descriptive Statistics for Perceived Usefulness Perceptions for High Schools

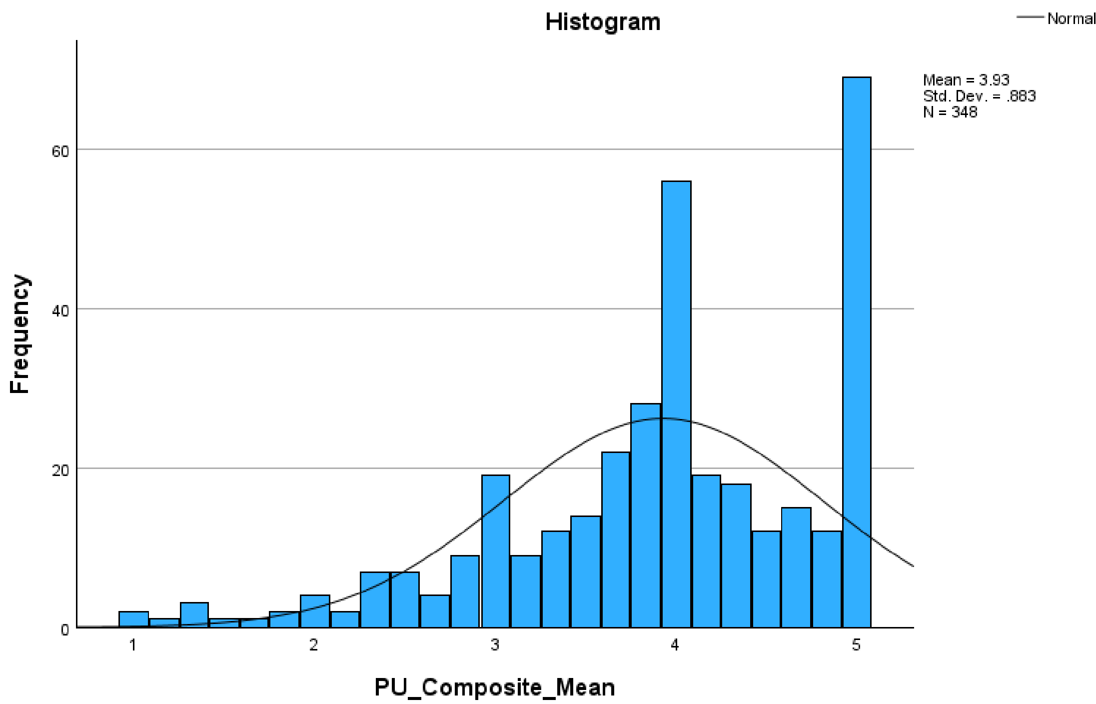
Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	46.33	8.90	79.25	-.253	-.637
Gender					
Female	3.79	0.97	0.93	-0.57	-0.47
Male	3.77	1.00	1.00	-1.06	1.00
Prefer not to Answer	3.83	-	-	-	-
Ethnicity					
Hispanic	4.75	0.35	0.13	-	-
Non-Hispanic	3.78	0.97	0.94	-0.74	0.09
Race					
Black/African- American	3.78	1.00	.99	-0.45	-0.81
White	3.80	0.98	0.96	-0.83	0.26
American Indian or Alaskan Native	3.5	0.71	0.50	-	-
Other	3.25	1.30	1.69	-	-

Note. Totals are representative of all high school respondents (*n* = 125).

As seen in Figure 10, the overall composite mean for PU (*M* = 3.93) is influenced by several outliers that create a negative skew. The histogram shows that the normal curve has shifted towards the right and is negatively skewed, indicating that teachers have an overall positive perception for PU for Google LMS usage.

Figure 10

Perceived Usefulness Composite Mean Frequency Graph

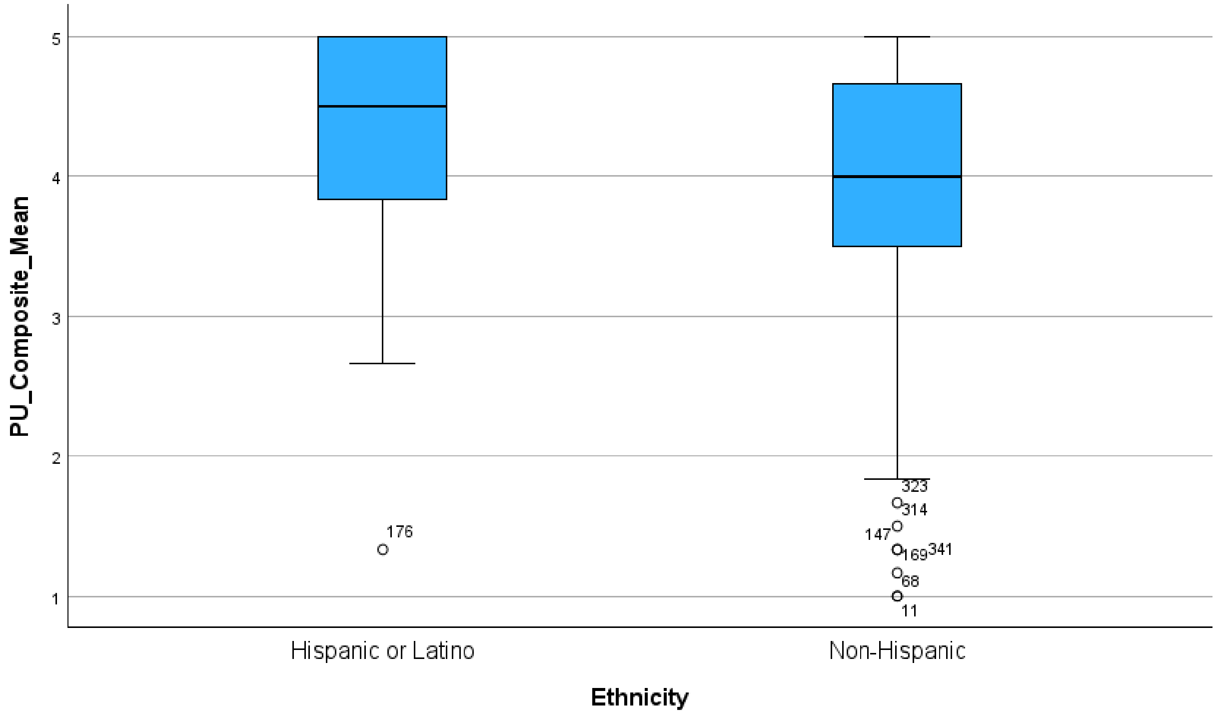


Note. Perceived usefulness frequency graph for all Modified TAM Survey respondents.

Figure 11 shows the distribution of PU perception by ethnicity. The horizontal line inside the boxes shows the median value for that group (Hispanic or Non-Hispanic). The long tails on either side of the box plot show the spread of PU scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their PU score is far away from the mean PU score (usually ± 2 standard deviations from the mean). It can be seen that non-Hispanics have seven outliers which are less than the median value. These case numbers are 11, 68, 147, 169, 314, 323, and 341. Hispanics have one outlier, case number 176. There were no outlier values which were greater than the median value.

Figure 11

Perceived Usefulness Composite Means by Ethnicity

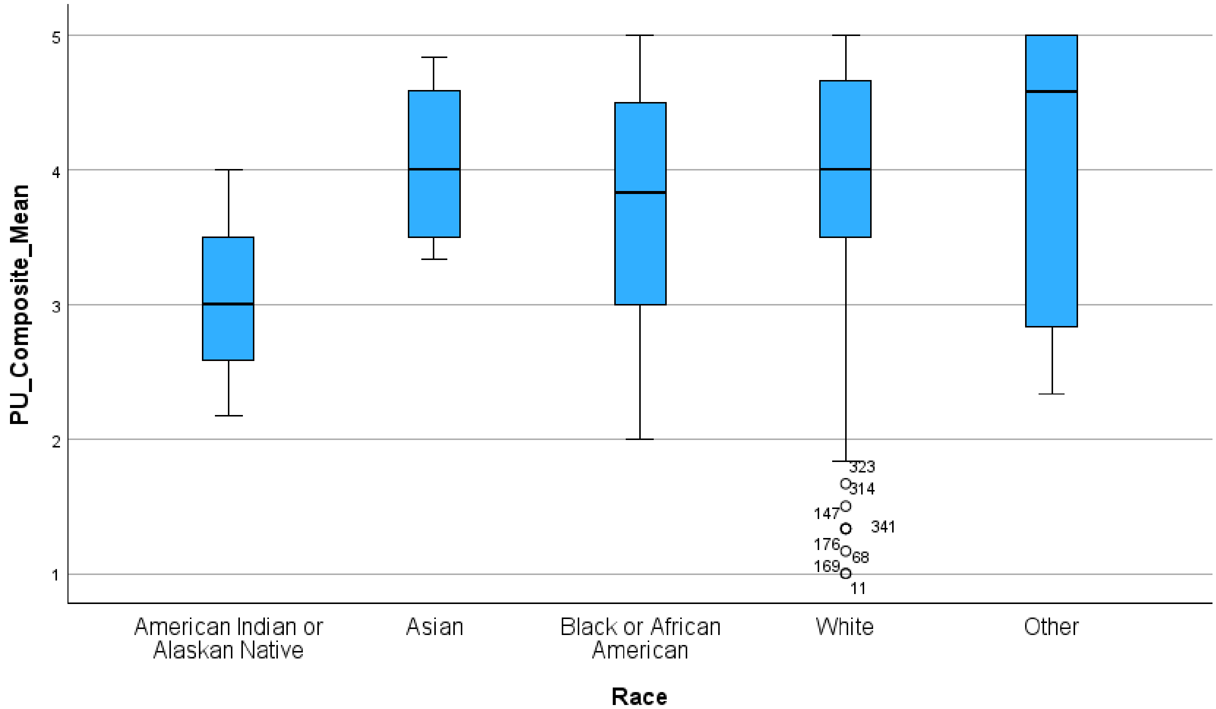


Note. Box plot with outliers for perceived usefulness composite means by ethnicity.

Figure 12 shows the distribution of PU perception by race. The horizontal line inside the boxes shows the median value for that group (American Indian or Alaskan Native, Asian, Black or African American, White, or Other). The horizontal lines at the top and bottom of each box plot show the spread of PU scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their PU score is far away from the mean PU score (usually ± 2 standard deviations from the mean). It can be seen that Whites have eight outliers which are less than the median value. These case numbers are 11, 68, 147, 169, 176, 314, 323, and 341. No other categories have outliers. There were no outlier values which were greater than the median value.

Figure 12

Perceived Usefulness Composite Means by Race

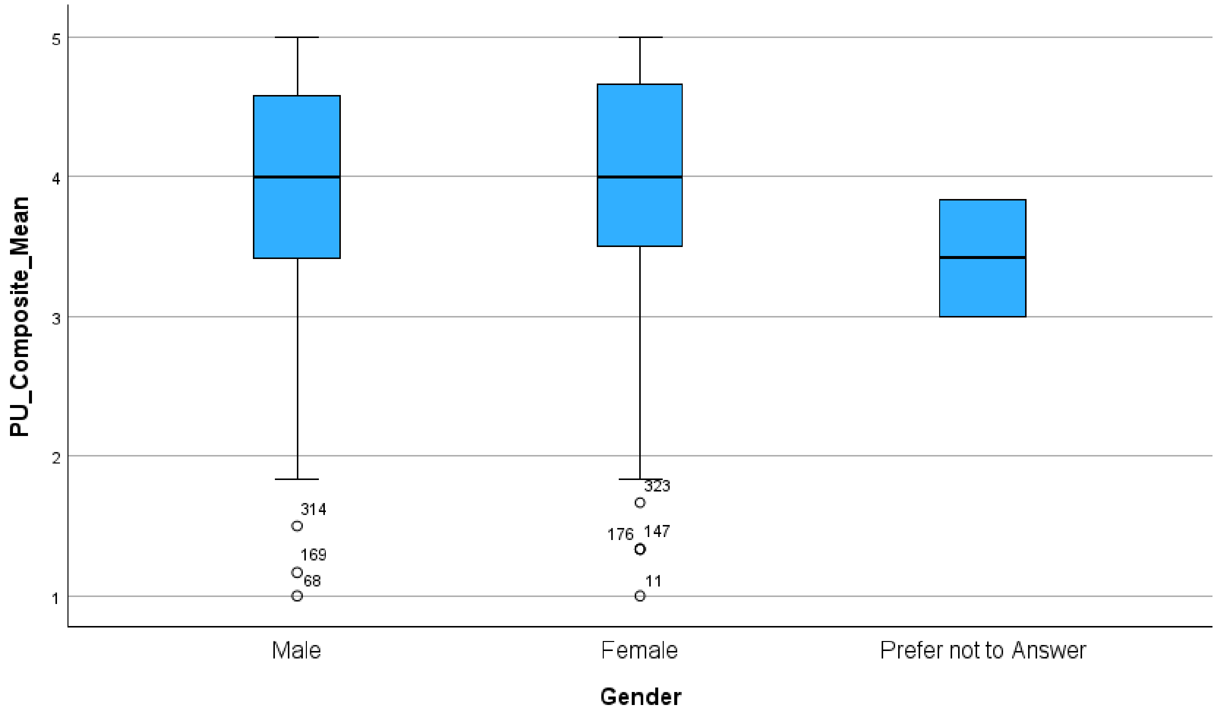


Note. Box plot with outliers for perceived usefulness composite means by race.

Figure 13 shows the distribution of PU perception by gender. The horizontal line inside the boxes shows the median value for that group (Male, Female, or Prefer not to Answer). The long tails on either side of the box plot show the spread of PU scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their PU score is far away from the mean PU score (usually ± 2 standard deviations from the mean). It can be seen that females have four outliers which are less than the median value. These case numbers are 11, 147, 176, and 323. Males have three outliers. The case numbers are 68, 169, and 314. There were no outlier values which were greater than the median value.

Figure 13

Perceived Usefulness Composite Mean by Gender

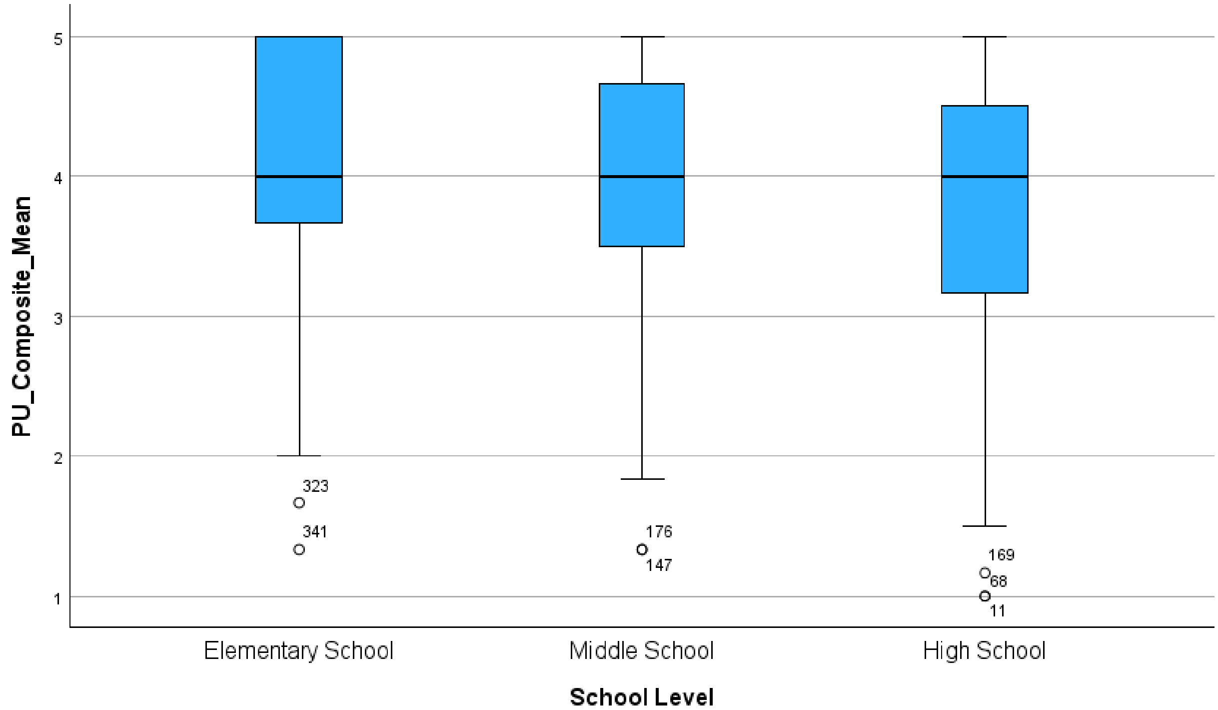


Note. Box plot with outliers for perceived usefulness composite means by gender.

Figure 14 shows the distribution of PU perception by school level. The horizontal line inside the boxes shows the median value for that group (elementary school, middle school, and high school). The long tails on either side of the box plot show the spread of PU scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their PU score is far away from the mean PU score (usually ± 2 standard deviations from the mean). It can be seen that high school teachers have three outliers which are less than the median value. These case numbers are 11, 147, 176, and 323. Males have three outliers. The case numbers are 11, 68, and 169. Middle school teachers have two outliers. Those case numbers were 147 and 167. Elementary school teachers have two outliers. Those case numbers were 323 and 341. There were no outlier values which were greater than the median value.

Figure 14

Perceived Usefulness Composite Mean by School Level



Note. Box plot with outliers for perceived usefulness composite means by school level.

Table 16 represents the correlations between perceived usefulness and behavioral intention to use in elementary school, middle school, high school, and overall. Each correlation is statistically significant and highlights the positive correlation that perceived usefulness has on behavioral intention to use. High school respondents (.675) have the highest correlation, with middle school respondents (.659) and elementary school respondents (.628) following. The overall correlation for all three grade levels (.656) is statistically significant, as well. These data suggest that higher perceived usefulness perceptions of the Google Classroom LMS result in higher behavioral intention to use the Google Classroom LMS.

Table 16

Perceived Usefulness Correlation with Behavioral Intention to Use

	Correlation with Behavioral Intention to Use	Significance Test
Elementary School	.628	< .001
Middle School	.659	< .001
High School	.675	< .001
Overall	.656	< .001

Note. Perceived usefulness correlation with behavioral intention to use disaggregated by school level.

Much like perceived ease of use, high school teachers correlated more strongly with behavioral intention to use than middle or elementary school teachers. This suggests that high school teachers may be more accurate with their reflection on the Google Classroom LMS than their counterparts. This data shows that perceived usefulness does have an effect on behavioral intention to use and that its effect is both notable and significant. Teachers who view the Google Classroom LMS as usable report that they are more likely to make plans to use it.

Perceived usefulness perceptions are affected by a number of variables such as ethnicity, gender, race, and school level. The trend of Hispanic or Latino respondents perceiving the Google Classroom LMS more favorably than their non-Hispanic or Latino counterparts continues with perceived usefulness. A notable difference from perceived ease of use, the racial minority Asian category rated the perceived usefulness of the Google Classroom LMS more highly than any other racial group. American Indian or Alaskan Native respondents continued to rate the Google Classroom LMS more negatively than other racial groups, while Black respondents also continued to rate it lowly. Female respondents perceived the usefulness of the Google Classroom LMS more highly than males and prefer not to answer counterparts. Elementary school respondents perceived that the Google Classroom LMS was more usable than did their middle and high school peers. High school respondents continued to perceive the Google Classroom LMS lower than did other levels.

Perceived usefulness correlated positively, and in a statistically significant manner, with behavioral intention to use for the Google Classroom LMS. The correlational data showed that perceived usefulness directly influenced behavioral intention to use, indicating that teachers who viewed the Google Classroom LMS as usable were more likely to make plans to use Google Classroom. While high school respondents perceived the usability of Google Classroom lower than middle and elementary, their correlation with behavioral intention to use was strongest and possibly indicates that high school teachers have a more thorough understanding of the Google Classroom LMS.

The composite scores for IT support perceptions were disaggregated by ethnicity, race, gender, and school level as shown in Tables 17 (elementary schools), 18 (middle schools), and 19 (high schools).

Table 17

Descriptive Statistics for Information Technology Support Perceptions for Elementary Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	44.28	8.60	73.91	0.01	-0.63
Gender					
Female	4.20	0.81	0.66	-0.87	1.13
Male	5.00	0.00	0.00	-	-
Ethnicity					
Hispanic	2.88	0.82	0.68	-	-
Non-Hispanic	4.25	0.82	0.67	-0.89	1.01
Race					
Asian	4.35	0.47	0.22	-	-
Black/African- American	4.18	0.12	0.01	-	-
White	4.24	0.82	0.67	-1.00	1.36
Other	2.53	-	-	-	-

Note. Totals are representative of all elementary school respondents (n = 82).

Table 17 shows the descriptive statistics for IT support perceptions by demographic variables for elementary school teachers. The mean age was 44 years. Males (*M* = 5.00) had a higher perception of IT support than females (*M* = 4.20). Non-Hispanics (M = 4.25) had higher perceptions of IT support than Hispanics (*M* = 2.88). The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of IT support scores. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the assumption of normally distributed data was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the IT support scores had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval). Similar trends can be seen in the distribution of IT support scores for middle and high school teachers.

Table 18 shows the descriptive statistics for IT support perceptions by demographic variables for elementary school teachers. The mean age was 45 years. Males (*M* = 4.36) had a higher perception of IT support than females (*M* = 4.18). Non-Hispanics (*M* = 4.24) had higher perceptions of IT support than Hispanics (*M* = 3.63).

Table 18

Descriptive Statistics for Perceived Ease of Use Perceptions for Middle Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	45.40	9.24	85.3	-0.33	-0.13
Gender					
Female	4.18	.070	0.49	-1.62	3.03
Male	4.36	0.65	0.42	-0.56	0.07
Prefer not to Answer	3.00	0.00	0.00	-	-
Ethnicity					
Hispanic	3.63	1.36	1.86	-1.52	2.52
Non-Hispanic	4.24	0.67	0.45	-1.11	1.06
Race					
Asian	4.41	1.18	1.39	-	-
Black/African- American	4.00	0.86	0.73	-1.36	1.62
White	4.24	0.69	0.48	-1.29	1.89
American Indian or Alaskan Native	3.94	-	-	-	-
Other	4.33	0.58	0.33	-1.73	-

Note. Totals are representative of all middle school respondents (*n* = 141)

The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of IT support scores. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values as well as Q-Q plots, show that the IT support scores had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval). Similar trends can be seen in the distribution of IT support scores for high school teachers.

Table 19 shows the descriptive statistics for IT support perceptions by demographic variables for elementary school teachers. The mean age was 46 years. Males (*M* = 4.03) had a higher perception of IT support than females (*M* = 4.00). Hispanics (*M* = 4.03) had higher perceptions of IT support than non-Hispanics (*M* = 4.02).

Table 19

Descriptive Statistics for Perceived Ease of Use Perceptions for High Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	46.33	8.90	79.25	-.253	-.637
Gender					
Female	4.00	.820	.673	-1.414	2.098
Male	4.03	.711	.507	-.743	.775
Prefer not to Answer	4.12	0.00	0.00	-	-
Ethnicity					
Hispanic	4.03	.000	.000	-	-
Non-Hispanic	4.02	.971	.942	-.742	.070
Race					
Black/African- American	3.89	.818	.668	-1.82	5.19
White	4.05	.783	.613	-1.17	1.478
American Indian or Alaskan Native	3.88	.471	.222	-	-
Other	3.47	5.00	5.00	-	-

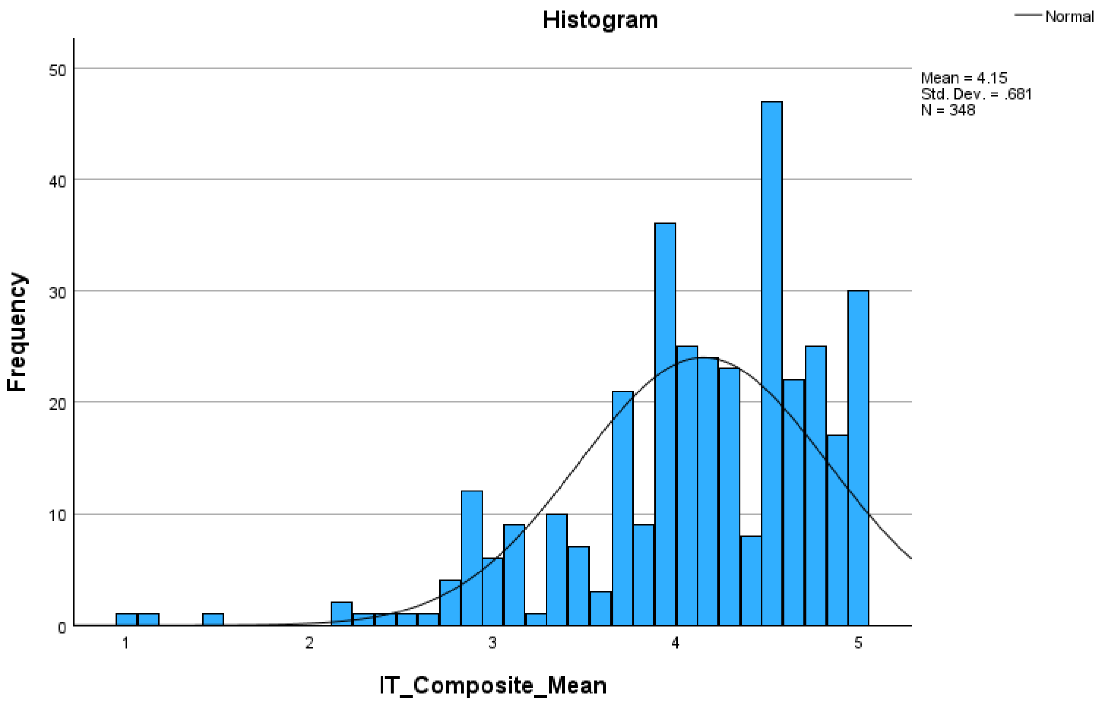
Note. Totals are representative of all high school respondents (n = 125).

The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of IT support scores. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the IT support scores had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval).

As seen in Figure 15, the overall composite mean for IT support (M = 4.15) is influenced by several outliers that create a negative skew. The histogram shows that the normal curve has shifted towards the right and is negatively skewed.

Figure 15

IT Support Composite Mean Frequency Graph

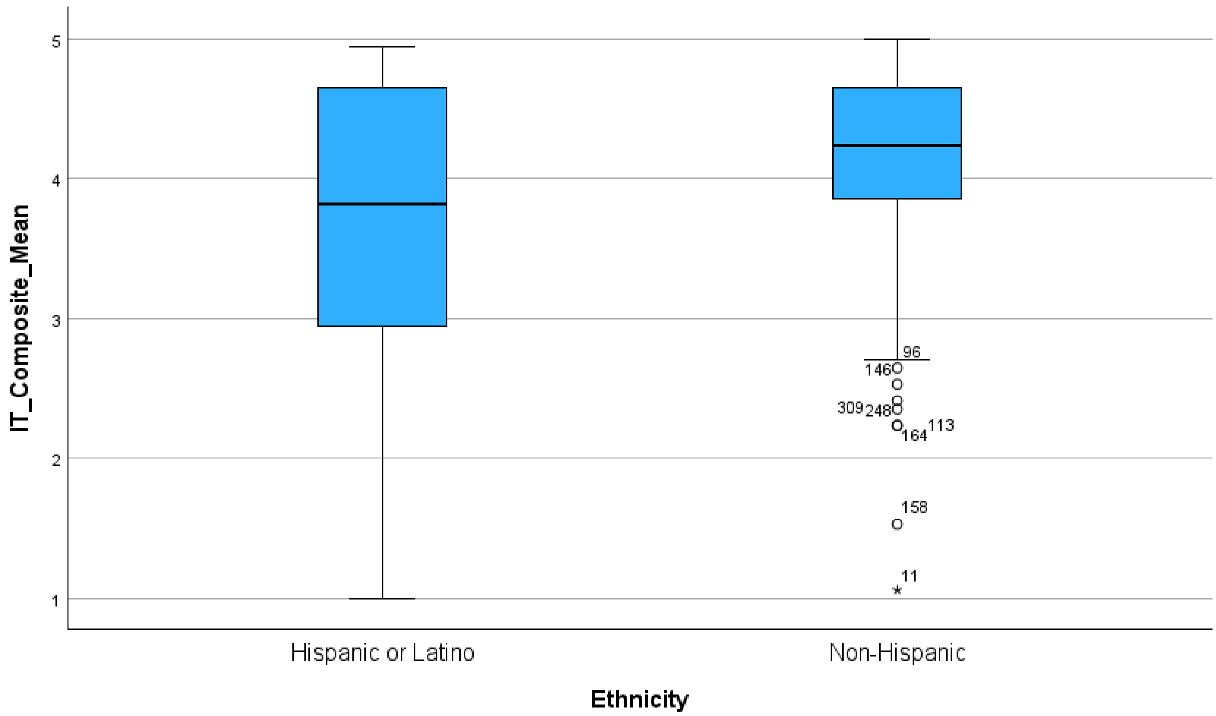


Note. Histogram with normality curve for information technology support composite means.

The skew indicates that teachers have an overall positive perception for the IT support that they received. Figure 16 shows the distribution of IT Support perception by ethnicity. The horizontal line inside the boxes shows the median value for that group (Hispanic or Non-Hispanic). The long tails on either side of the box plot show the spread of IT support scores for each group.

Figure 16

IT Support Composite Means by Ethnicity

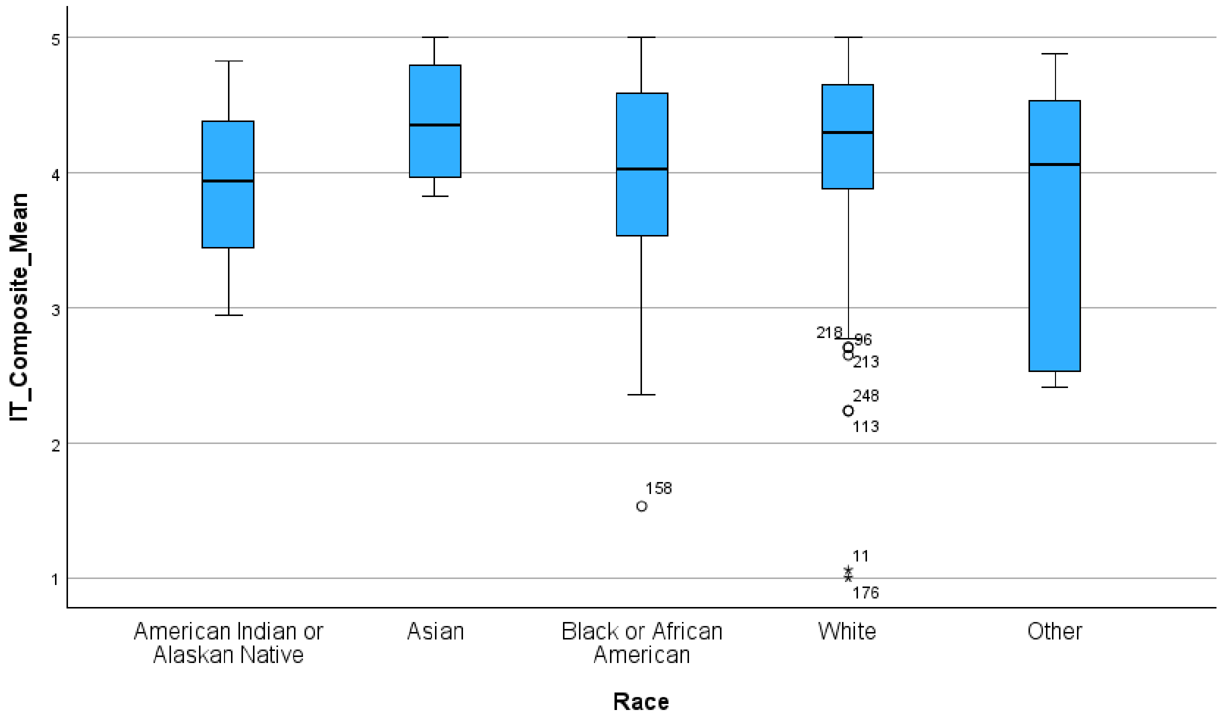


Note. Box plot with outliers for information technology support composite means by ethnicity.

The dots indicate the case numbers (or individuals) who are outliers, meaning that their IT support score is far away from the mean IT support score (usually ± 2 standard deviations from the mean). The non-Hispanic category has one extreme outlier, case number is number 11. It can be seen that non-Hispanics have eight total outliers which are less than the median value. These case numbers are 11, 96, 113, 146, 158, 164, 248, and 309. Hispanics have no outliers. There were no outlier values which were greater than the median value. Figure 17 shows the distribution of IT support perception by race. The horizontal line inside the boxes shows the median value for that group (American Indian or Alaskan Native, Asian, Black or African American, White, or Other).

Figure 17

IT Composite Mean by Race

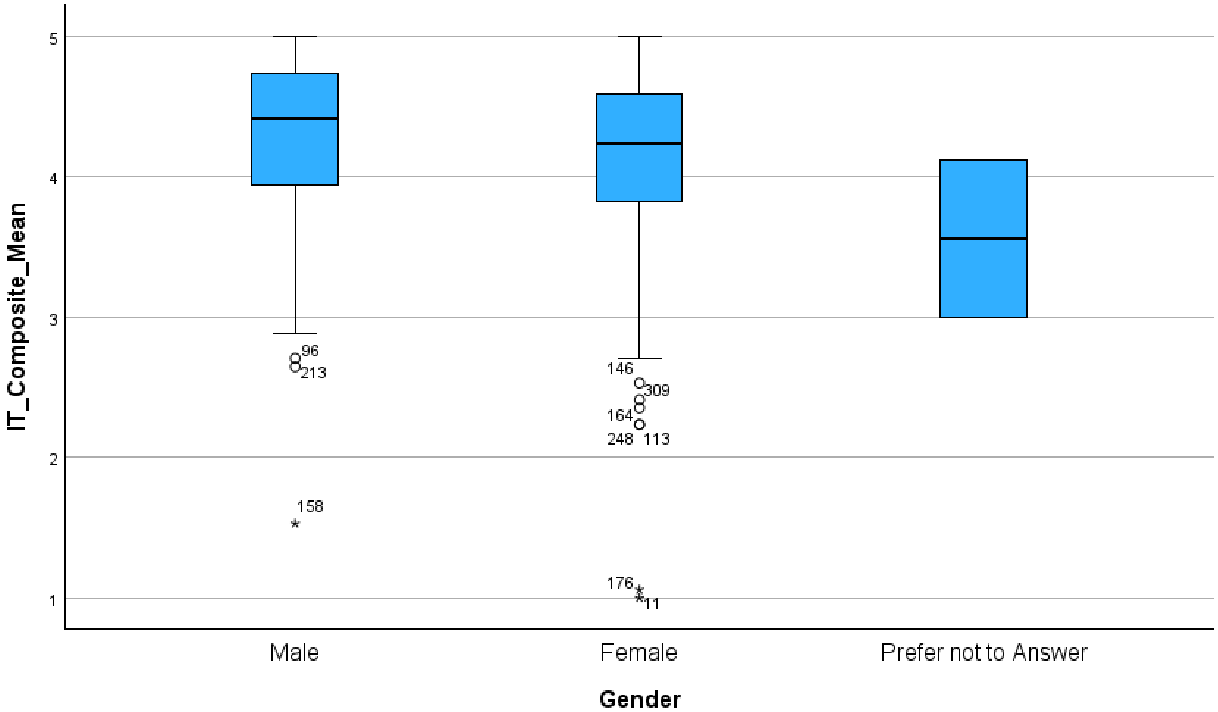


Note. Box plot with outliers for information technology support composite means by race.

The long tails on either side of the box plot show the spread of IT support scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their IT support score is far away from the mean IT score (usually ± 2 standard deviations from the mean). It can be seen that Whites have two extreme outliers which are less than the median value, case numbers 176 and 11. Overall, the White category has seven outliers. These case numbers are 11, 96, 113, 176, 213, 218, 248, 323, and 341. The Black category only has one outlier, case number 158. There were no outlier values which were greater than the median value. Figure 18 shows the distribution of IT support perception by gender. The horizontal line inside the boxes shows the median value for that group (male, female, and prefer not to answer). The long tails on either side of the box plot show the spread of IT support scores for each group.

Figure 18

IT Composite Mean by Gender

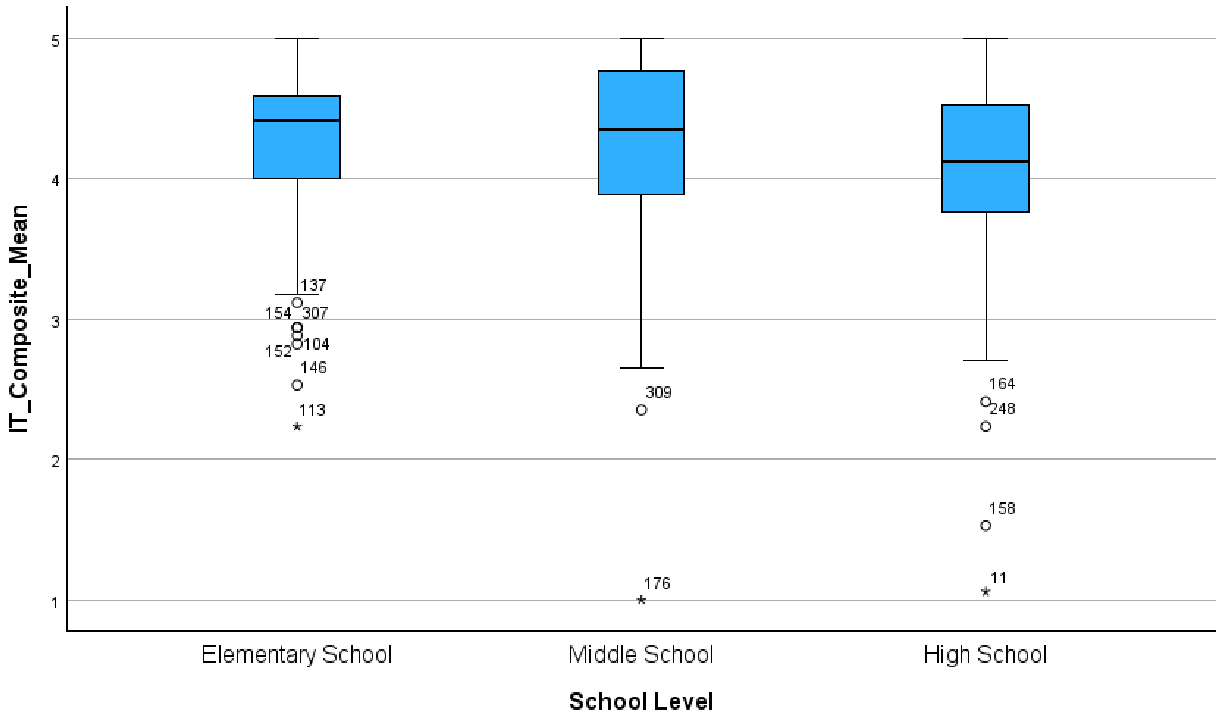


Note. Box plot with outliers for information technology support composite means by gender.

The dots indicate the case numbers (or individuals) who are outliers, meaning that their IT support score is far away from the mean IT score (usually ± 2 standard deviations from the mean). It can be seen that females have two extreme outliers which are less than the median value. These case numbers are 176 and 11. Overall, the female category has seven outliers. These case numbers are 11, 113, 146, 164, 176, 248, and 309. The male category has one extreme outlier. The case number is 158. The total number of outliers for the male category is three. The case numbers are 96, 158, and 213. There were no outlier values which were greater than the median value. Figure 19 shows the distribution of IT support perception by school level. The horizontal line inside the boxes shows the median value for that group (elementary school, middle school, and high school).

Figure 19

IT Support Composite Mean by School Level



Note. Box plot with outliers for information technology support by school level.

The long tails on either side of the box plot show the spread of IT support scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their IT support score is far away from the mean IT score (usually ± 2 standard deviations from the mean). It can be seen that elementary, middle, and high schools each had extreme outliers which were less than the median value. These case numbers were 113, 176, and 11 respectively. Overall, the elementary category had seven outliers. These case numbers are 104, 113, 137, 146, 152, 154, and 307. The middle school category had two total outliers. The case numbers were 176 and 309. The total number of outliers for the high school category was four. The case numbers were 11, 158, 164, and 248. There were no outlier values which were greater than the median value.

IT support perceptions are affected by a number of variables, such as ethnicity, gender, race, and school level. The trend of Hispanic or Latino respondents perceiving more favorably than their Non-Hispanic or Latino counterparts did not continue with IT support perceptions. A notable difference from perceived ease of use and perceived usefulness data, the Hispanic or Latino respondents viewed their IT support less favorably than did their non-Hispanic or Latino counterparts. The racial minority Asian category rated their IT support perceptions more highly than any other racial group. This is a shared trend with perceived usefulness. American Indian or Alaskan Native respondents continued to perceive more negatively than other racial groups while Black respondents also continued lower perceptions. Male respondents perceived their IT support more highly than their female and prefer not to answer counterparts. Elementary school respondents perceived their IT support more highly than did their middle and high school peers. High school respondents continued to rate items lower than did other levels.

The composite scores for attitudes towards use were disaggregated by the ethnicity, race, gender, and school level as shown in Tables 20 (elementary schools), 21 (middle schools), and 22 (high schools). Table 20 shows the descriptive statistics for attitudes towards use by demographic variables for elementary school teachers. The mean age was 44 years. Males (M = 4.6) had a higher perception of attitudes towards use than females (M = 4.03). Non-Hispanics (M = 4.05) had higher attitudes towards use than Hispanics (M = 3.8).

Table 20

Descriptive Statistics for Attitudes Towards Use Perceptions for Elementary Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	44.28	8.60	73.91	0.01	-0.63
Gender					
Female	4.03	0.85	0.72	-1.10	1.35
Male	4.60	0.57	0.32	-	-
Ethnicity					
Hispanic	3.80	0.85	0.72	-	-
Non-Hispanic	4.05	0.85	0.72	-1.14	1.46
Race					
Asian	3.60	1.70	2.88	-	-
Black/African-American	3.60	0.85	0.72	-	-
White	4.08	0.83	0.69	-1.24	1.95
Other	3.20	-	-	-	-

Note. Totals are representative of all elementary school respondents (*n* = 82).

The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of attitudes towards use. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the attitudes towards use had an approximately normal distribution, as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval). Similar trends can be seen in the distribution of attitudes towards use for middle and high school teachers.

Table 21 shows the descriptive statistics for attitudes towards use by demographic variables for elementary school teachers. The mean age was 45 years. Males (*M* = 4.14) had a lower perception of attitudes towards use than females (*M* = 4.21). Non-Hispanics (M = 4.20) had higher attitudes towards use than Hispanics (*M* = 3.70).

Table 21

Descriptive Statistics Attitudes Towards Use Perceptions for Middle Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age					
Gender	45.40	9.24	85.3	-0.33	-0.13
Female					
Male	4.21	0.82	0.68	-1.55	2.79
Prefer not to Answer	4.14	0.78	0.61	-0.86	0.48
Ethnicity	3.00	0.00	0.00	-	-
Hispanic					
Non-Hispanic	3.70	1.73	2.99	-1.26	0.51
Race	4.20	0.78	0.59	-1.18	1.35
Asian	4.41	1.18	1.39	-	-
Black/African- American	4.00	0.86	0.73	-1.36	1.62
White	4.24	0.69	0.48	-1.29	1.89
American Indian or Alaskan Native	3.94	-	-	-	-
Other	4.33	0.58	0.33	-1.73	-

Note. Totals are representative of all middle school respondents (*n* = 141).

The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of attitudes towards use scores. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the attitudes towards use had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval). Similar trends can be seen in the distribution of attitudes towards use scores for middle and high school teachers.

Table 22 shows the descriptive statistics for attitudes towards use by demographic variables for elementary school teachers. The mean age was 46 years. Males (M = 3.97) had a lower attitude towards use than females (M = 4.05). Non-Hispanics (M = 4.00) had higher attitudes towards use than Hispanics (M = 5.00).

Table 22

Descriptive Statistics for Attitudes towards Use for High Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	46.33	8.90	79.25	-.253	-.637
Gender					
Female	4.05	0.74	0.54	-0.83	0.94
Male	3.97	0.89	0.80	-0.82	0.03
Prefer not to Answer	4.20	0.00	0.00	-	-
Ethnicity					
Hispanic	5.00	.000	.000	-	-
Non-Hispanic	4.00	.0.79	.62	-.854	0.58
Race					
Black/African- American	3.89	.818	.668	-1.82	5.19
White	4.05	.783	.613	-1.17	1.478
American Indian or Alaskan Native	3.88	.471	.222	-	-
Other	3.47	5.00	5.00	-	-

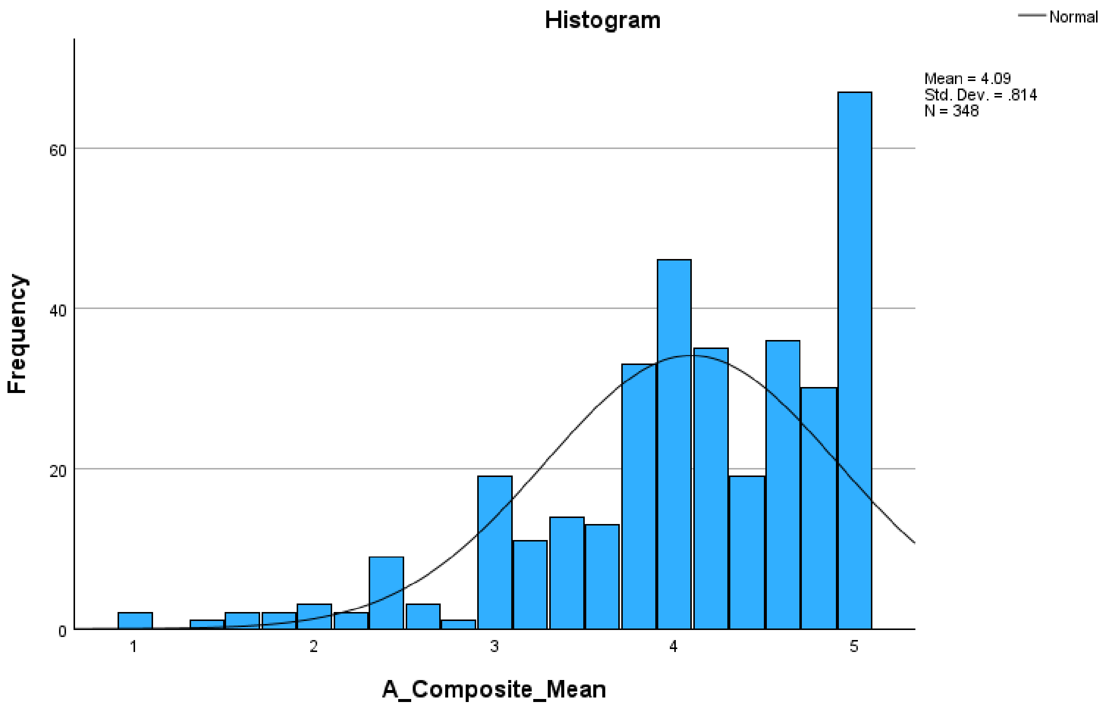
Note. Totals are representative of all high school respondents (*n* = 125).

The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of attitudes towards use. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the attitudes towards use had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval). Similar trends can be seen in the distribution of attitudes towards use for middle and high school teachers.

As seen in Figure 20, the overall composite mean for attitudes towards use (M = 4.09) is influenced by several outliers that create a negative skew. The histogram shows that the normal curve has shifted towards the right and is negatively skewed. It indicates that teachers have an overall positive attitude towards use.

Figure 20

Attitude Towards Use Composite Mean

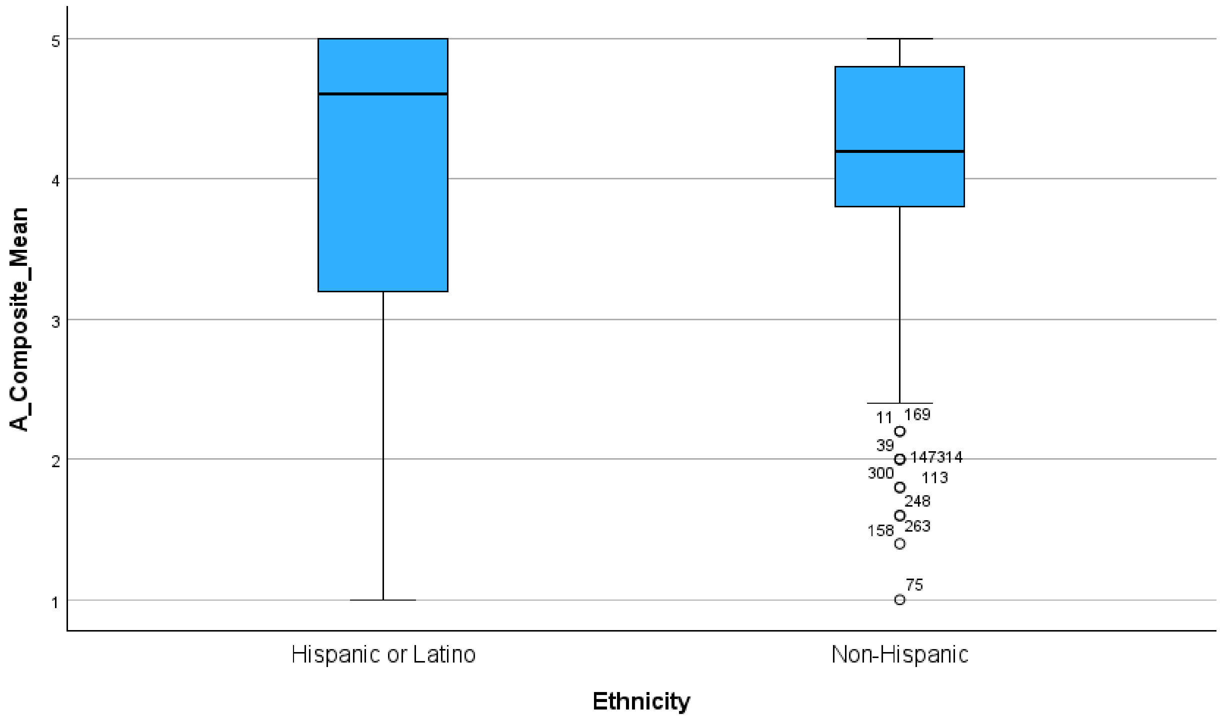


Note. Histogram with normality curve for attitudes towards use composite means.

Figure 21 shows the distribution of attitudes towards use by ethnicity. The horizontal line inside the boxes shows the median value for that group (Hispanic or Non-Hispanic). The long tails on either side of the box plot show the spread of attitudes towards use scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their attitudes towards use is far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that the non-Hispanic group had eleven total outliers, which are less than the median value. These case numbers are 11, 39, 75, 113, 147, 158, 169, 248, 263, 300, and 314. Hispanics have no outliers. There were no outlier values which were greater than the median value.

Figure 21

Attitudes Towards Use Composite Mean by Ethnicity

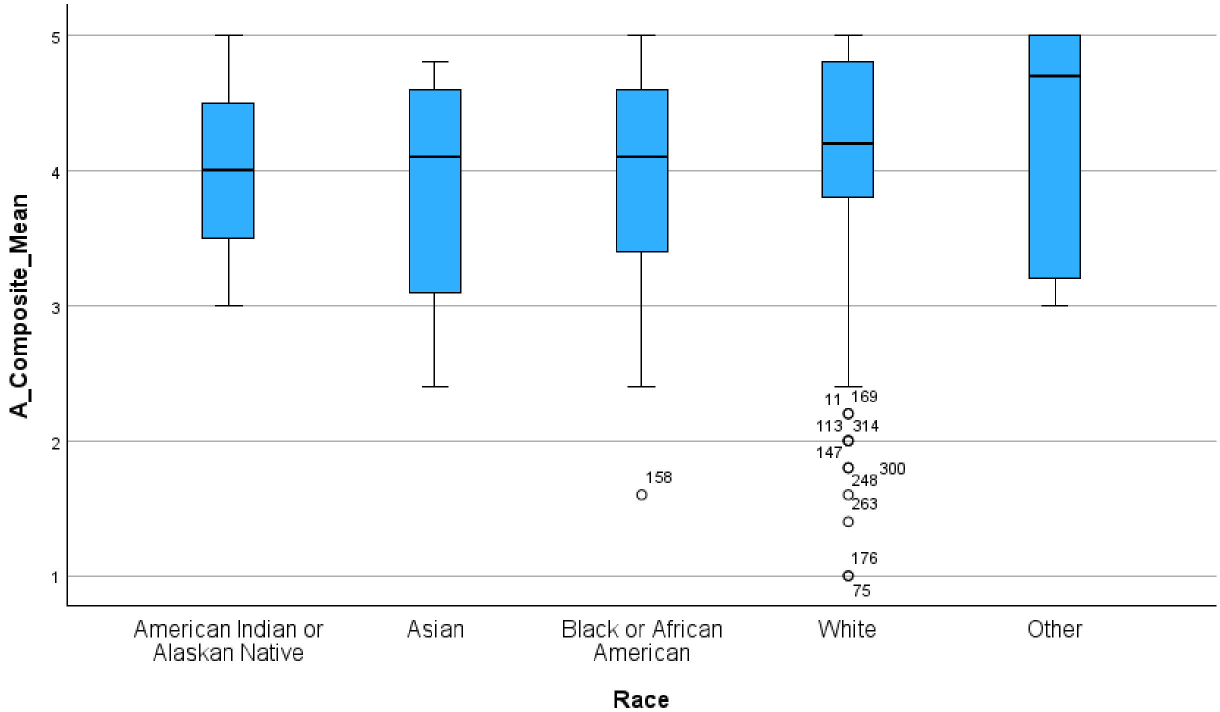


Note. Box plot with outliers for attitudes towards use by Ethnicity.

Figure 22 shows the distribution of attitudes towards use by race. The horizontal line inside the boxes shows the median value for that group (American Indian or Alaskan Native, Asian, Black or African American, White, and Other). The long tails on either side of the box plot show the spread of attitudes towards use scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their attitudes towards use is far away from the mean (usually ± 2 standard deviations from the mean). It can be seen Whites had ten total outliers which are less than the median value. These case numbers are 11, 75, 113, 147, 169, 176, 248, 263, 300, and 314. Blacks had one outlier. The case number was 158. There were no outlier values which were greater than the median value.

Figure 22

Attitudes Towards Use Composite Mean by Race

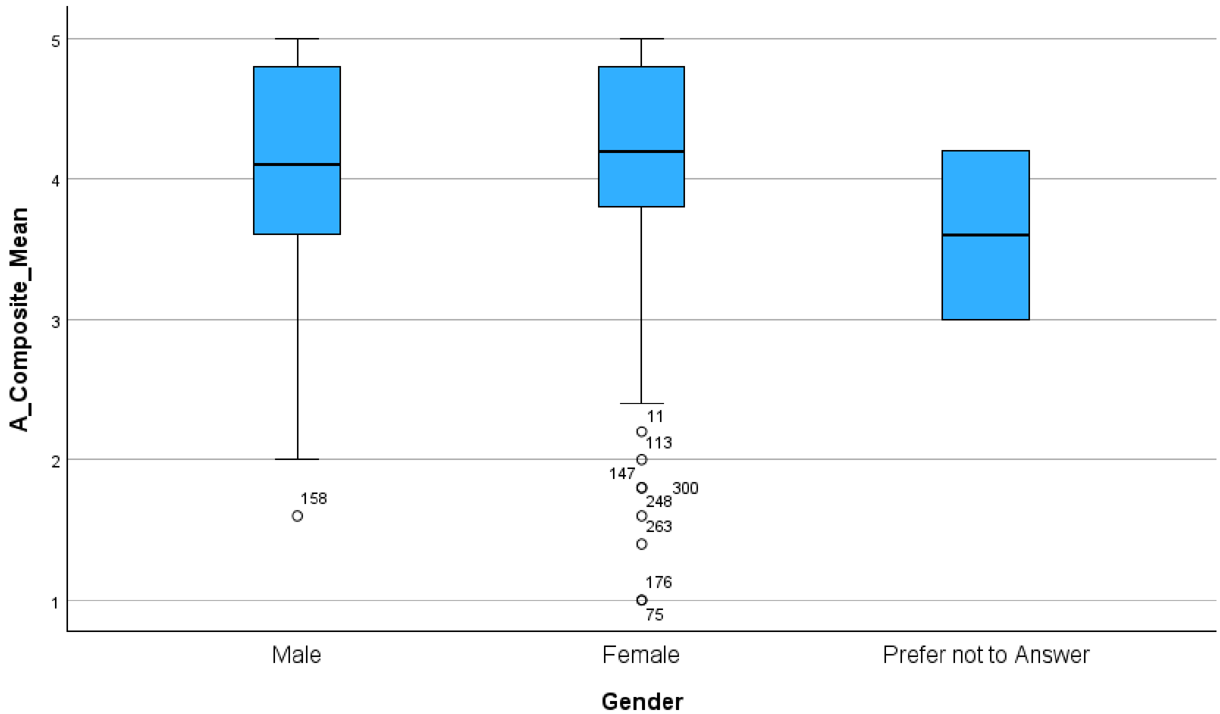


Note. Box plot with outliers for attitudes towards use composite means by ethnicity.

Figure 23 shows the distribution of attitudes towards use by gender. The horizontal line inside the boxes shows the median value for that group (American Indian or Alaskan Native, Asian, Black or African American, White, and Other). The long tails on either side of the box plot show the spread of attitudes towards use scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their attitudes towards use is far away from the mean (usually ± 2 standard deviations from the mean). It can be seen females had eight total outliers which are less than the median value. These case numbers are 11, 75, 113, 147, 176, 248, 263, and 300. Males had one outlier, case number 158. There were no outlier values which were greater than the median value.

Figure 23

Attitudes Towards Use Composite Means by Gender

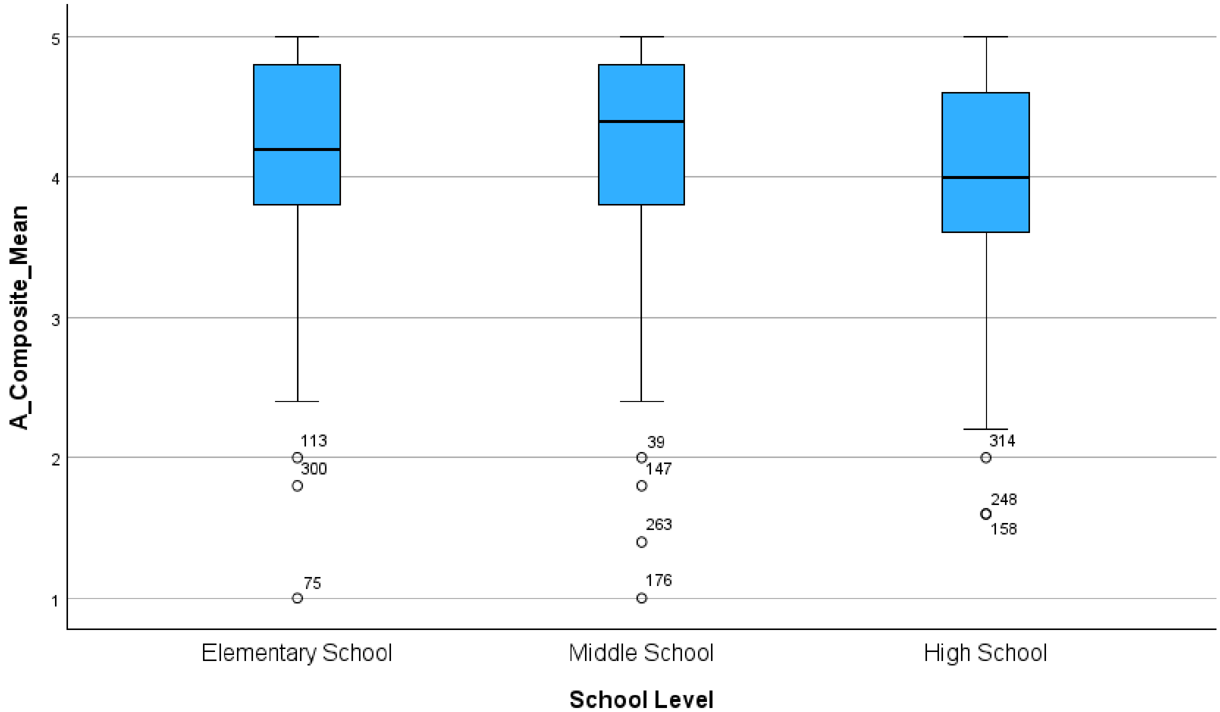


Note. Box plot with outliers for attitudes towards use composite means by Gender.

Figure 24 shows the distribution of attitudes towards use by school level. The horizontal line inside the boxes shows the median value for that group (elementary school, middle school, and high school). The long tails on either side of the box plot show the spread of attitudes towards use scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their attitudes towards use is far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that high schools had three total outliers which are less than the median value. These case numbers are 158, 248, and 314. Middle Schools had four outliers. The case numbers were 39, 147, 176, and 263. Elementary schools had three outliers. The case numbers were 75, 113, and 300. There were no outlier values which were greater than the median value.

Figure 24

Attitudes Towards Use Composite Mean by School Level



Note. Box plot with outliers for attitudes towards use composite means by gender.

Attitudes towards use are affected by a number of variables, such as ethnicity, gender, race, and school level. The trend of Hispanic or Latino respondents perceiving more favorably than their Non-Hispanic or Latino counterparts re-emerged with attitudes towards use. Aligning with the results from perceived ease of use and perceived usefulness, the Hispanic or Latino respondents viewed their attitudes towards use more favorably than did their non-Hispanic or Latino counterparts. The racial minority Other category reported attitudes towards use more highly than any other racial group. American Indian or Alaskan Native respondents continued to perceive more negatively than other racial groups, while Black respondents also continued lower perceptions. Female respondents perceived their attitudes towards use more highly than their male and prefer not to answer counterparts. Elementary school respondents perceived their attitudes towards use more highly than did their middle and high school peers. High school respondents continued to rate items lower than did other levels.

The composite scores for behavioral intention to use were disaggregated by ethnicity, race, gender, and school level as shown in Tables 23 (elementary schools), 24 (middle schools), and 25 (high schools). Table 23 shows the descriptive statistics for behavioral intention to use by demographic variables for elementary school teachers. The mean age was 44 years. Males (*M* = 5.0) had a higher perception of behavioral intention to use than females (*M* = 4.40). Non-Hispanics (M = 4.42) had higher behavioral intention to use than Hispanics (*M* = 4.33).

Table 23

Descriptive Statistics for Behavioral Intention to use for Elementary Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	44.28	8.60	73.91	0.01	-0.63
Gender					
Female	4.40	0.87	0.758	-1.54	1.82
Male	5.00	0.00	0.00	-	-
Ethnicity					
Hispanic	4.33	0.47	0.22	-	-
Non-Hispanic	4.42	0.87	0.76	-1.57	1.87
Race					
Asian	4.50	0.71	0.50	-	-
Black/African- American	4.67	0.47	0.22	-	-
White	4.43	0.85	0.73	-1.62	2.21
Other	2.33	-	-	-	-

Note. Totals are representative of all elementary school respondents (*n* = 82).

The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of behavioral intention to use. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the attitudes towards use had an approximately normal distribution, as all the skewness and kurtosis values were within the ±2 standard deviation range

(95% confidence interval). Similar trends can be seen in the distribution of behavioral intention to use for middle and high school teachers.

Table 24 shows the descriptive statistics for behavioral intention to use by demographic variables for middle school teachers. The mean age was 45 years. Males (*M* = 4.34) had a lower behavioral intention to use than females (*M* = 4.49). Non-Hispanics (*M* = 4.48) had higher behavioral intention to use than Hispanics (*M* = 3.60).

Table 24

Descriptive Statistics Attitudes Towards Use Perceptions for Middle Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	45.40	9.24	85.3	-0.33	-0.13
Gender					
Female	4.49	0.75	0.56	-1.91	5.02
Male	4.35	0.69	0.48	-0.49	-1.13
Prefer not to Answer	3.00	0.00	0.00	-	-
Ethnicity					
Hispanic	3.60	1.67	2.80	-1.09	0.54
Non-Hispanic	4.48	0.68	0.46	-1.16	1.11
Race					
Asian	4.00	1.41	2.00	-	-
Black/African- American	4.28	0.75	0.56	-.38	1.47
White	4.47	0.74	0.55	-1.70	4.05
American Indian or Alaskan Native	4.00	-	-	-	-
Other	4.67	0.58	0.33	-1.73	-

Note. Totals are representative of all middle school respondents (n = 141).

The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of behavioral intention to use. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis, values as well as Q-Q plots, show that the attitudes towards use had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range

(95% confidence interval). Similar trends can be seen in the distribution of behavioral intention to use for elementary and high school teachers.

Table 25 shows the descriptive statistics for behavioral intention to use by demographic variables for high school teachers. The mean age was 46 years. Males (*M* = 4.20) had a lower behavioral intention to use than females (*M* = 4.41). Non-Hispanics (*M* = 4.32) had lower behavioral intention to use than Hispanics (*M* = 5.00).

Table 25

Descriptive Statistics for Perceived Ease of Use Perceptions for High Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	46.33	8.90	79.25	-.253	-.637
Gender					
Female	4.41	0.80	0.64	-1.93	4.69
Male	4.20	0.85	0.72	-1.14	0.99
Prefer not to Answer	4.00	-	-	-	-
Ethnicity					
Hispanic	5.00	.000	.000	-	-
Non-Hispanic	4.32	.0.82	.67	-1.57	2.78
Race					
Black/African- American	4.19	0.86	0.74	-1.48	3.23
White	4.36	0.80	0.65	-1.71	3.47
American Indian or Alaskan Native	4.00	1.41	2.00	-	-
Other	4.00	1.41	2.00	-	-

Note. Totals are representative of all high school respondents (n = 125).

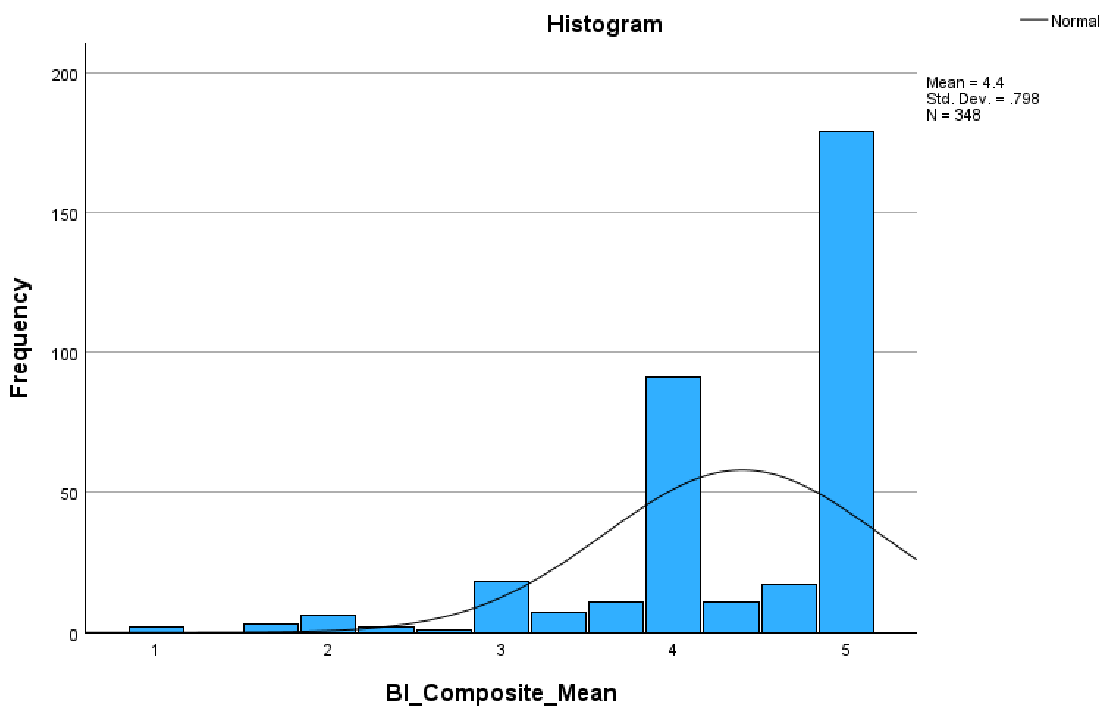
The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of behavioral intention to use. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the attitudes towards use had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range

(95% confidence interval). Similar trends can be seen in the distribution of behavioral intention to use for elementary and middle teachers.

As seen in Figure 25, the overall composite mean for behavioral intention to use (M = 4.40) is influenced by several outliers that create a negative skew. The histogram shows that the normal curve has shifted towards the right and is negatively skewed. It indicates that teachers have an overall positive attitude towards use.

Figure 25

Composite Means for Behavioral Intention to Use

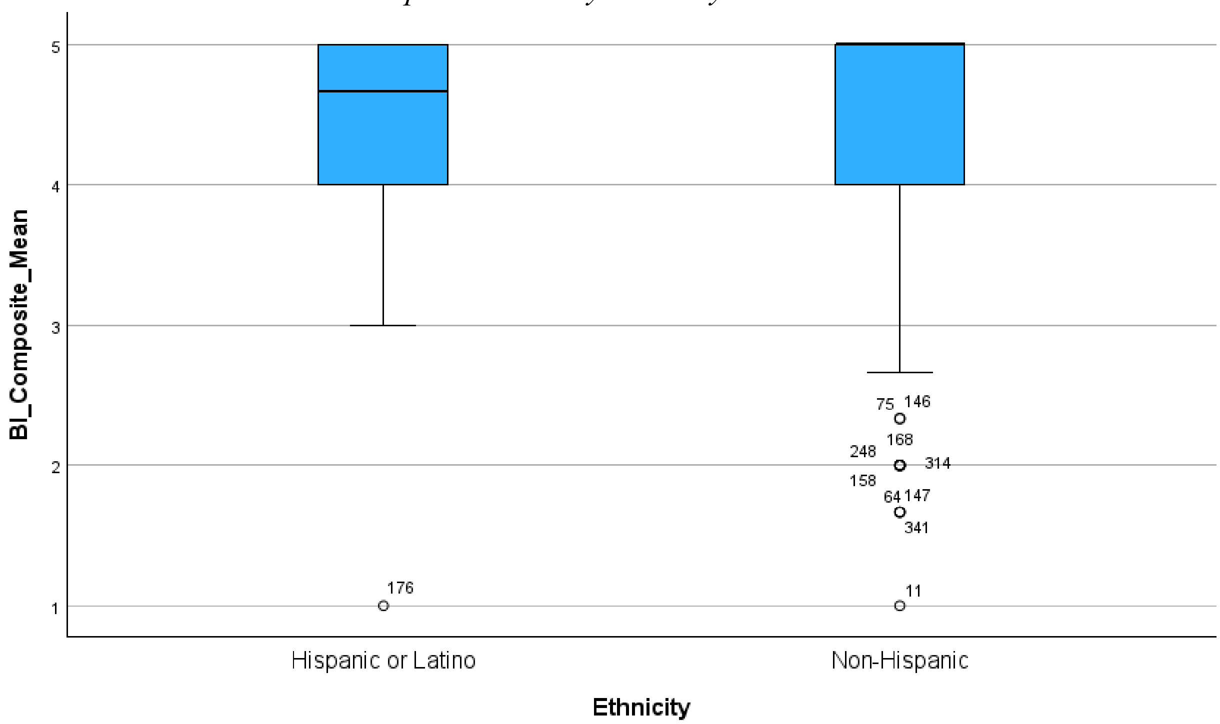


Note. Histogram with normality curve for behavioral intention to use composite means.

Figure 26 shows the distribution of behavioral intention to use by ethnicity. The horizontal line inside the boxes shows the median value for that group (Hispanic or Latino and Non-Hispanic). The long tails on either side of the box plot show the spread of attitudes towards use scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their attitudes towards use is far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that non-Hispanics had ten total outliers which were less than the median value. These case numbers were 11, 64, 75, 146, 147, 158, 168, 248, 314, and 341. Hispanic or Latinos had one outlier. The case number was 176. There were no outlier values which were greater than the median value.

Figure 26

Behavioral Intention to Use Composite Mean by Ethnicity

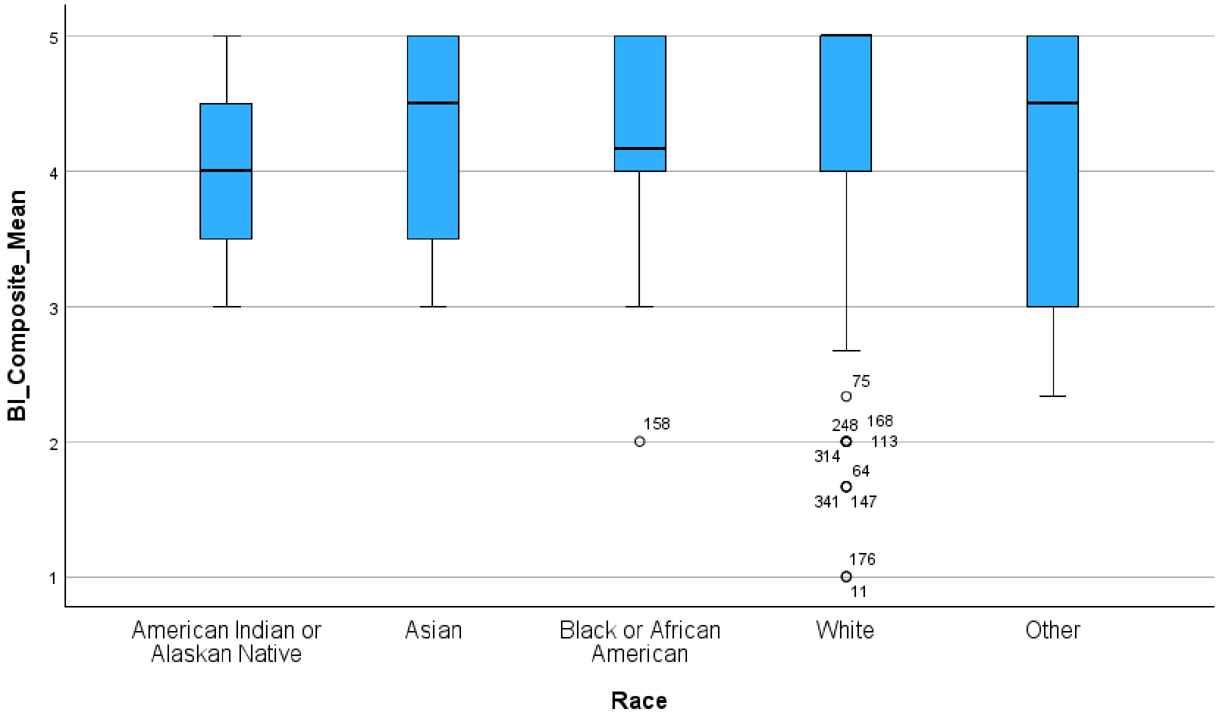


Note. Box plot with outliers for behavioral intention to use composite means by ethnicity.

Figure 27 shows the distribution of behavioral intention to use by race. The horizontal line inside the boxes shows the median value for that group (American Indian or Alaskan Native, Asian, Black or African American, White, or Other). The long tails on either side of the box plot show the spread of attitudes towards use scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their attitudes towards use is far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that Whites had ten total outliers which were less than the median value. These case numbers were 11, 64, 75, 113, 147, 168, 176, 248, 314, and 341. Black or African Americans had one outlier, case number 158. There were no outlier values which were greater than the median value.

Figure 27

Behavioral Intention to Use Composite Mean by Race

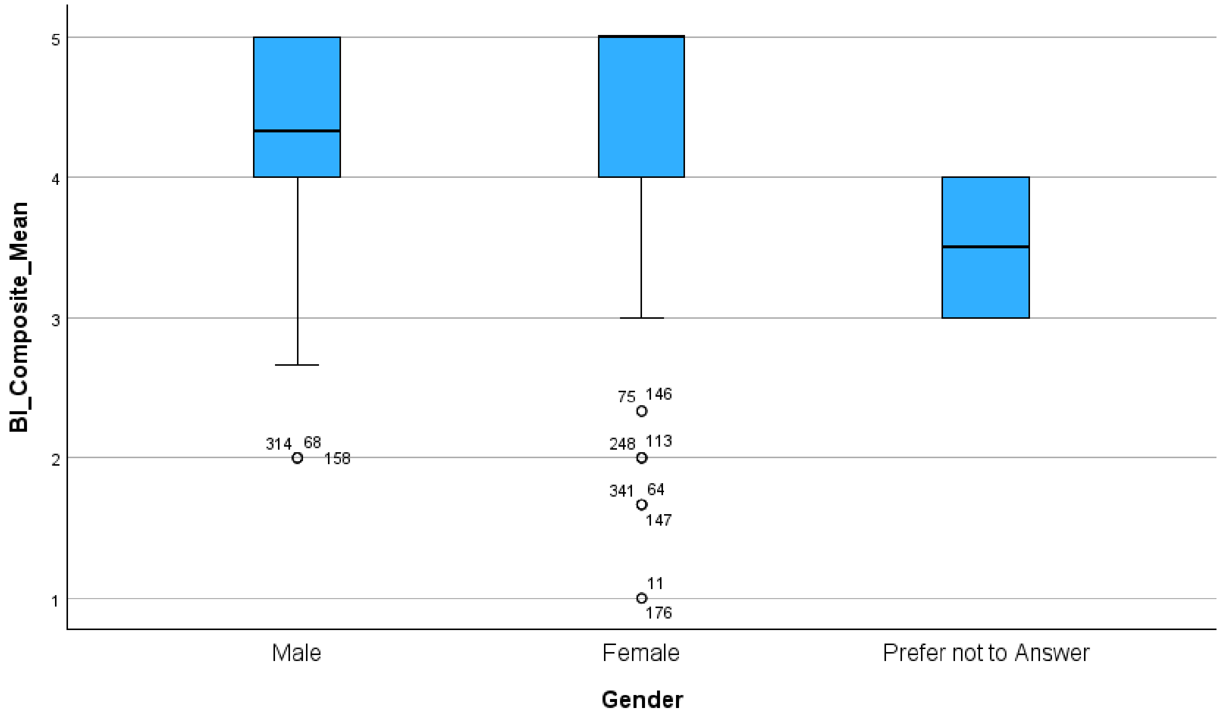


Note. Box plot with outliers for behavioral intention to use composite means by race.

Figure 28 shows the distribution of behavioral intention to use by gender. The horizontal line inside the boxes shows the median value for that group (male, female, and prefer not to answer). The long tails on either side of the box plot show the spread of attitudes towards use scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their attitudes towards use is far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that females had ten total outliers which were less than the median value. These case numbers were 11, 64, 75, 113, 147, 168, 176, 248, 314, and 341. Male respondents had three outliers. The case numbers were 68, 158, and 314. There were no outlier values which were greater than the median value.

Figure 28

Behavioral Intention to Use Composite Mean by Gender

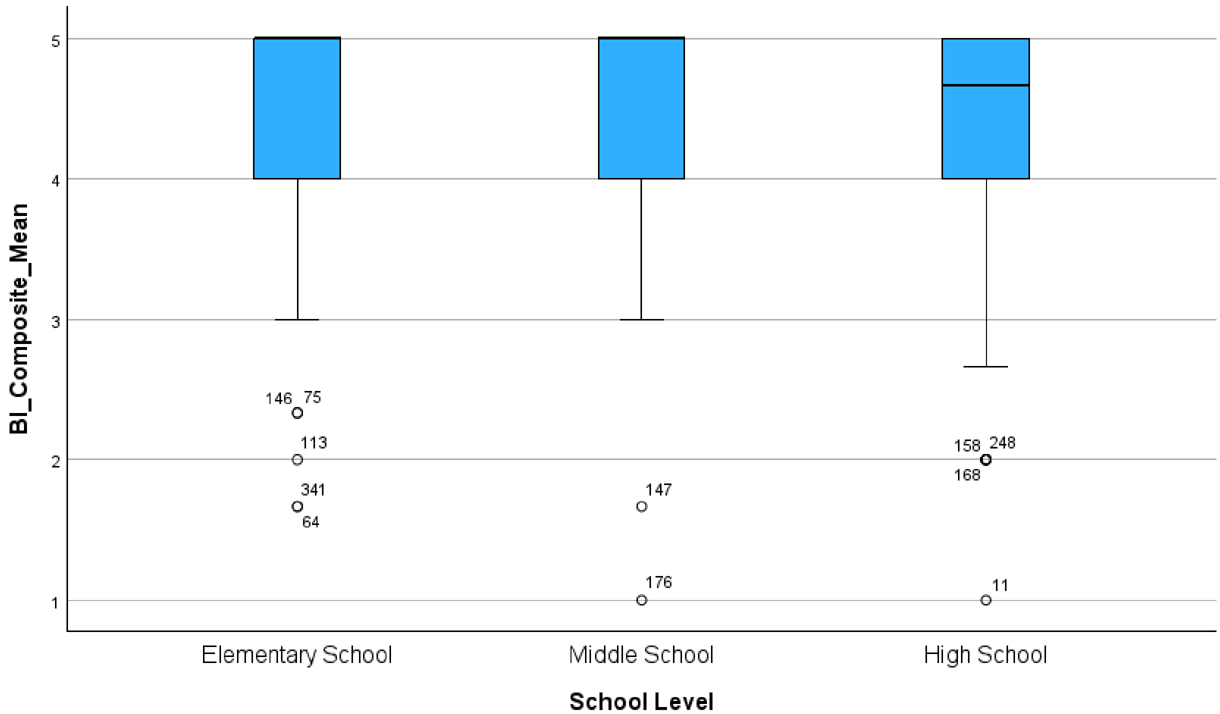


Note. Box plot with outliers for behavioral intention to use composite means by gender.

Figure 29 shows the distribution of behavioral intention to use by school level. The horizontal line inside the boxes shows the median value for that group (male, female, and prefer not to answer). The long tails on either side of the box plot show the spread of attitudes towards use scores for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their attitudes towards use is far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that elementary school teachers had five total outliers which were less than the median value. These case numbers were 64, 75, 113, 146, and 341. High school respondents had four outliers. The case numbers were 11, 158, 168, and 248. Middle school respondents had two outliers. The case numbers were 147 and 176. There were no outlier values which were greater than the median value.

Figure 29

Behavioral Intention to Use Composite Mean by School Level



Note. Box plot with outliers for behavioral intention to use composite means by school level.

Behavioral intention to use is affected by a number of variables, such as ethnicity, gender, race, and school level. The trend of Hispanic or Latino respondents perceiving more favorably than their non-Hispanic or Latino counterparts re-emerged with behavioral intention to use. Aligning with the results from IT support perceptions, the Hispanic or Latino respondents viewed their behavioral intention to use less favorably than did their non-Hispanic or Latino counterparts. The White category reported their behavioral intention to use more highly than any other racial group. American Indian or Alaskan Native respondents continued to perceive more negatively than other racial groups, while Black respondents also continued lower perceptions. Female respondents perceived their behavioral intention to use more highly than their male and prefer not to answer counterparts. Elementary school respondents perceived their behavioral intention to use more highly than did their middle and high school peers. High school respondents continued to rate items lower than did other levels.

The composite scores for attitudes towards use were disaggregated by the ethnicity, race, gender, and school level as shown in Tables 26 (elementary schools), 27 (middle schools), and 28 (high schools). Table 26 shows the descriptive statistics for functionality by demographic variables for elementary school teachers. The mean age was 44 years. Males (M = 5.0) had a higher perception of functionality than females (M = 3.76). Non-Hispanics (M = 3.80) had higher functionality perceptions than Hispanics (M = 3.38).

Table 26

Descriptive Statistics Functionality Perceptions for Elementary Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	44.28	8.60	73.91	0.01	-0.63
Gender					
Female	3.76	1.25	1.56	-0.36	0.84
Male	5.00	0.00	0.00	-	-
Ethnicity					
Hispanic	3.38	1.24	1.53	-	-
Non-Hispanic	3.80	1.25	1.58	-0.42	0.83
Race					
Asian	2.63	0.53	0.28	-	-
Black/African- American	4.00	0.71	0.50	-	-
White	3.83	1.27	1.60	-0.48	0.89
Other	2.75	-	-	-	-

Note. Totals reported are representative of all elementary school respondents (n = 82).

The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of functionality perceptions. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the functionality perceptions had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range

(95% confidence interval). Similar trends can be seen in the distribution of behavioral intention to use for middle and high school teachers.

Table 27 shows the descriptive statistics for functionality by demographic variables for middle school teachers. The mean age was 45 years. Males (*M* = 3.60) had a lower perception of functionality than females (*M* = 3.78). Non-Hispanics (*M* = 3.70) had lower functionality perceptions than Hispanics (*M* = 4.5).

Table 27

Descriptive Statistics Attitudes Towards Use Perceptions for Middle Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	45.40	9.24	85.3	-0.33	-0.13
Gender					
Female	3.78	1.25	1.56	-0.12	0.29
Male	3.60	0.95	0.90	-0.30	-1.12
Prefer not to Answer	3.00	0.00	0.00	-	-
Ethnicity					
Hispanic	4.5	1.40	1.97	-1.17	1.94
Non-Hispanic	3.70	1.16	1.36	-0.08	0.62
Race					
Asian	3.75	1.41	2.00	-	-
Black/African- American	3.93	1.04	1.08	-.38	1.47
White	3.69	1.19	1.41	-0.75	0.31
American Indian or Alaskan Native	3.00	-	-	-	-
Other	4.83	1.26	1.58	-0.59	-

Note: Totals reported are representative of all middle school respondents (*n* = 141).

The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of functionality perceptions. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the functionality perceptions had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range

(95% confidence interval). Similar trends can be seen in the distribution of behavioral intention to use for middle and high school teachers.

Table 28 shows the descriptive statistics for functionality by demographic variables for high school teachers. The mean age was 46 years. Males (*M* = 3.41) had a lower perception of functionality than females (*M* = 3.63). Non-Hispanics (*M* = 3.51) had higher functionality perceptions than Hispanics (*M* = 5.13).

Table 28

Descriptive Statistics for Perceived Ease of Use Perceptions for High Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	46.33	8.90	79.25	-.253	-.637
Gender					
Female	3.63	1.15	1.33	-0.10	0.34
Male	3.41	1.05	1.11	-0.23	0.75
Prefer not to Answer	2.25	-	-	-	-
Ethnicity					
Hispanic	5.13	1.24	1.53	-	-
Non-Hispanic	3.51	1.11	1.22	0.02	0.36
Race					
Black/African-American	3.78	0.75	0.56	1.82	4.16
White	3.52	1.15	1.33	0.01	0.23
American Indian or Alaskan Native	2.63	0.53	0.28	-	-
Other	3.75	1.77	3.13	-	-

Note. Totals reported are representative of all high school respondents (*n* = 125).

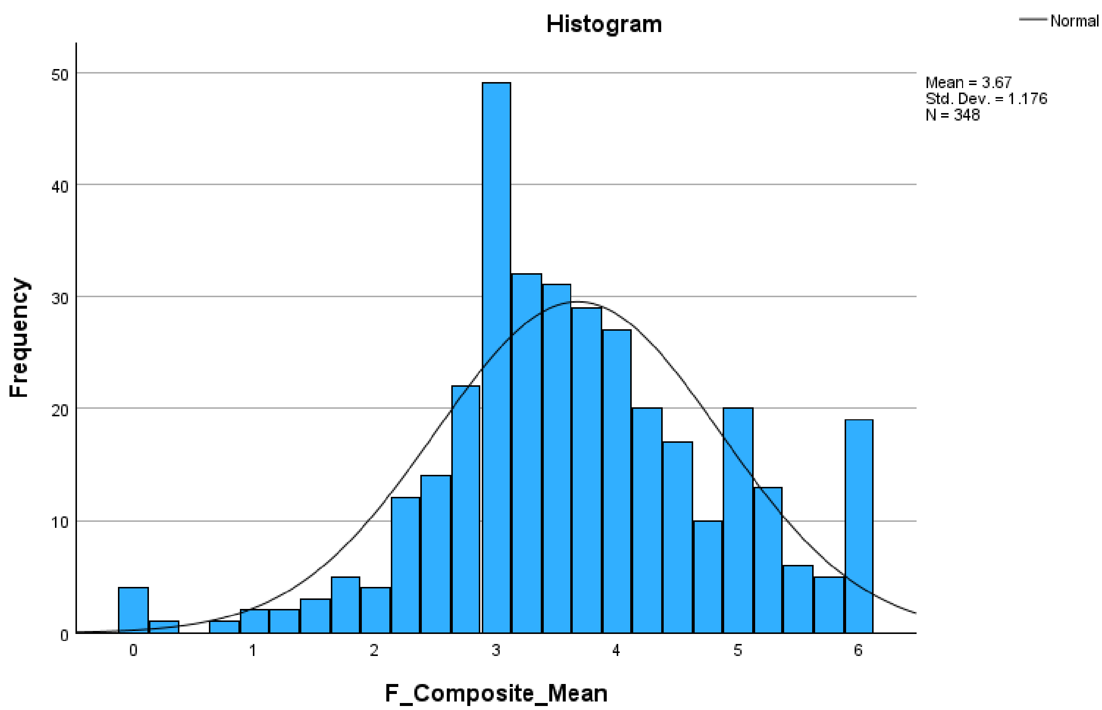
The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of functionality perceptions. The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the functionality perceptions had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range

(95% confidence interval). Similar trends can be seen in the distribution of behavioral intention to use for middle and high school teachers.

As seen in Figure 30, the overall composite mean for functionality (*M* = 3.67) is influenced by several outliers that create a negative skew. The histogram shows that the normal curve has shifted towards the right and is negatively skewed. It indicates that teachers have an overall positive attitude towards use.

Figure 30

Composite Means for Functionality

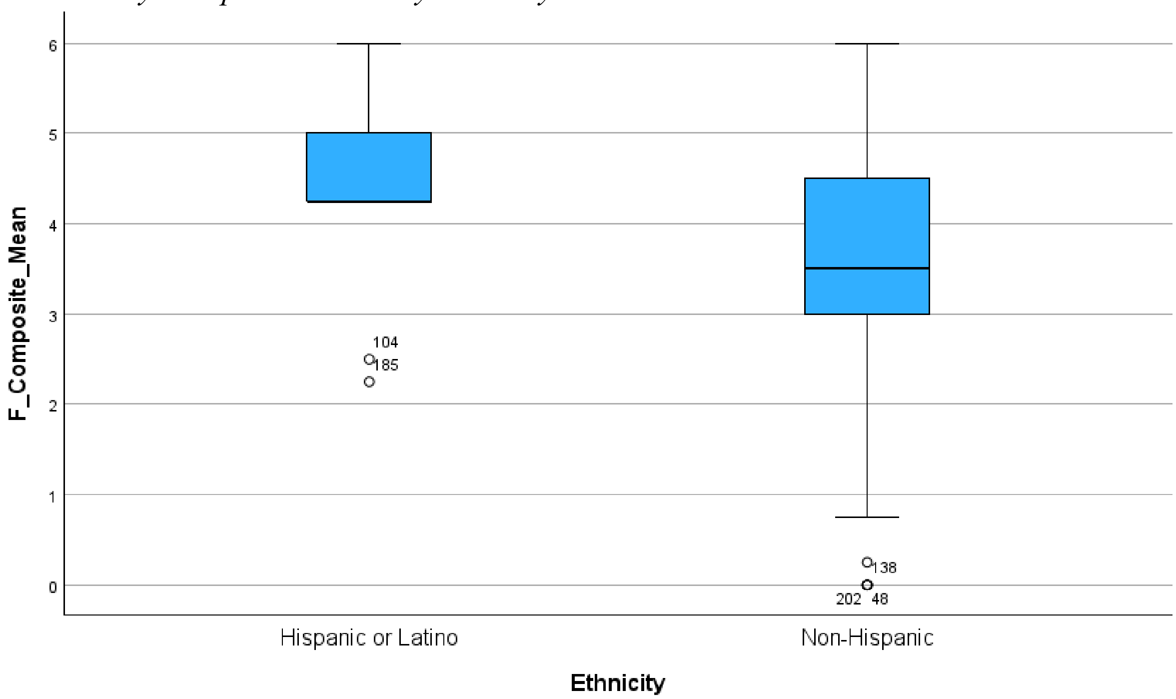


Note. Histogram with normality curve for functionality composite means. F stands for functionality.

Figure 31 shows the distribution of functionality perceptions by ethnicity. The horizontal line inside the boxes shows the median value for that group (Hispanic or Latino and Non-Hispanic). The long tails on either side of the box plot show the spread of functionality perceptions for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their functionality perceptions are far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that non-Hispanics had three total outliers which were less than the median value. These case numbers were 48, 238, and 202. Hispanic respondents had two outliers. The case numbers were 104, 185. There were no outlier values which were greater than the median value.

Figure 31

Functionality Composite Means by Ethnicity

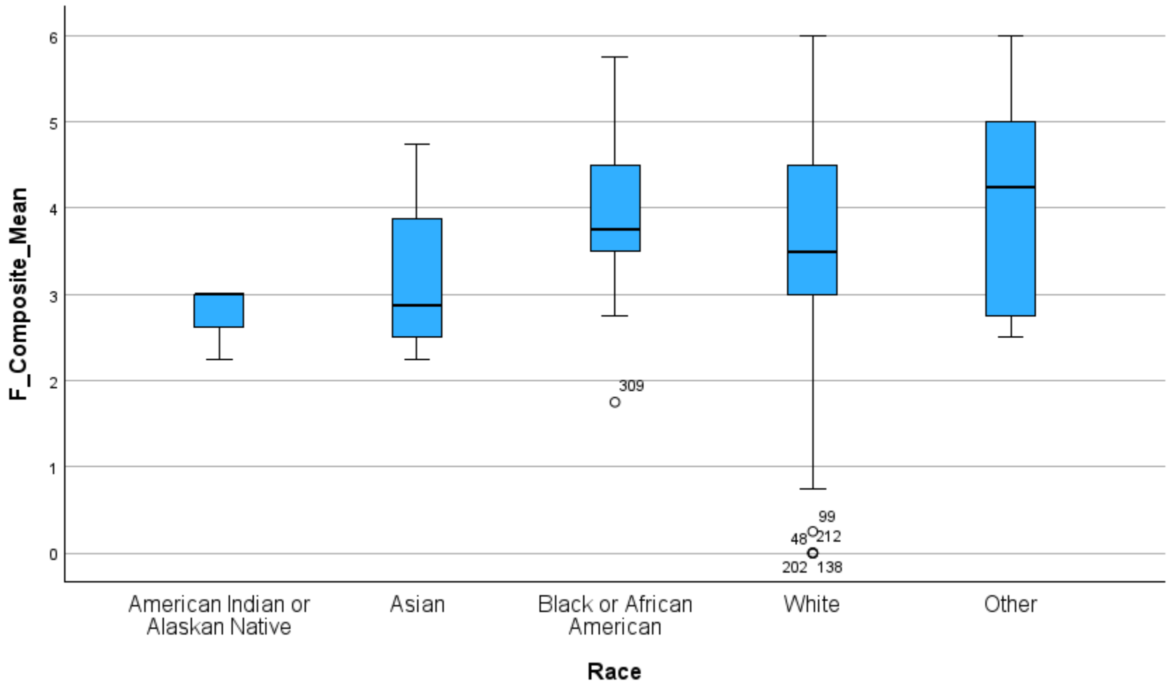


Note. Box plot with outliers for functionality composite means by ethnicity. F stands for functionality.

Figure 32 shows the distribution of functionality perceptions by race. The horizontal line inside the boxes shows the median value for that group (American Indian or Alaskan Native, Asian, Black or African American, White, and Other). The long tails on either side of the box plot show the spread of functionality perceptions for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their functionality perceptions are far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that Whites had five total outliers which were less than the median value. These case numbers were 48, 99, 138, 202, and 212. Black respondents had one outlier, case number 309. There were no outlier values which were greater than the median value.

Figure 32

Functionality Composite Means by Race

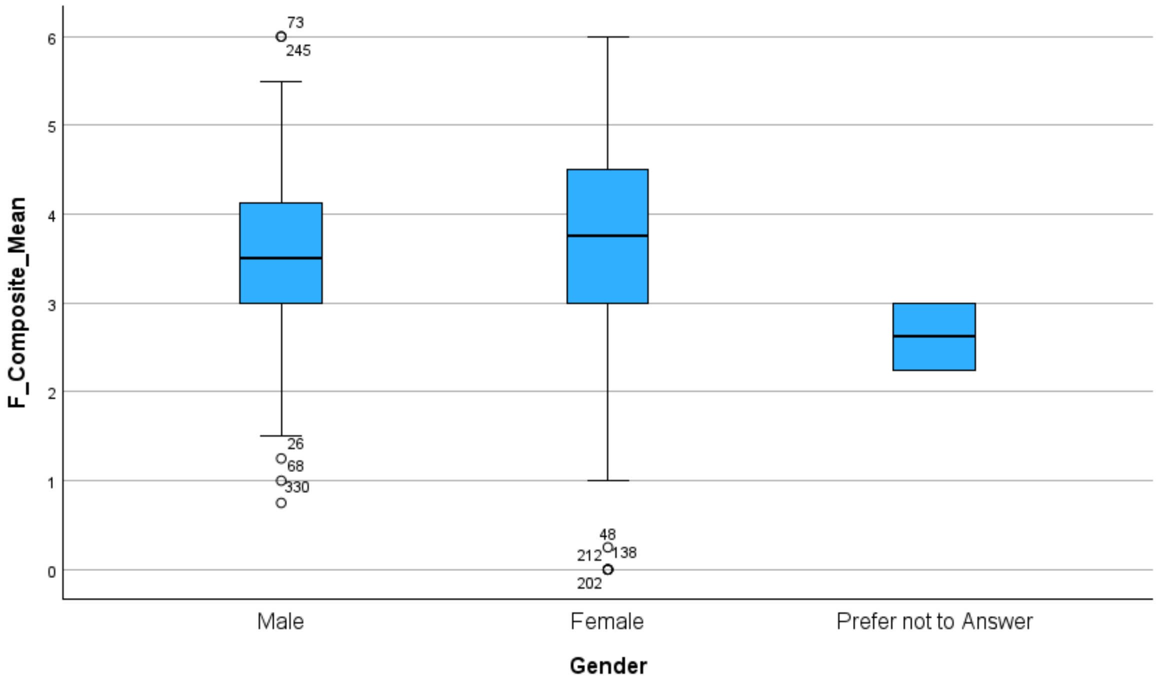


Note. Box plot with outliers for functionality composite means by race. F stands for functionality.

Figure 33 shows the distribution of functionality perceptions by Gender. The horizontal line inside the boxes shows the median value for that group (male, female, and prefer not to answer). The long tails on either side of the box plot show the spread of functionality perceptions for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their functionality perceptions are far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that females had four total outliers which were less than the median value. These case numbers were 48, 138, 202, and 212. Male respondents had three outliers. The case numbers were 26, 68, and 330. There were no outlier values which were greater than the median value.

Figure 33

Functionality Composite Mean by Gender

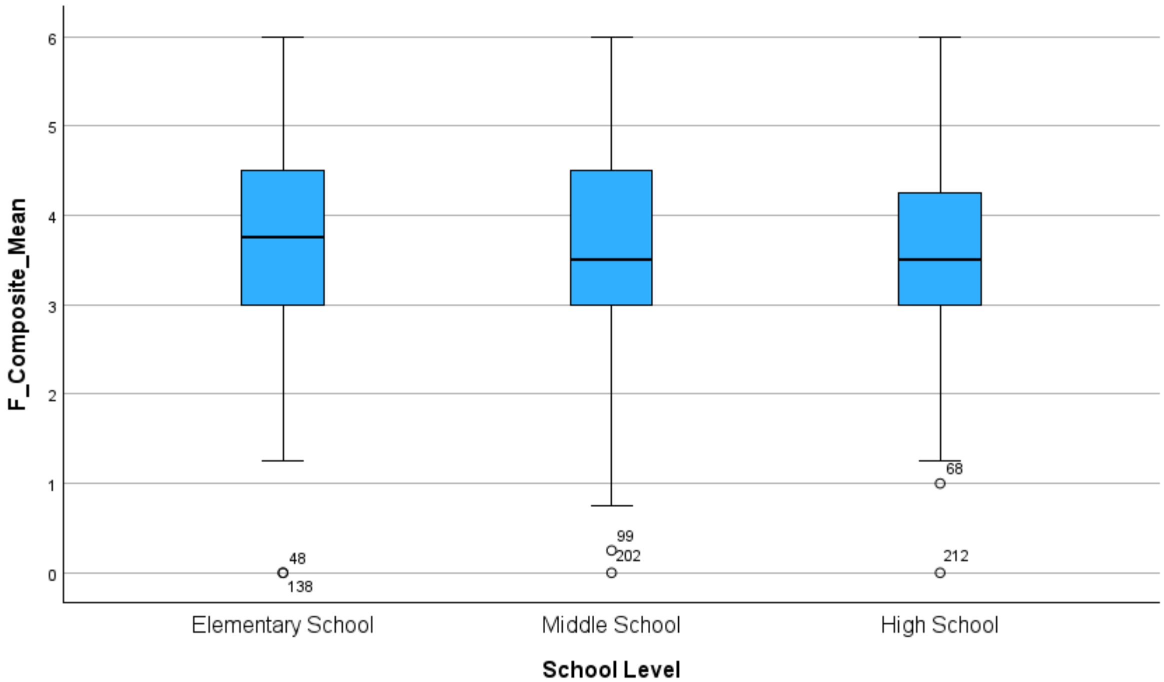


Note. Box plot with outliers for functionality composite means by gender. F stands for functionality.

Figure 34 shows the distribution of functionality perceptions by school level. The horizontal line inside the boxes shows the median value for that group (elementary school, middle school, and high school). The long tails on either side of the box plot show the spread of functionality perceptions for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their functionality perceptions are far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that middle school had two total outliers which were less than the median value. These case numbers were 99 and 202. High school respondents had two outliers. The case numbers were 68 and 212. Elementary schools had two outliers. The case numbers were 48 and 138. There were no outlier values which were greater than the median value.

Figure 34

Functionality Composite Means by School Level



Note. Box plot with outliers for functionality composite means by school level. F stands for functionality.

Functionality perceptions are affected by a number of variables, such as ethnicity, gender, race, and school level. The trend of Hispanic or Latino respondents perceiving more favorably than their non-Hispanic or Latino counterparts continued perceptions. A notable difference was seen between Hispanic and non-Hispanic respondents. The racial minority Black or African American category rated their functionality perceptions more highly than any other racial group besides Other. This is unique to functionality perceptions. American Indian or Alaskan Native respondents continued to perceive more negatively than other racial groups, while Asian respondents were lower than in any other construct. Female respondents perceived the functionality of the Google Classroom LMS more highly than their male and prefer not to answer counterparts. Elementary school respondents perceived the functionality of the Google

Classroom LMS more highly than did their middle and high school peers. High school respondents continued to rate items lower than did other levels.

Table 29 shows the descriptive statistics for usability perceptions by demographic variables for elementary school teachers. The mean age was 44 years. Males (*3.25*) had a higher perception of usability perceptions than females (*M* = 2.70). Non-Hispanics (*M* = 2.76) had higher usability perceptions than Hispanics (*M* = 2.00). The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of usability perceptions.

Table 29

Descriptive Statistics of Usability Perceptions for Elementary Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	44.28	8.60	73.91	0.01	-0.63
Gender					
Female	2.70	1.79	3.22	0.42	-1.40
Male	3.25	3.18	10.1	-	-
Ethnicity					
Hispanic	2.00	0.00	0.00	-	-
Non-Hispanic	2.76	1.81	3.28	-0.37	-1.45
Race					
Asian	2.13	1.59	2.53	-	-
Black/African- American	2.38	1.94	3.78	-	-
White	2.76	1.83	3.35	0.38	-1.48
Other	1.00	-	-	-	-

Note. Totals reported are representative of all elementary school respondents (*n* = 82).

The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the usability perceptions had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval). Similar trends can be seen in the distribution of usability perceptions for middle and high school teachers.

Table 30 shows the descriptive statistics for usability perceptions by demographic variables for middle school teachers. The mean age was 45 years. Males (*M =2.83*) had a higher perception of usability perceptions than females (*M* = 2.80). Non-Hispanics (*M* = 2.80) had lower usability perceptions than Hispanics (*M* = 3.00). The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of usability perceptions.

Table 30

Descriptive Statistics of Usability Perceptions for Middle Schools

Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	45.40	9.24	85.3	-0.33	-0.13
Gender					
Female	2.81	1.91	3.64	0.29	-1.66
Male	2.83	1.70	2.90	0.28	-1.36
Prefer not to Answer	1.00	0.00	0.00	-	-
Ethnicity					
Hispanic	3.00	1.96	3.84	-0.07	-2.70
Non-Hispanic	2.80	1.85	3.44	0.31	-1.58
Race					
Asian	1.88	1.24	1.53	-	-
Black/African-American	2.69	1.71	2.92	.24	-1.74
White	2.83	1.87	3.51	0.29	-1.60
American Indian or Alaskan Native	1.00	-	-	-	-
Other	3.58	2.27	5.15	-1.52	-

Note. Totals reported are representative of all middle school respondents (*n* = 141).

The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values, as well as Q-Q plots, show that the usability perceptions had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval). Similar trends can be seen in the distribution of usability perceptions for elementary and high school teachers.

Table 31 shows the descriptive statistics for usability perceptions by demographic variables for middle school teachers. The mean age was 46 years. Males (*2.64*) had a lower perception of usability perceptions than females (*M* = 2.88). Non-Hispanics had higher (*M* = 2.80) usability perceptions than Hispanics (*M* = 1.00). The measures of dispersion (standard deviation, variance, skewness, and kurtosis) do not indicate a large variance in the distribution of usability perceptions.

Table 31

Descriptive Statistics of Usability Perceptions for High Schools

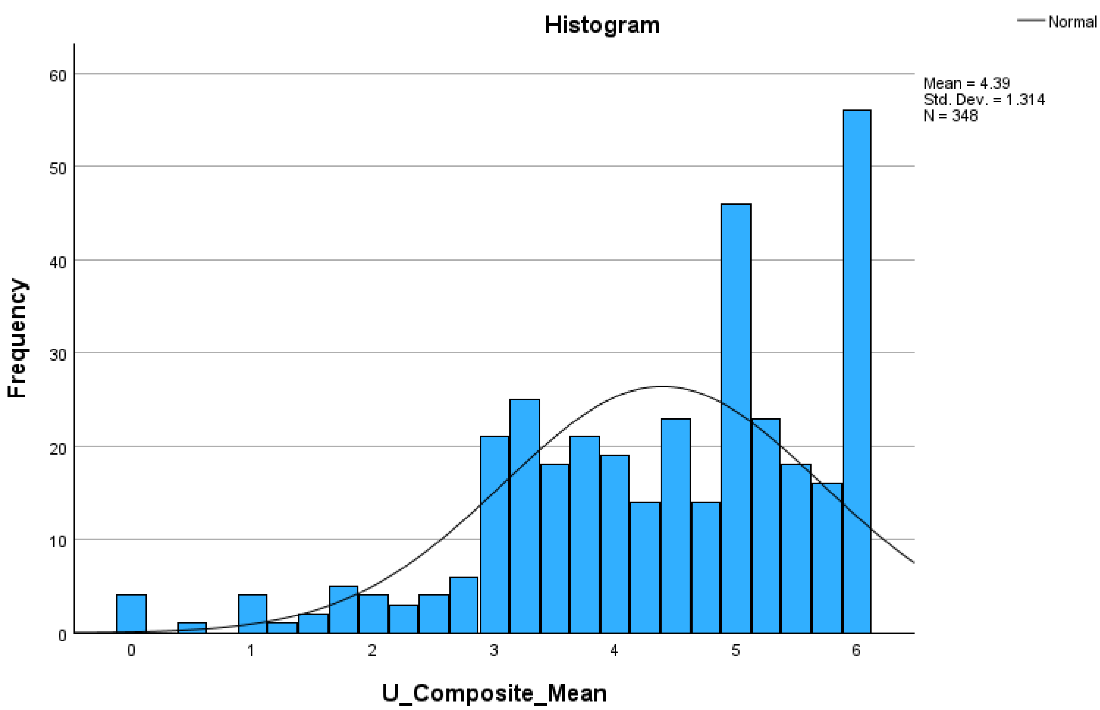
Demographic	Mean	SD	Variance	Skewness	Kurtosis
Age	46.33	8.90	79.25	-.253	-.637
Gender					
Female	2.88	1.72	2.94	0.0	0.34
Male	2.64	1.70	2.90	0.4	-1.60
Prefer not to Answer	1.00	-	-	-	-
Ethnicity					
Hispanic	1.00	0.00	0.00	-	-
Non-Hispanic	2.80	1.71	2.92	0.13	-1.58
Race					
Black/African-American	3.31	1.63	2.66	-0.34	-1.14
White	2.72	1.72	2.95	0.22	-1.58
American Indian or Alaskan Native	2.38	1.94	3.78	-	-
Other	2.88	2.65	7.03	-	-

Note. Totals reported are representative of all high school respondents (*n* = 125).

The normality tests (Kolmogorov-Smirnov and Shapiro Wilk's) in SPSS were violated, which shows that the normality assumption was not met. However, close examination of skewness and kurtosis values as well as Q-Q plots show that the usability perceptions had an approximately normal distribution as all the skewness and kurtosis values were within the ±2 standard deviation range (95% confidence interval). Similar trends can be seen in the distribution of usability perceptions for elementary and middle school teachers. Usability composite means are shown in figure 35.

Figure 35

Usability Composite Means



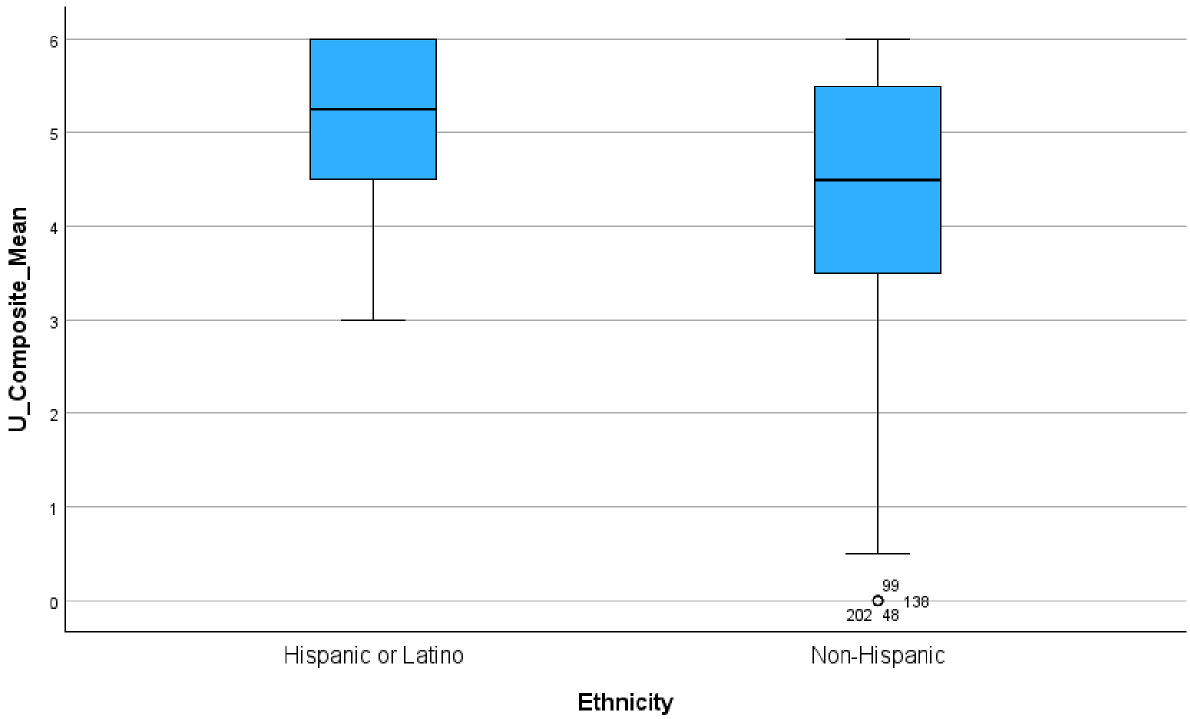
Note. Histogram with normality curve for usability composite means. U stands for usability.

Figure 35 shows the overall composite mean for usability ($M = 4.39$) is influenced by several outliers that create a negative skew. The histogram shows that the normal curve has shifted towards the right and is negatively skewed. It indicates that teachers have an overall positive perception of the usability of the Google Classroom LMS.

Figure 36 shows the distribution of usability perceptions by ethnicity. The horizontal line inside the boxes shows the median value for that group (Hispanic or Latino and Non-Hispanic). The long tails on either side of the box plot show the spread of usability perceptions for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their usability perceptions are far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that the non-Hispanics group had four total outliers which were less than the median value. These case numbers were 48, 99, 138 and 202. There were no outlier values which were greater than the median value.

Figure 36

Usability Composite Means by Ethnicity



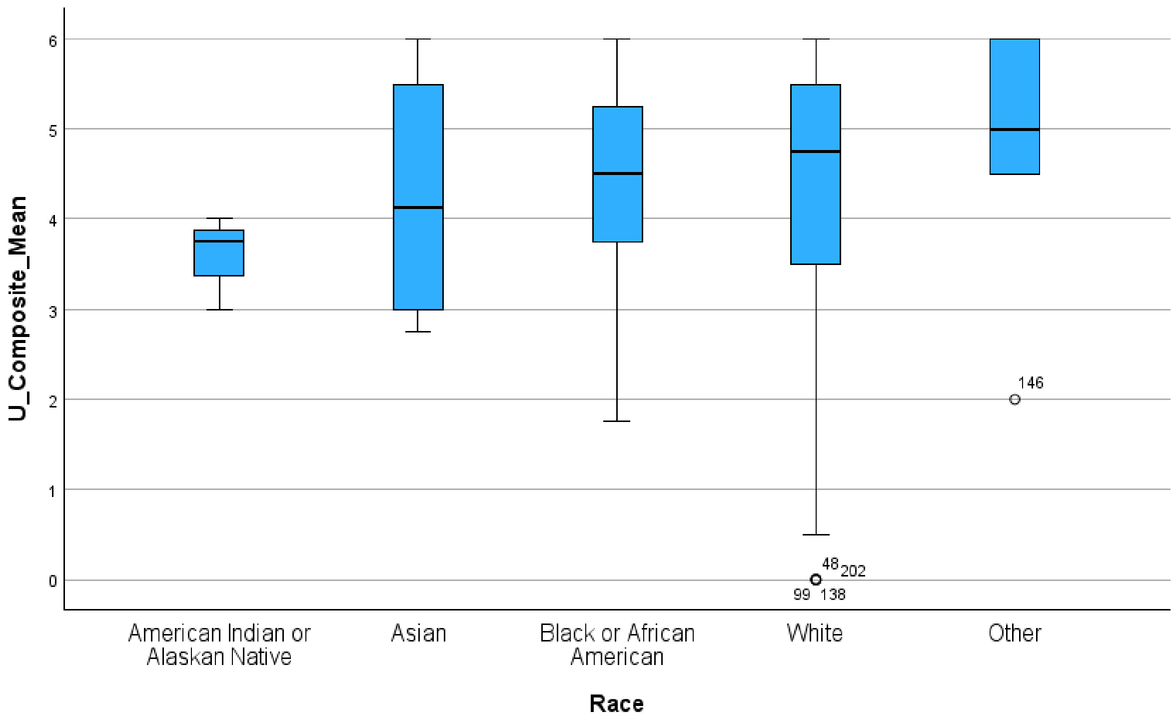
Note. Box plot with outliers for usability composite means by ethnicity. U stands for usability.

Figure 37 shows the distribution of usability perceptions by race. The horizontal line inside the boxes shows the median value for that group (American Indian or Alaskan Native, Asian, Black or African American, White, and Other). The long tails on either side of the box plot show the spread of usability perceptions for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their usability perceptions are far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that Whites had four total outliers which were less than the median value. These case numbers were 48, 99, 138 and 202.

The Other category had one outlier. The case number was 146. There were no outlier values which were greater than the median value.

Figure 37

Usability Composite Means by Race

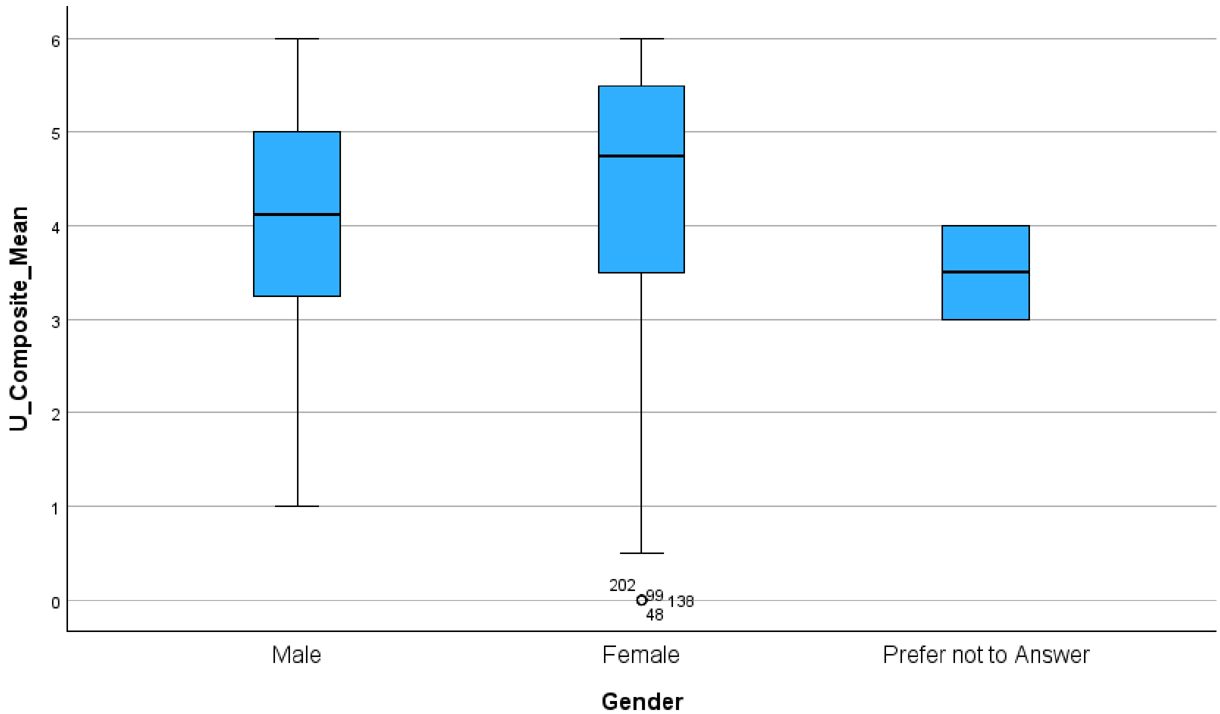


Note. Box plot with outliers for usability composite means by race. U stands for usability.

Figure 38 shows the distribution of usability perceptions by gender. The horizontal line inside the boxes shows the median value for that group (male, female, and prefer not to answer). The long tails on either side of the box plot show the spread of usability perceptions for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their usability perceptions are far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that females had four total outliers which were less than the median value. These case numbers were 48, 99, 138 and 202. The case number was 146. There were no outlier values which were greater than the median value.

Figure 38

Usability Composite Means by Gender

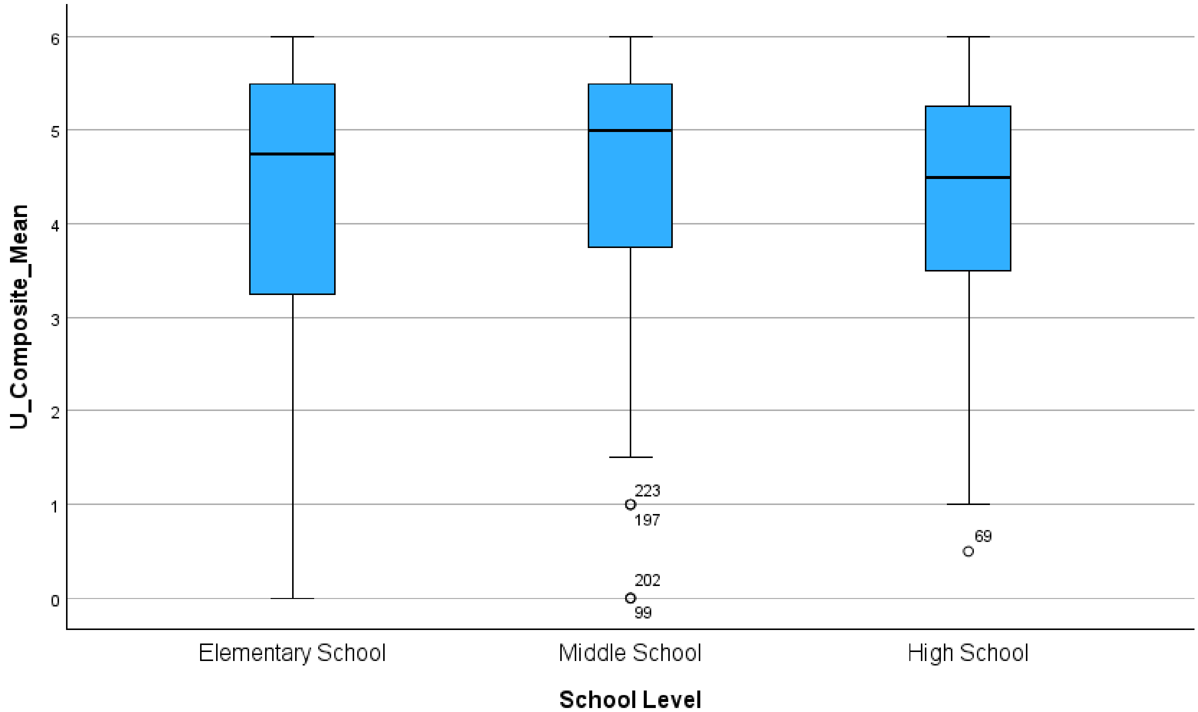


Note. Box plot with outliers for usability composite means by gender. U stands for usability.

Figure 39 shows the distribution of usability perceptions by school level. The horizontal line inside the boxes shows the median value for that group (elementary school, middle school, and high school). The long tails on either side of the box plot show the spread of usability perceptions for each group. The dots indicate the case numbers (or individuals) who are outliers, meaning that their usability perceptions are far away from the mean (usually ± 2 standard deviations from the mean). It can be seen that middle school had four total outliers which were less than the median value. These case numbers were 99, 197, 202, and 223. High school teachers had one outlier, case number 69. There were no outlier values which were greater than the median value.

Figure 39

Usability Composite Means by School Level



Note. Box plot with outliers for usability by school level. U stands for usability.

Usability perceptions are affected by a number of variables, such as ethnicity, gender, race, and school level. The trend of Hispanic or Latino respondents perceiving more favorably than their non-Hispanic or Latino counterparts continued with usability perceptions. A large difference was seen between Hispanic and non-Hispanic respondents. The racial minority Black or African American respondents rated their functionality perceptions more highly than any other minority racial group besides Other. This is similar, yet not as pronounced, to functionality perceptions. American Indian or Alaskan Native respondents continued to perceive more negatively than other racial groups, while Asian respondents' perceptions resembled the lower perceptions reported for functionality. Female respondents perceived the functionality of the Google Classroom LMS more highly than their male and prefer not to answer counterparts. Middle school respondents perceived the functionality of the Google Classroom LMS more highly than did their middle and high school peers. High school respondents continued to rate items lower than did other.

Pearson Correlation tests were computed in the SPSS program. Table 32 below shows overall composite means, standard deviations, and correlations between each of the exogenous variables. Perceived ease of use had a large correlation (r = 0.64) with perceived usefulness that was significant at the 0.01 level. Functionality had strong positive correlations with PU (r = 0.54) and PEOU (r = 0.59) that were both significant at the 0.01 level. IT support had weak positive correlations with PU (r = 0.36), PEOU (r = 041), and Functionality (r = 0.30), Each of these correlations were significant at the 0.01 level.

Behavioral intention to use (BI) had strong positive correlations with PU (r = 0.63), PEOU (r =0.72), and Functionality (r = 0.52). It also had a weak positive correlation with IT support (r = 0.42). Each of these correlations were significant at the 0.01 level. Attitudes towards use had strong positive correlations with PU (r = 0.60), PEOU (r = 0.63), and BI (r = .74). It had a small positive correlation with IT support (r = .29). Each of these correlations was significant at the .01 level except for attitudes towards use and BI which was significant at the 0.05 level. Actual usage had weak positive correlations with BI (r = 0.24) and attitudes towards use (r = 0.26) which were significant at the 0.05 and 0.01 level respectively.

Correlation Analysis

Table 32

Variable Correlation Table Combined

	Mean	SD	PU	PEOU	U	F	ITS	BI	ATU	AU
PU	4.01	0.82	1.00							
PEOU	4.19	0.79	0.60**	1.00						
U	2.72	1.81	-0.052	0.03	1.00					
F	3.79	1.25	0.45**	0.41**	-0.01	1.00				
ITS	4.22	0.64	0.44**	0.44**	-0.01	0.27**	1.00			
BI	4.05	0.84	0.66**	0.68**	0.06	0.34**	0.48**	1.00		
ATU	4.41	0.86	0.72**	0.59**	-0.50	0.38**	0.46**	0.73**	1.00	
AU	5.97	7.05	0.21	0.12	-0.08	0.22	-0.02	0.14*	0.21*	1.00

Note. * Denotes a significant correlation at the 0.05 level (2-tailed). ** Denotes a significant correlation at the 0.01 level (2-tailed). SD stands for standard deviation. PU stands for perceived usefulness. PEUO stands for perceived ease of use. U stands for usability. F stands for functionality. ITS stands for IT support. BI stands for behavioral intention to use. ATU stands for attitudes towards use. AU stands for actual usage.

Pearson Correlation tests were computed in the SPSS program. Table 33 shows composite means, standard deviations, and correlations between each of the exogenous variables at the elementary school level. Perceived ease of use had a strong correlation (r = 0.60) with perceived usefulness that was significant at the 0.01 level. Functionality had weak positive correlations with PU (r = 0.45) and PEOU (r = 0.41) that were both significant at the 0.01 level. IT support had weak positive correlations with PU (r = 0.44), PEOU (r = 0.44), and Functionality (r = 0.27), Each of these correlations were significant at the 0.01 level. Behavioral intention to use (BI) had strong positive correlations with PU (r = 0.66) and PEOU (r =0.78) and a weak correlation with functionality (r = 0.34) and IT support (r = 0.42). Each of these correlations were significant at the 0.01 level. Attitudes towards use had strong positive correlations with PU (r = 0.72), PEOU (r = 0.59), and BI (r = .73). It had a small positive correlation with functionality (r = 0.38) and IT support (r = .29). Each of these correlations was significant at the .01 level. Actual usage had weak positive correlations with BI (r = 0.14) and attitudes towards use (r = 0.21) which were significant at the 0.05 level.

Table 33

Correlation Table for Elementary School Respondents

	M	SD	PU	PEOU	U	F	ITS	BI	ATU	AU
PU	3.92	0.88	1.00							
PEOU	4.20	0.75	0.64**	1.00						
U	2.77	1.79	0.10	0.03	1.00					
F	3.67	1.18	0.54**	0.59**	0.12	1.00				
ITS	4.15	0.68	0.36**	0.41**	0.16	0.30**	1.00			
BI	4.09	0.81	0.63**	0.72**	0.18	0.34**	0.42**	1.00		
ATU	4.40	0.80	0.60**	0.63**	0.08	0.44**	0.29**	0.74**	1.00	
AU	7.15	7.89	0.21	0.07	-0.07	0.11	-0.10	0.24**	0.26**	1.00

Note. * Denotes a significant correlation at the 0.05 level (2-tailed). ** Denotes a significant correlation at the 0.01 level (2-tailed). M stands for mean. SD stands for standard deviation. PU stands for perceived usefulness. PEUO stands for perceived ease of use. U stands for usability. F stands for functionality. ITS stands for IT support. BI stands for behavioral intention to use. ATU stands for attitudes towards use. AU stands for actual usage.

Pearson Correlation tests were computed in the SPSS program. Table 34 shows composite means, standard deviations, and correlations between each of the exogenous variables at the middle school level. Perceived ease of use had a strong correlation (r = 0.60) with perceived usefulness that was significant at the 0.01 level. Functionality had weak positive correlations with PU (r = 0.42) and PEOU (r = 0.39) that were both significant at the 0.01 level. IT support had strong positive correlations with PU (r = 0.53), PEOU (r = 0.50), and a weak positive correlation with functionality (r = 0.31), Each of these correlations were significant at the 0.01 level. Behavioral intention to use (BI) had strong positive correlations with PU (r = 0.66), PEOU (r =0.65) and IT support (r = 0.54) and a weak correlation with functionality (r = 0.28). Each of these correlations were significant at the 0.01 level. Attitudes towards use had strong positive correlations with PU (r = 0.74), PEOU (r = 0.54), BI (r = .71) and IT support (r = 0.56). It had a small positive correlation with functionality (r = 0.34). Each of these correlations was significant at the .01 level. Actual usage had weak positive correlations with PU (r = 0.31), PEOU (*r* = 0.17), Usability (*r* = 0.17), Functionality (*r* – 0.21), BI (*r* = 0.22) and attitudes towards use (*r* = 0.30) which were all significant at the 0.05 level except PU and attitudes towards which were significant at the 0.01 level.

Table 34

Correlation Table for Middle School Respondents

	Mean	SD	PU	PEOU	U	F	ITS	BI	ATU	AU
PU	3.98	0.83	1.00							
PEOU	4.31	0.70	0.60**	1.00						
U	2.80	1.85	-0.07	0.09	1.00					
F	3.73	1.18	0.42**	0.39**	-0.01	1.00				
ITS	4.22	0.68	0.53**	0.50**	-0.04	0.31**	1.00			
BI	4.18	0.81	0.66**	0.65**	0.02	0.28**	0.54**	1.00		
ATU	4.44	0.74	0.74**	0.54**	-0.70	0.34**	0.56**	0.71**	1.00	
AU	7.30	8.37	0.31**	0.17*	-0.17*	0.21*	0.12	0.22*	0.30**	1.00

Note. * Denotes a significant correlation at the 0.05 level (2-tailed). ** Denotes a significant correlation at the 0.01 level (2-tailed). SD stands for standard deviation. PU stands for perceived usefulness. PEUO stands for perceived ease of use. U stands for usability. F stands for functionality. ITS stands for IT support. BI stands for behavioral intention to use. ATU stands for attitudes towards use. AU stands for actual usage.

Pearson Correlation tests were computed in the SPSS program. Table 35 shows composite means, standard deviations, and correlations between each of the exogenous variables at the high school level. Perceived ease of use had a strong correlation (*r* = 0.59) with perceived usefulness that was significant at the 0.01 level. Functionality had weak positive correlations with PU (*r* = 0.42) and PEOU (*r* = 0.30) that were both significant at the 0.01 level. IT support had weak positive correlations with PU (*r* = 0.38), PEOU (*r* = 0.39), and functionality (*r* = 0.19), Each of these correlations were significant at the 0.01 level except functionality which was significant at the 0.05 level. Behavioral intention to use (BI) had strong positive correlations with PU (*r* = 0.68), PEOU (*r* =0.68) and a weak correlation with functionality (*r* = 0.27) and IT support (*r* = 0.46). BI's correlation with functionality was significant at the 0.05 level and its correlation with IT support was significant at the 0.01 level. Attitudes towards use had strong positive correlations with PU (*r* = 0.79), PEOU (*r* = 0.61), and BI (*r* = .75). It had a small positive correlation with functionality (*r* = 0.40), and IT support (*r* = 0.44). Each of these correlations was significant at the .01 level. Actual usage had a weak positive correlation with functionality (*r* = 0.32) and was significant at the 0.01 level.

Table 35

Correlation Table for High School Respondents

	Mean	SD	PU	PEOU	U	F	ITS	BI	ATU	AU
PU	3.78	0.97	1.00							
PEOU	4.10	0.78	0.59**	1.00						
U	2.78	1.71	-0.12	-.03	1.00					
F	3.53	1.12	0.42**	0.30**	-0.94	1.00				
ITS	4.02	0.70	0.38**	0.39**	-0.08	0.19*	1.00			
BI	4.02	0.79	0.68**	0.68**	0.01	0.27*	0.46**	1.00		
ATU	4.33	0.82	0.79**	0.61**	-0.13	0.40**	0.44**	0.75**	1.00	
AU	7.76	8.09	0.13	0.11	-0.02	0.32**	-0.11	0.02	0.07	1.00

Note. * Denotes a significant correlation at the 0.05 level (2-tailed). ** Denotes a significant correlation at the 0.01 level (2-tailed). SD stands for standard deviation. PU stands for perceived usefulness. PEUO stands for perceived ease of use. U stands for usability. F stands for functionality. ITS stands for IT support. BI stands for behavioral intention to use. ATU stands for attitudes towards use. AU stands for actual usage.

Perceived ease of use has a strong positive correlation with behavioral intention to use. Pearson Correlation Coefficients were 0.72, 0.65, and 0.68 across elementary school, middle school, and high school respectively. Each correlation was significant at the 0.01, further validating strong positive correlation between the perceived ease of use and behavioral intention to use. Perceived usefulness also had strong positive correlations with behavioral intention to use. The Pearson Correlation Coefficients were 0.63, 0.66, and 0.68 across elementary school, middle school, and high school. Each of these correlations was also significant at the .01 level, highlighting the strong correlation between perceived usefulness and behavioral intention to use. IT support reported mixed levels of correlation with behavioral intention to use. The Pearson Correlation Coefficients were 0.42, 0.54, and 0.46 across elementary school, middle school, and high school respectively. These correlations were not as strong as prior constructs, yet were not weak, and were all significant at the .01 level, indicating the medium-strength, statistically significant, positive correlation that IT support has on behavioral intention to use.

Functionality and usability had wide differences in their correlations with behavioral intention to use. Functionality maintained weak positive correlations with behavioral intention to use. The Pearson Correlation Coefficients for functionality and behavioral intention to use were 0.38, 0.32, and 0.27 across elementary school, middle school and high school respectively. Each of these correlations were significant at the 0.01 level, except for high school which was significant at the 0.05 level. Usability's correlation with behavioral intention to use was both minor and non-significant. The Pearson Correlation Coefficients for usability and behavioral intention to use were 0.18, 0.02, and 0.01 across elementary school, middle school, and high school respectively. None of the usability correlations with behavioral intention to use were significant at any level. These results show that functionality maintains a weak positive correlation with behavioral intention to use while usability has a negligible effect.

Perceived ease of use and perceived usefulness both have strong positive correlations with attitude towards use. The Pearson Correlation Coefficients for perceived ease of use and attitude towards use were 0.63, 0.54, and 0.61 across elementary school, middle school, and high school. Each correlation was significant at the 0.01 level. The Pearson Correlation Coefficients for perceived usefulness and attitudes towards use were 0.60, 0.74, and 0.79 across elementary school, middle school, and high school respectively. Each of correlation was significant at the 0.01 level. The results show that perceived ease of use and perceived usefulness each have strong, statistically significant, positive correlations with attitude towards use.

Attitude towards use has a strong positive correlation with behavioral intention to use. The Pearson Correlation Coefficients for attitude towards use and behavioral intention to use were 0.71, 0.74, and 0.75 across elementary school, middle school, and high school respectively. Each of these correlations is significant at the 0.01 level. These results show that attitude towards use has a strong, statistically significant, positive correlation with behavioral intention to use. Behavioral intention to use has a weak positive correlation with actual system usage. The Pearson Correlation Coefficient for behavioral intention to use with actual system usage was 0.24, 0.22, and 0.02 across elementary school, middle school, and high school respectively. Each of these coefficients, except for the high school respondent category, was significant at the 0.05 level. These results show that behavioral intention to use has a weak, yet statistically significant, positive correlation with actual usage. It is interesting to note that while consistently reporting lower means in each variable surveyed, high school respondents consistently maintained a stronger correlation between the constructs above.

Qualitative: Assessment Issues

Out of 348 total respondents, 345 individuals responded to the question, “What assessment problems did you face during online learning?” The most frequent response was none. There were 153 respondents who stated that they did not experience any assessment problems in online learning. The next most frequent response was cheating and academic integrity. Seventy respondents mentioned the broader topic of cheating, while 41 addressed test security, 11 mentioned the inability to monitor students during assessments, and 18 addressed various other problems revolving around assuring academic integrity. For example, one respondent stated, “Students used Google Translate to do their foreign language work, or Googled answers to questions. Plagiarism was outrageous and unstoppable. Students blatantly copied each other.”

Following academic honesty, technical problems were the next most frequent topic with 33 respondents making comment. The three main sub-topics for technical problems were limited access, devices, and connectivity issues. One respondent elaborated, “Many students didn't have access to a great internet connection or computer. So, programs on google classroom can be difficult to use on a phone.” The next most common response was the lack of training. Lack of training for teachers (16) and students (15) was equally problematic. Additionally, with a frequency of 31, teachers mentioned barriers that were specific to a subject, the teacher, or age group of students. An example was the comment, “For Kindergarten this was difficult because some of the standards required verbal assessment.”

Comments addressing lack of motivation and engagement (23) lend themselves to late work or non-completion of assignments (13). Teachers found it difficult to engage their students in the online environment, and this effected assessments. One teacher responded, “Students turning assignments in on time was the main problem. Many students were not logging in or joining class virtually, so they would miss instruction and then not do the assessment.”

Responses to assessment problems in online learning fall into four themes. The first theme is that a large portion of teachers did not experience any problems at all. This “no problems” theme is important to note. The next theme is testing security. All topics from cheating, to monitoring, to general academic integrity can fall into this category. The third theme is engagement. Many teachers found it extremely hard to get students to show up, focus, and complete assessments during the period of online learning. Without the in-person engagement opportunities, along with a lack of training for students and teachers, educators were not able to adequately engage their students. The fourth theme is accessibility. Accessibility problems are anything from internet issues to lack of electronics. There were many barriers for students due to where they lived, their home electronics or lack thereof, and even knowledge barriers. With all of the potential problems and variables involved, teachers did the best they could for their students.

Qualitative: Barriers to Implementation

Following assessment issues with online learning, 345 respondents answered the second exploratory question of this study. Respondents were asked, "What barriers did you face in implementing online learning?" The responses with the highest frequency, 133 comments, revolved around technical problems. Sub-categories of technical problems were access (47), technology in general (42), technical problems (23), and devices (21). These technical barriers to implementation were especially difficult for teachers to work through because they often had no recourse to help students through these difficulties. While many schools had technology for check-out, there was no way to ensure that students had adequate internet connection or experience using personal technologies. One respondent explained, "Our biggest hurdle was accessibility. Some of our students did not have internet access or even a way to get to the school system-provided hotspots."

The second highest frequency response was environment, with 54 respondents mentioning conditions related to the home environment, parental assistance, and appropriate space to use technology. Many students had younger siblings in the home that played a role in creating distractions. There were also the daily home occurrences that may distract students. Many students also lacked parental assistance or a quiet space to use their technology. A high school respondent explained, "Definitely environmental. Online learning is not for everybody, either on the teaching end or the student end. As a teacher or student, discipline and good time management are a must."

The third most common response was the "other" category. Like the assessment question, many teachers noted specific barriers for subjects, students, or age group. Forty-four teacher responses were coded into this category with one detailing, "My main barrier is math and online tools to use with math. Manipulatives online are great but with elementary students, it requires another set of skills that need to be taught before they are able to utilize them."

The fourth most common response was lack of training. Along with being a problem for assessing students, lack of training was also a general barrier for both students and teachers. Thirty-one respondents mentioned lack of training for teachers and/or students. One respondent stated, "Because it was such a quick jump into an LMS, lack of training was an issue." The fourth most common response was engagement and motivation. Twenty-seven teachers stated that student engagement was a problem for them and many struggled to get their students to attend.

Similar to assessment problems, barriers to implementation can be grouped into four themes. The first theme is access. Access includes technical problems, internet connectivity, device access, and other related problems. The second theme is environment. Environment encompasses anything from home environment, to parental assistance, to work space. The third theme is training. Lack of training for teachers was a huge barrier to implementing online learning. The final theme is micro problems. Micro problems refer to problems specific to a teacher, subject, or specific grade level. These types of problems, while certainly valid, do not necessarily apply to teachers of different subject areas or grade levels.

Path Analysis

According to O’Rourke and Hatcher (2013), Path analysis is the multivariate extension of linear regression where multiple regression models can be run simultaneously in one path analysis model. The difference between the path analysis model and CFA is that the former utilizes only observed variables and no latent constructs. On the other hand, CFA utilizes both the latent construct and indicator variables (survey items that measure the attributes of construct). Path analysis serves as an exploratory step before CFA model specification as it helps to assess the correlations between the variables and the magnitude of impact made by the independent variables on the dependent variable scores. In this dissertation, the researcher utilized the composite scores associated with the constructs that are stated in Figure 3.

There are 14 guidelines that should be followed when conducting path analysis, CFA, and SEM analyses. These rules are that only independent variables may covary, one residual term is created for each dependent variable, exogenous variable do not need residual terms, variances must be estimated for all independent variables and residual terms, covariances must be estimated for each possible combination of exogenous variables, covariance is not calculated for residual terms, one equation corresponds with each endogenous variable, variable names should be on the left of the equal sign, variables with direct effects should be on the right side of the equal sign, neither exogenous variables nor residual terms should ever be on the left side of the equal sign, there must be a unique path coefficient for each independent variable, the last item in each equation must be a disturbance term, each parameter estimated should be named, insert a value into the name to fix a value, and multiple constrained variables should have the same name. Each of these rules were followed and the requisite equations were entered into the SAS program using the PROC CALIS command and will be used alongside confirmatory factor analysis (O’Rourke & Hatcher, 2013).

Squared multiple correlations are the total variance explained in each endogenous variable by a set of exogenous variables are stated in line equations. Table 36 reports the squared multiple correlations as calculated on the SAS platform. As shown in Table 36, 55.8% of variance in attitudes towards use can be explained by perceived usefulness and perceived ease of use.

Table 36

Squared Multiple Correlations

Variables	Error Variance	Total Variance	R-Square
Attitudes Towards Use	0.029	0.662	0.558
Actual Usage	62.266	63.547	0.020
Behavioral Intention to Use	0.274	0.637	0.570
Perceived Ease of Use	0.407	0.570	0.286
Perceived Usefulness	1.456	0.781	0.468

Note. R-square is the total variance explained in the endogenous variable by all the exogenous variables that predict at as shown in the path diagram (Figure 42).

Actual usage has a total variance of 0.020 that can be explained by behavioral intention to use composite scores. Approximately, 57% of variance in behavioral intention to use can be explained by attitudes towards use and perceived usefulness. Similarly, 28.6% of variance in perceived ease of use can be explained by perceived usefulness and IT support. Furthermore, 46.8% of variance in perceived usefulness is explained by functionality and IT support. Attitudes towards use, behavioral intention to use, and perceived usefulness all show an intermediate level of variance explained. Actual usage and perceived ease of use show a lower variance indicating that they are not as well explained by their exogenous variables. Table 37 furthers this information by showing the standardized total effect of each exogenous variable on every endogenous variable. The standardized effects of functionality, IT support, and perceived ease of use are all small to medium. Notably, perceived ease of use has a negative total effect on perceived usefulness.

Table 37

Standardized Total Effects

Endogenous Variable	Exogenous Variable	Standardized Total Effect
PU Composite	F Composite	0.354
PU Composite	ITS Composite	0.344
PU Composite	PEOU Composite	-0.432
PEOU Composite	PU Composite	0.548
PEOU Composite	ITS Composite	0.357
ATU Composite	PU Composite	0.487
ATU Composite	PEOU Composite	-0.095
BI Composite	ATU Composite	0.539
BI	PU Composite	0.427
Actual Usage	BI Composite	0.142

Note. Negative numbers indicate a negative effect on the endogenous variable. SD stands for standard deviation. PU stands for perceived usefulness. PEUO stands for perceived ease of use. U stands for usability. F stands for functionality. ITS stands for IT support. BI stands for behavioral intention to use. ATU stands for attitudes towards use. AU stands for actual usage.

The standard effects for perceived usefulness and IT support on perceived ease of use are strong and medium respectively. The standard effects for perceived usefulness and perceived ease of use on attitudes toward use are strongly positive and weakly negative respectively. Standard effects for attitudes towards use and perceived usefulness on behavioral intention to use are strongly and medium positive respectfully. The total effect of behavioral intention to use on actual usage is small positive. Table 38 shows path estimates for each endogenous variable and the exogenous variables by which they are affected.

The estimated path coefficients for this initial model significantly differed from zero. Each path coefficient, except for IT support on perceived ease of use, was determined to be a significant value < .05. Path estimates for perceived usefulness on perceived ease of use (0.548) and attitudes towards use on behavioral intention to use (0.539) were showed that the exogenous variables were able to obtain large percentages of variance for their respective endogenous variables. Conversely, perceived ease of use on attitudes towards use and behavioral intention to use on actual usage only obtained small percentages of variance for their respective endogenous variables.

Table 38

Path Estimates by Variable

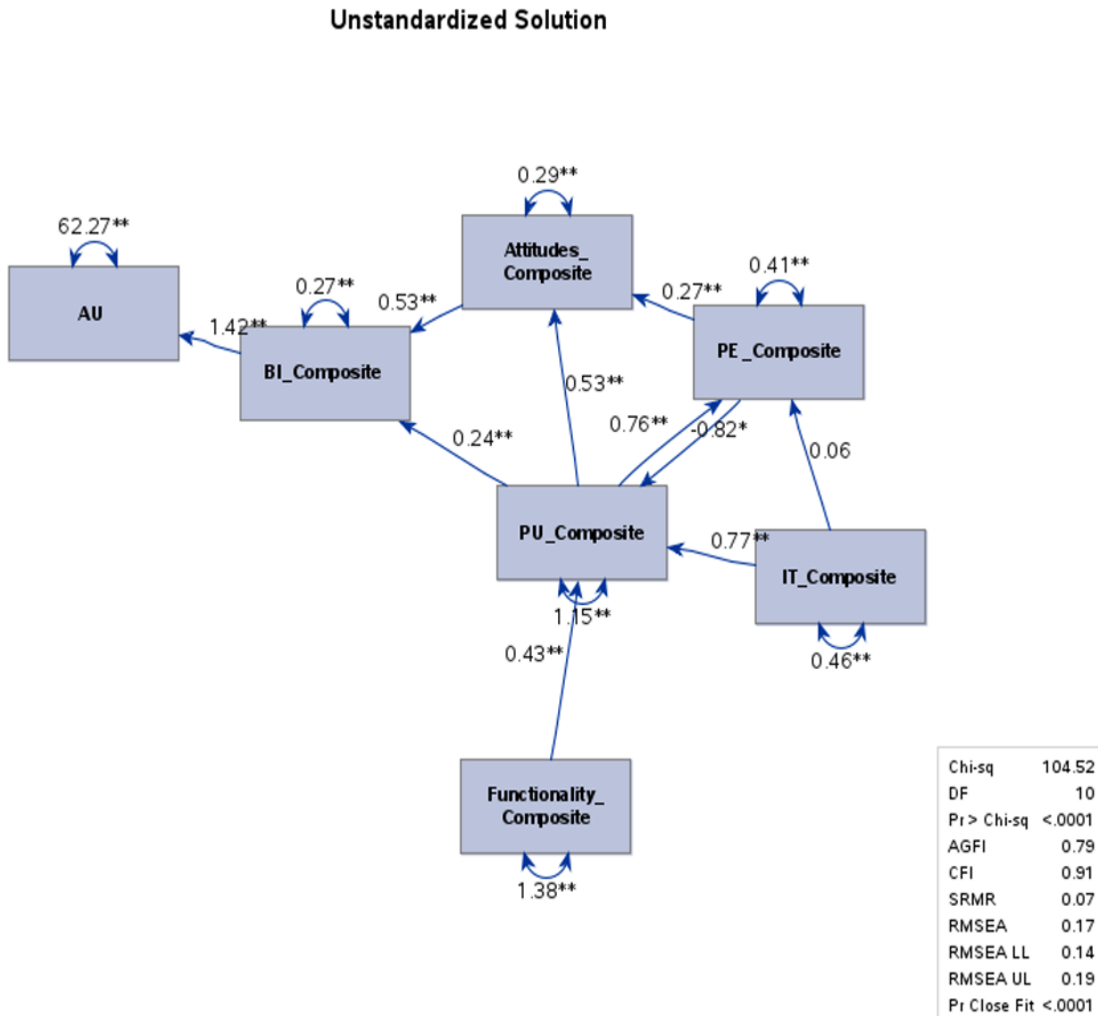
Endogenous Variable	Exogenous Variable	Path Estimate
PU Composite	F Composite	0.354
PU Composite	ITS Composite	0.344
PU Composite	PEOU Composite	-0.432
PEOU Composite	PU Composite	0.548
PEOU Composite	ITS Composite	0.357
ATU Composite	PU Composite	0.487
ATU Composite	PEOU Composite	-0.095
BI Composite	ATU Composite	0.539
BU Composite	PU Composite	0.427
AU	BI Composite	0.142

Note. Negative path estimates indicate negative relationships between two variables. SD stands for standard deviation. PU stands for perceived usefulness. PEUO stands for perceived ease of use. U stands for usability. F stands for functionality. ITS stands for IT support. BI stands for behavioral intention to use. ATU stands for attitudes towards use. AU stands for actual usage.

Figure 40 below is an unstandardized solution from the path analysis performed using the SAS program that shows the relationships among the different variables in the Modified Technology Acceptance Model. Arrows pointing in a specific direction show the direct effects of one observed variable on another. For example, perceived usefulness has a path estimate of 0.53 for its effect on attitudes towards use. Some variables also have indirect effects on other variables. For example, IT composite effects attitudes towards use through perceived usefulness and perceived ease of use.

Figure 40

Path Diagram



Note. ** Indicates a path coefficient is significant at the < .01 level. * Indicates a path coefficient is significant at the < .05 level.

Fit indices for the path diagram can also be seen in this figure. The chi-square value for this path diagram is 104.52 which is relatively high with 10 degrees of freedom. CFI for this path is 0.91 indicating an acceptable fit. SRMR is 0.07 also indicating an acceptable fit. Root mean square error of approximation (RMSEA) is 0.17 which is high yet within limits of acceptability. The RMSEA upper and lower 90% of 0.14 and 0.19 respectively, are close together and also within the limits of acceptability indicating an acceptable model fit. Overall, this path diagram shows a well-fitting model. The large majority of path coefficients are statistically significant at $p < .01$ and in the hypothesized direction.

Confirmatory Factor Analysis

Confirmatory factor analysis CFA) was performed to assess the viability of the Modified Technology Acceptance theoretical model. CFA was performed using the maximum likelihood method by entering a variance-covariance matrix. Table 39 shows the statistical power and degrees of freedom, which indicate a goodness-of-fit indices for the models in this study's path analyses.

Table 39

Statistical Power

Degrees of Freedom	Sample Size	Power
867	348	1

Note. Statistical power of 1 indicates a zero percent chance of a type II error.

Chi-square is added to allow for evaluation of the base model and revised models. The sample size of this study (n = 348) creates enough statistical power to detect medium and large effect sizes. Table 40 shows Standardized Root Mean Square Residual (SRMR), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and 90 percent confidence intervals for RMSEA (O'Rourke & Hatcher, 2013).

This CFI of the initial model is 0.941 which is greater than .94 and indicates a good fit between the data and estimated path models. The RMSEA estimate of 0.0558 is lower than 0.9 and extremely close to 0.05, which indicates an acceptable fit that is borderline good. The SRMSR of 0.0456 is lower than 0.05, which indicates a good fit. The range of the lower and upper 90% estimate for RMSEA is extremely close together and is within acceptable fit, which further indicates a good model fit

Table 40

Fit Comparison Table

Model	X^2	df	ΔX^2	Δdf	CFI	SRMR	RMSEA	RMSEA CL_{90}
Initial Model	1803.79	867	-	-	.9419	.0456	.0558	.0522-.0594
Modified Model 1	1662.76	824	141.03	43	.9459	.0444	.0542	.0504-.0579
Modified Model 2	1559.52	782	103.24	42	.9480	.0442	.0535	.0497-.0574
Accepted Model	1448.12	741	111.4	41	.9513	.0415	.0558	.0484-.0564

Note. X^2 = chi square, df = degrees of freedom, CFI = comparative fit index, SRMR = standardized root mean square residual, RMSEA = root mean square error of approximation, RMSEA CL_{90} = RMSEA 90% confidence limits.

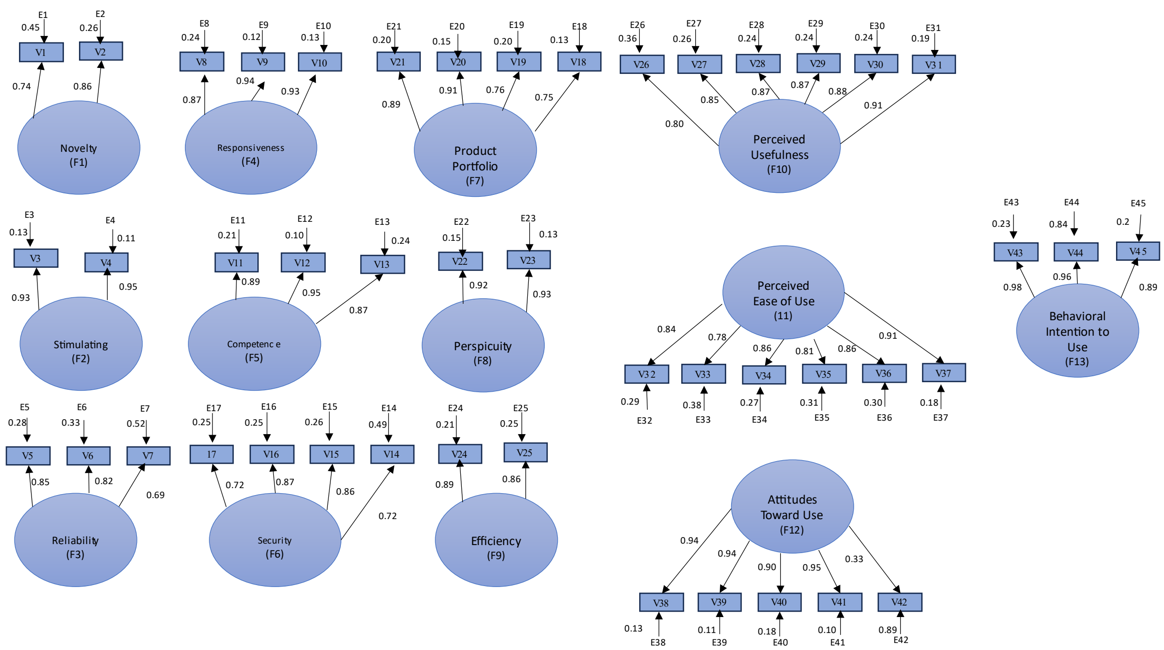
. Accordingly, the first Modified Technology Acceptance Model that hypothesized functionality and IT support significantly predicts perceived usefulness. IT support and usability significantly predict perceived ease of use. Perceived ease of use significantly predicts perceived usefulness. Perceived usefulness and perceived ease of use significantly predict attitudes towards use. Perceived usefulness and attitudes towards use significantly predict behavioral intention to use. Finally, behavioral intention to use finally predicts actual usage is assumed to be correct. In turn, all exogenous variables were assumed to be correlated (O'Rourke & Hatcher, 2013).

Figure 41, below, created through this study, shows the initial CFA model with each latent variable and their associated observed variables with each variable being one survey item. Each latent variable is represented by an oval shape and has multiple observed variables that are represented by a rectangle shape. Each latent variable has an associated error term shown as "E." Arrows from latent variables towards their associated observed variable also have a coefficient that represents the strength of the relationship between the latent variable and observed variable.

For example, behavioral intention to use has coefficients of .098, 0.96, and 0.89 with V43, V44, and V45 respectively.

Figure 41

Initial CFA Model



Note. Arrows point in the direction of hypothesized relationships.

Additionally, arrows pointing from error terms towards observed variables contain an error variance. This CFA model shows that the latent constructs in the Modified TAM are accurately measured by their associated observed variables and that each latent variable has strong factor loadings with their corresponding observed variable. Error variances associated with observed variables are quite low and show that the observed variables are valid indicators of the construct's attributes.

Table 41 to follow shows information concerning relationships between the exogenous latent variables in the Modified TAM CFA model. Trends include a strong positive covariance between functionality and IT support that is statistically significant. Functionality maintains a weak, yet still significant, covariance with usability. Functionality has a weak and significant covariance with perceived usefulness. Perceived ease of use and perceived usefulness show an extremely strong, statistically significant, covariance with each other reflecting their closeness. Perceived usefulness shows a strong and statistically significant covariance with attitudes towards use. Perceived ease of use also has a strong and statistically significant covariance with attitudes towards use. Additionally, perceived ease of use has a strong and statistically significant covariance with behavioral intention to use. Attitudes towards use shows a strong and statistically significant covariance with behavioral intention to use. This information further underscores the strength of the Modified TAM's CFA model.

Table 41

Covariances Among Exogenous Variables

Var1	Var2	Parm	Est	Est-F	Var1	Var2	Parm	Est	Est-F
F1	F2	CF1F2	0.883	0.831	F4	F11	CF4F11	0.267	0.277
F1	F3	CF1F3	0.222	0.222	F4	F12	CF4F12	0.261	0.261
F1	F4	CF1F4	0.114	0.114	F4	F13	CF4F13	0.293	0.90
F1	F5	Cf1F5	0.112	0.121	F5	F6	CF5F6	0.623	0.623
F1	F6	CF1F6	0.203	0.203	F5	F7	CF5F7	0.510	0.509
F1	F7	CF1F7	0.433	0.433	F5	F8	CF5F8	0.048	0.048
F1	F8	CF1F8	0.668	0.668	F5	F9	CF5F9	0.045	0.045
F1	F9	CF1F9	0.720	0.720	F5	F10	CF5F10	0.268	0.265
F1	F10	CF1F10	0.470	0.482	F5	F11	CF5F11	0.273	0.289
F1	F11	CF1F11	0.449	0.468	F5	F12	CF5F12	0.282	0.282
F1	F12	CF1F12	0.404	0.404	F5	F13	CF5F13	0.318	0.318
F1	F13	CF1F13	0.373	0.364	F6	F7	CF6F7	0.517	0.517
F2	F3	CF2F3	0.230	0.230	F6	F8	CF6F8	0.160	0.160
F2	F4	CF2F4	0.120	0.120	F6	F9	CF6F9	0.144	0.144
F2	F5	CF2F5	0.104	0.104	F6	F10	CF6F10	0.324	0.331
F2	F6	CF2F6	0.222	0.222	F6	F11	CF6F11	0.350	0.359
F2	F7	CF2F7	0.403	0.403	F6	F12	CF6F12	0.339	0.339
F2	F8	CF2F8	0.745	0.745	F6	F13	CF6F13	0.380	0.368
F2	F9	CF2F9	0.788	0.788	F7	F8	CF7F8	0.388	0.387
F2	F10	CF2F10	0.449	0.454	F7	F9	CF7F9	0.451	0.451
F2	F11	CF2F11	0.397	0.414	F7	F10	CF7F10	0.664	0.658
F2	F12	CF2F12	0.410	0.410	F7	F11	CF7F11	0.556	0.589
F2	F13	CF2F13	0.323	0.312	F7	F12	CF7F12	0.632	0.632
F3	F4	CF3F4	0.807	0.807	F7	F13	CF7F13	0.629	0.619
F3	F5	CF3F5	0.847	0.847	F8	F9	CF8F9	0.912	0.912

Var1	Var2	Parm	Est	Est-F	Var1	Var2	Parm	Est	Est-F
F3	F6	CF3F6	0.653	0.653	F8	F10	CF8F10	0.464	0.453
F3	F7	CF3F7	0.596	0.596	F8	F11	CF8F11	0.629	0.630
F3	F8	CF3F8	0.176	0.176	F8	F12	CF8F12	0.435	0.434
F3	F9	CF3F9	0.189	0.189	F8	F13	CF8F13	0.460	0.445
F3	F10	CF3F10	0.407	0.405	F9	F10	CF9F10	0.600	0.590
F3	F11	CF3F11	0.443	0.458	F9	F11	CF9F11	0.551	0.565
F3	F12	CF3F12	0.417	0.417	F9	F12	CF9F12	0.533	0.538
F3	F13	CF3F13	0.423	0.420	F9	F13	CF9F13	0.494	0.480
F4	F5	CF4F5	0.941	0.941	F10	F11	CF10F11	0.638	0.640
F4	F6	CF4F6	0.556	0.556	F10	F12	CF10F12	0.793	0.769
F4	F7	CF4F7	0.445	0.446	F10	F13	CF10F13	0.680	0.631
F4	F8	CF4F8	0.054	0.054	F11	F12	CF11F12	0.642	0.660
F4	F9	CF4F9	0.049	0.049	F11	F13	CF11F13	0.689	0.680
F4	F10	CF4F10	0.220	0.218	F12	F13	CF12F13	0.756	0.745

Note. Covariance table for all 13 exogenous variables including estimate, standard error, and significance test. Var 1 is variable 1, Var 2 is variable 2, parm is parameter, est is estimate number 1 and est-f is the final estimate.

Table 42 shows the standardized effects in linear equations. The table shows that CFA model contains significant relationships between the observed variables and latent constructs. Table 42 shows that the latent factors explain the variance observed variables well.

Table 42

Standardized Effects in Linear Equations

Variable	Parameter	Estimate	Estimate-F	Variable	Parameter	Estimate	Estimate-F
V1	F1	0.74174	0.74175	V24	F9	0.88815	0.88752
V2	F1	0.86284	0.86282	V25	F9	0.86810	0.86871
V3	F2	0.93291	0.93352	V26	F10	0.80101	0.80290
V4	F2	0.94651	0.94588	V27	F10	0.84582	0.86085
V5	F3	0.84654	0.84708	V28	F10	0.86522	0.87422
V6	F3	0.82084	0.82034	V29	F10	0.86892	0.87007
V7	F3	0.69239	0.69219	V30	F10	0.88050	0.87416
V8	F4	0.87010	0.87011	V31	F10	0.90100	-
V9	F4	0.94036	0.94031	V32	F11	0.84414	-
V10	F4	0.92988	0.92992	V33	F11	0.77686	0.78771
V11	F5	0.88706	0.88695	V34	F11	0.85872	0.85260
V12	F5	0.94792	0.94815	V35	F11	0.80979	0.83323
V13	F5	0.87324	0.87309	V36	F11	0.86143	0.83751
V14	F6	0.71723	0.71711	V37	F11	0.90904	0.90672
V15	F6	0.86235	0.86231	V38	F12	0.93558	0.93535
V16	F6	0.86707	0.86728	V39	F12	0.94298	0.94337
V17	F6	0.86431	0.86422	V40	F12	0.90470	0.90461
V18	F7	0.74764	0.74897	V41	F12	0.94881	0.94874
Variable	Parameter	Estimate	Estimate-F	Variable	Parameter	Estimate	Estimate-F
V19	F7	0.76055	0.76010	V42	F12	0.32863	0.32841
V20	F7	0.90917	0.90868	V43	F13	0.97740	0.98865
V21	F7	0.89273	0.89279	V44	F13	0.96443	0.95686
V22	F8	0.92157	0.92008	V45	F13	0.8948	-
V23	F8	0.92994	0.93144				

Note. Estimate-F shows the estimates from the modified model 3. Var 1 is variable 1, Var 2 is variable 2, parm is parameter, est is estimate number 1 and est-f is the final estimate.

Table 43 represents significance tests for factor loadings. According to O'Rourke and Hatcher, standardized effects in linear equations shows the level that each variable explains a specific construct. This output is also paired with a *t*-test in order to determine the significance of each estimate.

Table 43

Significance Tests for Factor Loading

Variable	Error Variance	Total Variance	R-Square	Variable	Error Variance	Total Variance	R-Square
V1	.885	1.970	.550	V24	.396	1.874	.787
V2	.415	1.633	.745	V25	.530	2.150	.755
V3	.240	1.850	.872	V26	.340	.943	.642
V4	.200	1.924	.895	V27	.293	1.030	.741
V5	.264	.931	.718	V28	.277	1.103	.764
V6	.271	.832	.673	V29	.251	1.026	.757
V7	.401	.771	.479	V30	.224	.998	.764
V8	.238	.980	.757	V31	-	-	-
V9	.110	.951	.884	V32	-	-	-
V10	.123	.912	.865	V33	.304	.767	.621
V11	.207	.972	.787	V34	.200	.750	.727
V12	.083	.814	.899	V35	.305	.887	.694
V13	.183	.771	.762	V36	.170	.654	.701
V14	.357	.734	.514	V37	.117	.674	.822
V15	.170	.663	.744	V38	.105	.844	.875
V16	.255	1.026	.752	V39	.107	.968	.890
V17	.208	.823	.747	V40	.170	.925	.818
V18	.475	1.077	.561	V41	.089	.895	.900
V19	.368	.872	.578	V42	.935	1.049	.108
V20	.153	.880	.826	V43	.032	.723	.977
V21	.162	.800	.797	V44	.047	.671	.916`
V22	.323	2.143	.847	V45	-	-	-
V23	.300	2.211	.868				

Note. Squared multiple correlations table including all forty-five variables error variance, total variance, and R-Square values

Any non-significant measurements should be deleted from the model. In this study, V1-V2 represent novelty, V3-V4 represent stimulating, V5-V7 represents reliability, V8-V10 represents responsiveness, V11-V13 represents competence, V14-V17 represents security, V18-V21 represent product portfolio, V22-V23 represent perspicuity, V24-V25 represent Efficiency, V26-V31 represents perceived usefulness, V32-37 represents perceived ease of use, V38-V42 represent attitudes towards use, and V43-V45 represent behavioral intention to use. All factors were significant (.0001) with estimates ranging from .32863 to .97740 (O'Rourke & Hatcher,2013).

Although several indices for this model suggested good fit, as shown in Table 42, other indices were less than desirable. The Goodness of Fit Index (GFI) was .8155 and considered not acceptable due to being below .90. Additionally, the chi-square absolute index was 1803.75 which is considered high. GFI and chi-square point to a less strong fit. At first look, the totality of data supported a likelihood that the model fit the data while also showing a possible need for revisions to the model (O'Rourke & Hatcher, 2013).

Modification indices were analyzed to decide if suggested revisions were able to be completed. As a first step, path coefficients were reviewed to determine if any paths in the initial model should be removed. All t values for path coefficients were statistically significant ($p < 0.05$). The Wald test, as shown in table 44, was then conducted in order to test paths' contribution to model fit. The Wald test showed that path CF5F9 carried a chi-square 0.58 and was identified as a candidate for removal. However, this path is between two constructs that cannot be deleted and were therefore not removed (O'Rourke & Hatcher, 2013).

Table 44

Stepwise Multivariate Wald Test

	Cumulative Statistics			Univariate Increment	
Parm	Chi-Square	DF	Pr > ChiSq	Chi-Square	Pr > ChiSq
CF5F9	0.58	1	0.45	0.58	0.45
CF4F9	0.68	2	0.71	0.10	0.75
CF5F8	0.81	3	0.85	0.13	0.72
CF4F8	0.90	4	0.92	0.09	0.76
CF1F4	3.70	5	0.59	2.80	0.09
CF1F5	4.49	6	0.61	0.79	0.37
CF2F5	5.51	7	0.60	1.02	0.31
CF2F4	7.42	8	0.49	1.90	0.17

Note. Cumulative statistics and univariate increment are on the left and right side respectively. Parm is parameter, DF is degrees of freedom, and PR > ChiSq is parameter greater than chi-square.

Next, Lagrange Multipliers (LM) were examined in order to determine if the model could be meaningfully improved by adding or deleting a path. Table 45 to follow shows the top ten, in descending order, greatest LM stat for paths from exogeneous variables.

Table 45

Rank Order of Ten Largest LM Stat for Paths from Exogenous Variables

To	From	LM Stat	Pr > ChiSq	Parm Change
V45	F12	37.55	<.0001	0.21
V31	F13	34.28	<.0001	0.21
V45	F11	28.71	<.0001	0.16
V32	F7	27.55	<.0001	0.19
V38	F13	26.76	<.0001	0.17
V33	F7	25.38	<.0001	0.20
V35	F7	24.53	<.0001	0.20
V31	F12	23.13	<.0001	0.20
V21	F13	22.02	<.0001	0.18
V16	F4	21.47	<.0001	0.20

Note. V45-V16 are ranked 1-10 respectively. Parm is parameter, DF is degrees of freedom, PR > ChiSq is parameter greater than chi-square, and parm change is parameter change.

V45 was chosen to be removed for two main reasons. Survey items are only allowed to load on one exogenous variable and V45 was loading on two separate variables. The second reason that V45 was chosen is due to the fact that it was ranked as the most impactful variable for removal. The resulting model, called CFA Modified Model 1, was re-estimated. As expected, the removal of V45 resulted in improved fit indices for the CFA Modified Model 1. As shown in table 36, the chi-square of modified model 1 was considerably lower than the chi-square of the initial model. SRMSR also decreased indicating a better fit. RMSEA estimate decreased marginally while the upper and lower 90% limit remained close together. The goodness of fit index and comparative fit index both increased.

Although improved, the goodness-of-fit statistics for the Modified Model 1 remained less than desired. The chi-square (1662.76) and goodness of fit index (.8221) both remained too high and too low respectively. Modification indices were examined a second time to determine if another deletion could be made. Table 42 compares the initial model, Modified Model 1, and Modified Model 2. As can be seen in figure 40, V31 loads on F12 and VF13. V31 was chosen for removal because it breaks the rule that only endogenous variables are allowed to co-vary and it was listed as number five on the 10 largest LM stat for paths from exogenous variables chart as seen in table. V31 was subsequently removed. As expected, the removal of V31 resulted in improved goodness-of-fit statistics for the Modified Model 2. As shown in table 36, the chi-square for Modified Model 2 was considerably lower than Modified Model 1 and the initial model. The SRMR, RMSEA estimate, RMSEA lower and upper 90% confidence limits were al improved. The comparative fit index was also marginally improved.

Although improved in the Modified Model 2, not all goodness of fit indices were ideal even after the second modification, the chi-square for Modified Model 2 was too high at 1559.52 and the goodness of fit index only increased to 0.8284. Model of fit indices were examined a third time. V32 was found to load on F7 and F10 and was also listed as the number one variable for deletion per the updated rank order of Table 43. V32 was subsequently delete and the model was re-estimated. As theorized, goodness of fit indices for the Modified Model 3 indicate that the third round of modifications improved the model fit. Chi-square was lowered along with SRMR, RMSEA estimate and the upper 90% and lower 90% confidence limits remained close to each other while breaking in to the desirable range. The comparative fit indices were also above 0.95 indicating a good fit. Table 36 also shows a comparison between the four different models

In accordance with these findings, the Modified Model 3 appears to be the best depiction of associated variables in this study. The revisions made from the initial model each led to an improved model. In accordance with the data, figure 42 will represent the final model.

Figure 42

Final CFA Model

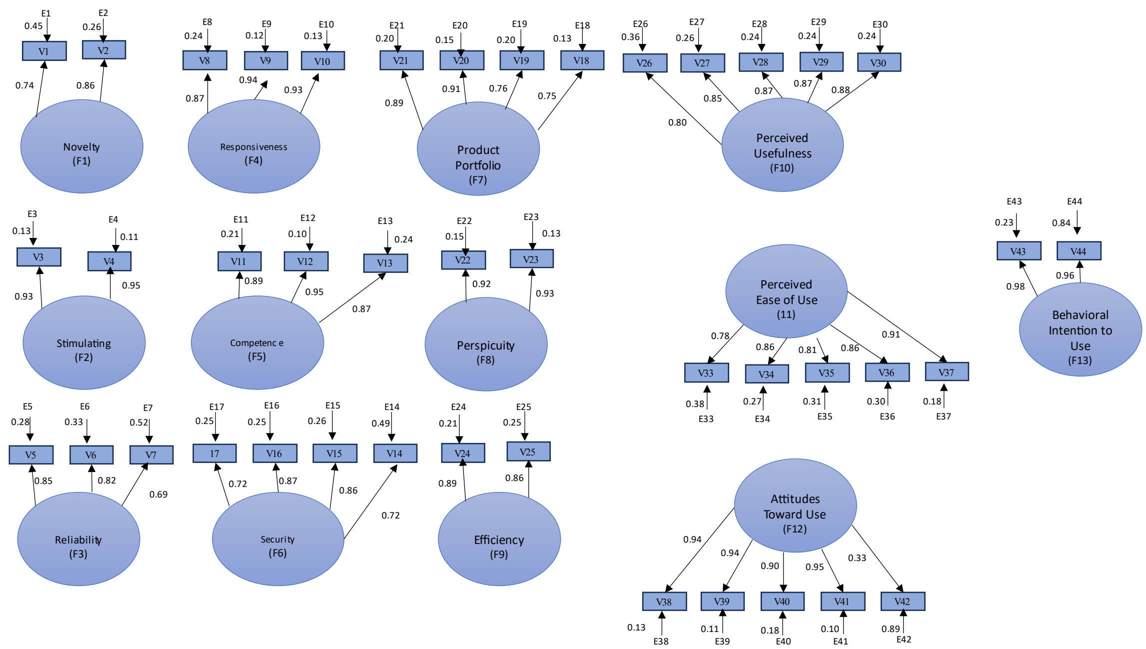


Table 46 to follow shows squared multiple correlations for the final CFA model. According to O'Rourke and Hatcher (2013), R^2 values greater than .39 are considered ideal. All R^2 values in table 43 are greater than .50 and the majority are much higher. These results fulfill indicator reliability for the final CFA model (O'Rourke & Hatcher, 2013).

Table 46

Properties of the Revised Measurement Model

Construct / Indicator	Standardized Loading	Indicator Reliability	Error Variance	Variance Extracted
Novelty (0.785)				0.647
V1	0.74	0.55	0.45	
V2	0.86	0.74	0.26	
Stimulating (0.938)				0.647
V3	0.93	0.87	0.13	
V4	0.95	0.89	0.11	
Reliability (0.831)				0.623
V5	0.85	0.72	0.28	
V6	0.82	0.67	0.33	
V7	0.69	0.48	0.52	
Responsiveness (0.938)				0.835

V8	0.87	0.75	0.25	
V9	0.94	0.88	0.12	
V10	0.93	0.86	0.14	
Competence (0.930)				0.816
V11	0.89	0.79	0.21	
V12	0.95	0.90	0.10	
V13	0.87	0.76	0.24	
Security (0.898)				0.689
V14	0.72	0.51	0.49	
V15	0.86	0.74	0.26	
V16	0.87	0.75	0.25	
V17	0.86	0.75	0.25	
Product Portfolio (0.898)				0.690
V18	0.75	0.56	0.44	
V19	0.76	0.58	0.42	
V20	0.91	0.83	0.17	
V21	0.89	0.80	0.20	
Usability (0.94)				0.830
V22	0.92	0.85	0.15	
V23	0.93	0.87	0.13	
V24	0.89	0.79	0.21	
V25	0.87	0.75	0.25	
Perceived Usefulness (0.93)				0.760
V26	0.80	0.64	0.36	
V27	0.86	0.74	0.26	
V28	0.87	0.76	0.24	
Construct / Indicator	Standardized Loading	Indicator Reliability	Error Variance	Variance Extracted
V29	0.87	0.76	0.24	
V30	0.87	0.76	0.24	
Perceived Ease of Use (0.92				0.740
V33	0.79	0.62	0.38	
V34	0.85	0.73	0.27	
V35	0.83	0.69	0.31	
V36	0.84	0.70	0.30	
V37	0.91	0.82	0.18	
Attitudes Towards Use (0.92)				0.720
V38	0.94	0.87	0.13	
V39	0.94	0.89	0.11	
V40	0.90	0.82	0.18	
V41	0.95	0.90	0.10	
V42	0.33	0.11	0.89	
Behavioral Intention to Use				0.920
V43	0.99	0.98	0.02	
V44	0.96	0.92	0.08	

Note. All tests were significant at the $p < 0.01$. Cronbach's alpha is in parentheses.

O'Rourke and Hatcher (2013) further explain that, when conducting research using multiple scales, the researcher should calculate Cronbach alpha values to test the reliability of scale responses. Cronbach alpha values greater than .69 are considered acceptable with values between .80-.90 being considered ideal. Cronbach alphas greater than .90 may indicate item redundancy. In order to calculate Cronbach alpha, standardized factor loadings were squared and then divided by the squared standardized loading factor plus the error variance. For example, to calculate novelty, the researcher must compute $(.74 + .86)^2 / ((.74 + .86)^2 + (.45 + .26))$ in order to calculate the Cronbach alpha of 0.785. Next, error variance is calculated to measure the amount of variance of factors due to measurement error. In order to calculate error variance, all factor loadings were added and then divided by the factor loadings plus the error variances. For example, to calculate the variance of factors for novelty, the researcher must compute (.74 + .86) / (.74 + .86 + .45 + .26) in order to find 0.647. Table 45 displays these reliability estimates for every variable that was included in the final measurement model. Reliability data is represented in the third column. All factors, including Cronbach's alpha, are statistically significant and acceptable. Variance extracted values show that over 50% of each construct is explained by its survey items (O'Rourke & Hatcher, 2013).

In order to test convergent validity, the t-test value of each factor loading was assessed for statistical significance. According to O'Rourke and Hatcher (2013), convergent validity of each factor is demonstrated when all factor loadings of corresponding indicators are statistically significant. In the case of this study, all factor loadings are significant showing that convergent validity is satisfied. In order to test discriminant validity, the researcher must conduct the chi-square difference test. To conduct the test, the researcher examines the SAS output covariances among exogenous variables and sets the variables with the highest covariance value between F4 and F5. The model is re-run to determine the new chi-square for the model. In this case, the original chi-square from the final CFA model was 1448.402 with 741 degrees of freedom. After constraining a factor to one and re-running the model, the new CFA was 1512.6199. These two numbers are subtracted leaving 64.4797 with 1 degree of freedom. The critical value of chi-square from the chi-square table is 3.85 at the 0.05 significance level. Because 64.4797 is greater than 3.85, the null hypothesis is rejected and it is determined that F4 and F5 are distinct constructs. This test demonstrates discriminant validity (O'Rourke & Hatcher, 2013).

Structural Equation Modeling (SEM)

Table 47 to follow represents the standardized effects in linear equations of the structural equation model and shows the effects that the exogenous variables (predictors) have on the endogenous variables (dependent). This table shows the direct influences on important factors for this study. For example, variable F10 (perceived usefulness) is affected by F1-F7, and F11, which equate to the different factors that make up functionality, IT support, and perceived ease of use. Likewise, F11 (perceived ease of use) is affected by F3-F9 which make up IT support and usability.

Table 47

Standardized Effects in Linear Equations

Variable	Predictor	Estimate	Pr > |t|
F10	F1	0.05	0.5972
F10	F2	0.11	0.2327
F10	F3	0.14	0.2228
F10	F4	-0.19	0.2519
F10	F5	0.03	0.8943
F10	F6	-0.04	0.5322
F10	F7	0.43	< .0001
F10	F11	0.31	< .0001
F11	F3	0.40	0.0014
F11	F4	0.03	0.8524
F11	F5	-0.28	0.1867
F11	F6	-0.01	0.8579
F11	F7	0.38	< .0001
F11	F8	0.88	< .0001
F11	F9	-0.49	0.0096
F12	F10	0.59	< .0001
F12	F11	0.29	< .0001
F13	F10	0.15	0.0155
F13	F12	0.63	< .0001
F14	F13	0.14	0.0071

Note. Standardized effects of the final SEM model.

Table 48 to shows the squared multiple correlations of the final SEM model. F10-F14 are fully endogenous variables. For perceived usefulness (F10), 58% of variance was explained by the exogeneous constructs. For perceived ease of use (F11), 61% of variance was explained by the exogeneous constructs. For attitudes towards use (F12), 65% of variance was explained by the exogeneous constructs. For behavioral intention to use (F13), 57% of variance was explained by attitudes towards use and perceived usefulness exogeneous constructs. Finally, only 2% of F14 (actual usage) is explained by behavioral intention to use. It should be noted that many paths were not statistically significant. For example, paths from F1-F6 on to F10 are all not significant at the < .05 level. Only the pathways between PP and PU (0.43), PU and PEOU (0.31), PP and PEOU (0.38), perspicuity and PEOU (0.88), PU and ATU (0.59), PEOU and ATU (0.29), ATU and BI (0.63), PU and BI (0.15), and BI with AU (0.14) were significant at the < .05 level. This shows that higher level constructs may need to be more closely evaluated on their sub-components.

Table 48

Squared Multiple Correlations

Variable	Error Variance	Total Variance	R-Square
F10	0.35	0.84	0.58
F11	0.22	0.56	0.61
F12	0.28	0.81	0.65
F13	0.31	0.71	0.57
F14	58.86	60.11	0.02

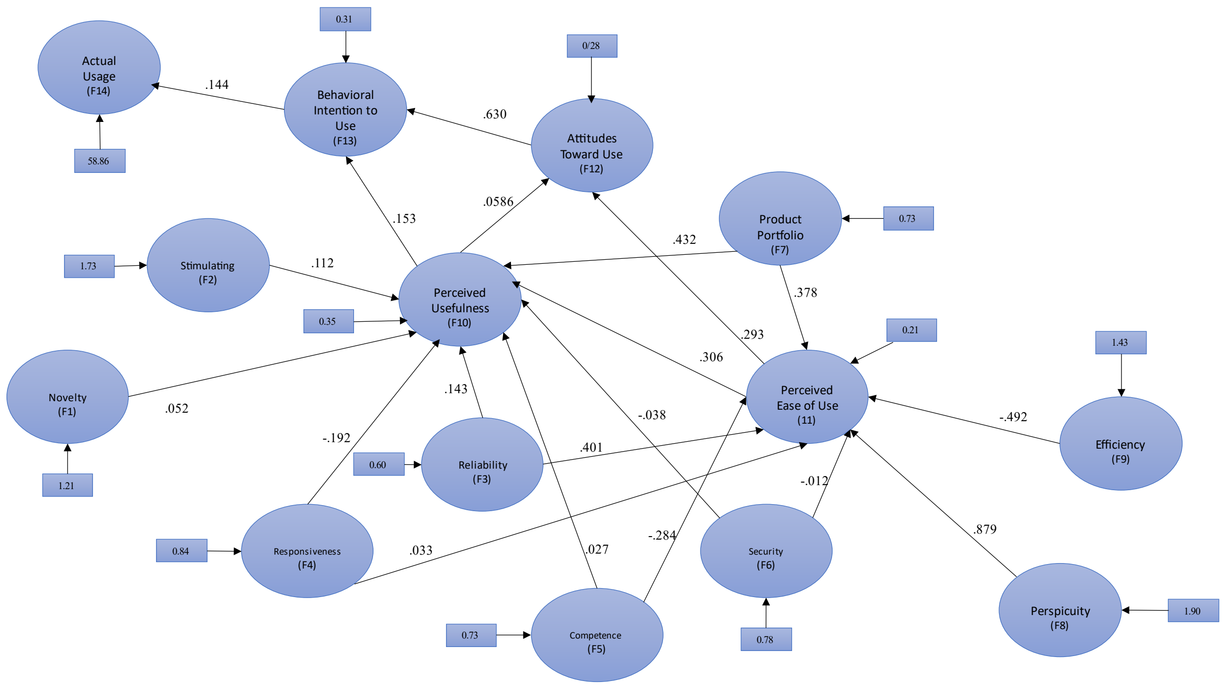
Note. Squared multiple correlations of the final SEM model.

This study followed a three-step approach in order to reach a final structural model. The first step was calculating the theoretical model (Figure 42) using path analysis. The second step was using confirmatory factor analysis to create a measurement model (Figure 44). Figure 44 shows the third revision of the measurement model in which variables 31, 32, and 45 were removed. Figure 43 represents the structural model. The main difference between the structural model and measurement model is that the former specifies causal pathways from the exogenous constructs to the endogenous constructs.

Much like CFA revisions, structural equation models are revised based on the same 14 guidelines. However, when testing revisions to this model, the chi-square and goodness of fit index did not change significantly. Likewise, the nomological validity of the structural model was tested by a chi-square difference test between it and the final CFA model. The chi-square for the structural model was 1622.7911. 1622.7911 – 1448.1402 = 174.6491. The degrees of freedom for the structural model were 803. 803 – 741 = 62. The resulting chi-square difference is greater than 79.082 at the < .05 significance level. Using the totality of fit index data, the initial SEM model is accepted as the final model with no revisions.

Figure 43

Structural Equation Model



Note. Pointed arrows show the effect direction between constructs.

Summary

The results presented in this chapter are extremely thorough and detailed. The researcher begins by explaining demographic data for the 348 respondents of the Modified TAM survey. Following the demographic data, descriptive data were reported. Composite means were created for each main construct in the Modified TAM including functionality, usability, IT support, perceived usefulness, perceives ease of use, attitudes towards use, behavioral intention to use, and actual usage. Composite mean scores were then disaggregated by ethnicity, race, gender, and school level. Differences noted between composite mean scores by race were particularly illuminating in that there may need to be specific training, or outreach, done for minority teachers in regards to the Google Classroom LMS.

Pearson correlation coefficients were conducted between all three school levels, elementary schools, middle schools, high school, and the major Modified TAM components listed herein. Prevailing trends between schools showed that elementary, and to a lesser extent middle schools, rated the Modified TAM components more highly than their high school counterparts. Interestingly, high school respondents' perceptions of the Google Classroom LMS tended to correlate more closely with their behavioral intention to use and actual usage. While rating the components less highly than elementary and middle school teachers, their feelings more accurately portrayed their usage intentions.

Path analysis was then conducted and followed directly by confirmatory factor analysis. Confirmatory factor analysis showed that the large majority of survey items accurately measured the constructs that they were intended to measure. Three revisions were made between the initial and final CFA models. V31, V32, and V45 were removed from the final CFA model which improved fit indices. Finally, a structural equation model was created including specified paths and path co-efficient between laten constructs. Due to a lack of improvement when removing or adding new pathways, no revisions were made to the structural model and the initial model was accepted.

Chapter V: Discussion

Introduction

The onset of the COVID-19 pandemic triggered widespread school closures, forcing both teachers and students to transition to online learning. These emergency changes exposed many educators to the challenges of online instruction for the first time, including issues related to connectivity, academic integrity, test security, and student engagement. Despite these hurdles, teachers and students adapted by persevering through extreme circumstances. This period of emergency online learning provided K-12 teachers with a unique opportunity to use Learning Management Systems (LMS) such as Google Classroom, gaining significant insights into their perceptions of educational technology. The growth of online learning created an opportunity for schools and teachers to learn the most effective aspects of this type of instruction in order to enhance student achievement. This correlational research study aims to capitalize on these experiences, while gathering key data on technology usage and acceptance to aid K-12 schools in improving their online learning strategies.

This study introduced additional constructs of functionality, usability, and IT support in the modified version of the Technology Acceptance Model (TAM) that was originally developed by Davis (1989). These constructs provide a more nuanced understanding of the factors that influence technology acceptance. This research builds on the foundation created by the work of Davis (1989) by expanding on the original TAM components of perceived ease of use, perceived usefulness, attitudes towards use, and behavioral intention to use. While the survey in this study uses the Google Classroom LMS as the technology being evaluated, other LMS could be used as determined by the population being surveyed.

The significance of this study is in its focus on K-12 teacher technology acceptance, an area that has seen limited research post-COVID-19, with most prior studies conducted before the pandemic or at the collegiate level. The inclusion of the Modified TAM constructs functionality, usability, and IT support, alongside a concerted focus on K-12 educators, distinguishes this study as unique and worthwhile. To the best of the researcher's knowledge, no other study integrates these dimensions in the context of K-12 education, making this research a strong contribution to the body of research. This study is also crucial for identifying challenges in online assessment and barriers to effective implementation. The insights gained from this study will be valuable for school leaders attempting to support their teaching staff in the event of future emergencies that may require online instruction.

Chapter five will discuss the major findings and conclusions of this research, addressing its contributions to professional knowledge and educational leadership. It will also explore the implications of these findings for diversity and offer recommendations for future research. The chapter will detail the relationships among functionality, usability, IT support, perceived usefulness, perceived ease of use, attitudes towards use, behavioral intention to use, and actual usage. Additionally, it will present themes identified from teachers' reported challenges in implementing and assessing online learning environments.

Discussion of Findings

This study validates the TAM, to demonstrate support for its traditional constructs within the context of K-12 teachers' acceptance of the Google Classroom LMS. Data analysis showed significant positive correlations between the main TAM constructs and behavioral intention to use the Google Classroom LMS. More specifically, perceived ease of use and perceived usefulness have strongly positive effects on attitudes towards use which in turn had a strongly positive effect on behavioral intention to use.

Perceived ease of use had strong positive Pearson correlation coefficients with attitude towards use across all grade levels (elementary, middle, and high), having coefficients of 0.59, 0.63, 0.54, and 0.61 respectively. SEM analysis showed that perceived ease of use accounted for 29. 3 % of variance in attitudes towards use. The Pearson correlation coefficients between perceived usefulness and attitudes towards use in elementary, middle, and high school were 0.60, 0.74, and 0.79 respectively. SEM analysis showed that perceived usefulness accounted for 58.6 % of variance in attitudes towards use.

The Pearson correlation coefficients between perceived ease of use and behavioral intention to use in elementary, middle, and high school levels were 0.72, 0.65, and 0.68, respectively. The Pearson correlation coefficients between perceived usefulness and behavioral intention to use in elementary, middle, and high school levels were 0.63, 0.66, 0.68 respectively. SEM analysis showed that 15.3% of behavioral intention to use variance can be explained by perceived usefulness. The Pearson correlation coefficients between attitude towards use and behavioral intention to use in elementary, middle, and high school levels were 0.71, 0.74, and 0. respectively. SEM analysis showed that attitudes towards use accounted for 63.0 % of variance in behavioral intention to use. The Pearson correlation coefficients between behavioral intention to use and actual system usage in elementary, middle, and high school levels were 0.24, 0.22, and 0.02 respectively. Behavioral intention to use only accounted for 5.3% of variance in actual system usage. These findings are statistically significant, furthering the previous research by Davis (1989), Venkatesh and Davis (2000), and Alharbi and Drew (2014), which laid the groundwork showing the construct's correlation with behavioral intention to use (Davis, 1989; Venkatesh and Davis, 2000; Alharbi and Frew (2014).

It is important to note that the data presented in this study, while confirming much of the original TAM study, does provide further insight into interactions between TAM constructs. In the original TAM model, attitudes towards use are influenced by both perceived usefulness and perceived ease of use. This study confirms the interaction but appears to show that perceived usefulness has a larger effect on attitudes towards use than perceived ease of use. Likewise, behavioral intention to use is influenced by attitudes towards use and perceived usefulness. Attitudes towards use appears to have a much larger effect on behavioral intention to use than perceived usefulness. Finally, behavioral intention to use appears to have only a small effect on actual usage, indicating that factors such as individual differences, as noted by Burton-Jones and Hubona (2005), might significantly influence actual usage behavior (Burton-Jones & Hubona, 2005).

Actual usage is a complex concept as described by Turner et al. (2010). Turner et al. found that actual usage is more directly influenced by behavioral intention to use than perceived usefulness. However, they noted that actual usage discrepancies may be because of the way actual usage is measured. Turner et al. (2010) differentiated actual usage into objective and subjective usage. Subjective usage is self-reported usage, similar to the way that usage was reported in this study. However, Turner et al. (2010) determined that objective usage, such as computer logs, is likely a more accurate way to measure actual usage. A problem noted is that objective usage is much harder to gather, due to the necessity of artifacts, than subjective usage. Future studies, including further studies using the Modified TAM, should attempt to use objective actual usage in order to determine if it better correlates with behavioral intention to use, perceived usefulness, and attitudes towards use (Turner et al., 2010).

The second key finding indicates that IT support significantly correlates with perceived usefulness and perceived ease of use of the Google Classroom LMS. The Pearson correlation coefficients between perceived usefulness and IT support in elementary, middle, and high school levels were 0.36, 0.53, and 0.38 respectively. Interestingly, the only IT support sub-construct that was significant was product portfolio which accounted for 43.1 % of variance in perceived usefulness. The Pearson correlation coefficients between perceived ease of use and IT support in elementary, middle, and high school levels were 0.41, 0.50, and 0.39 respectively. Like perceived usefulness and IT support, several exogenous variables such as novelty, stimulating, responsiveness, competence, and security were not significant. For example. However, reliability and product portfolio accounted for 40.1 and 37.8 percent of variance respectively in perceived ease of use.

Additionally, IT support significantly correlates with behavioral intention to use the Google Classroom LMS. Pearson correlation coefficients between IT support and behavioral intention to use in elementary, middle, and high school levels were 0.42, 0.54, and 0.46 respectively. These correlations with behavioral intention to use, together with IT support's influence on perceived ease of use and perceived usefulness, show the important role of IT support as noted in studies by Ruggiero and Mong (2015), Zheng et al. (2018), and Alenezi (2011). These studies, along with this author's study, show the importance of strong IT support in facilitating teacher technology use and acceptance in the K-12 setting. However, more research may need to be conducted on the sub-constructs that make up IT support in order to ensure their relevance.

The third key finding was a significant difference in the correlations of the constructs functionality and usability. Strong positive Pearson correlation coefficients between functionality and perceived usefulness in elementary, middle, and high school levels were 0.54, 0.42, and 0.42) respectively. In contrast, SEM analysis showed that none of the functionality sub-constructs significantly affected the variance of perceived usefulness. Novelty and stimulating had $Pr > |t|$ scores of 0.5972 and 0.2327 respectively. The functionality components of this study, novelty and stimulating, are quite closely related to components from a study by Marikyan et al. (2023). In the Marikyan et al. study, the authors found that performance expectations, defined as the degree to which an individual believes using a technology will help in their job completion, are likewise non-significant predictors of actual usage. However, the Marikyan et al. study found that the individual user's innovativeness, defined as a person's willingness to try a new technology, was a significant predictor of technology usage. Future studies may consider shifting novelty and stimulating variables more towards the attributes of the user rather than the LMS (Marikyan et al., 2023).

Additionally, functionality showed weak but significant positive correlations with behavioral intention to use. The Pearson correlation coefficients between functionality and behavioral intention to use in the elementary, middle, and high school levels were 0.38, 0.32, and 0.27 respectively. The Pearson correlation coefficients between usability and perceived usefulness in elementary, middle, and high school levels were 0.04, 0.09, and -0.03 respectively. Usability and behavioral intention to use did not exhibit any significant correlations. The Pearson correlation coefficients between usability and behavioral intention to use in the elementary, middle, and high school levels were 0.18, 0.02, and 0.01 respectively. According to SEM analysis, the only usability subconstruct that was statistically significant was perspicuity which accounted for 88.0 % of variance in perceived ease of use.

These findings suggest that more research needs to be done on the functionality and usability constructs specifically in relation to their effects on perceived usefulness and perceived ease of use. On one hand, the Pearson coefficients of functionality indicate a relatively strong correlation with perceived usefulness yet SEM analysis disputes this data. On the other hand, Pearson coefficients of usability and perceived ease of use indicate weak, if any, correlations while SEM analysis shows a strongly positive influence of perspicuity on perceived ease of use. These findings challenge the results of Holden and Rada (2011), who found that usability was a significantly important factor in technology acceptance. Holden and Rada (2011) found that usability, in combination with perceived ease of use, showed a higher level of influence on attitudes towards use than perceived ease of use alone. Future studies on this topic can be used to test if usability should remain a separate construct, or have perspicuity incorporated into a more inclusive perceived ease of use (Holden & Rada, 2011).

The fourth key finding of this study was that there were significant discrepancies between various sub-constructs and the endogenous variables that they are hypothesized to influence. As previously mentioned, several sub-constructs including novelty, stimulating, responsiveness, competence, and security did not significantly influence perceived usefulness or perceived ease of use. It may be that product portfolio, rather than reliability, responsiveness, competence, and security, is simply the better indicator of perceived usefulness and perceived ease of us. These variables and resulting pathways were retained due to the positive Pearson correlations of the secondary constructs and their assigned endogenous variables, along with a minimal change to fit indices upon elimination. Ideally, further research should be conducted on these constructs. Specifically, the functionality and usability components need to be re-tested using a more detailed sliding scale, or re-worked into Likert-style questions. IT support components need further research to determine if components should be retained or removed from the IT support construct.

The fifth key finding of this study involves the details of key finding four at the micro level. The discrepancies between the above-mentioned sub-constructs and endogenous variables were shown through a disconnect between Pearson correlations and SEM analysis. For example, the Pearson correlations involving functionality were statistically significant while the SEM analysis showed the opposite. Conversely, the Pearson correlations involving usability were not statistically significant while the SEM analysis of the perspicuity sub-construct showed a strongly positive correlation with perceived usefulness. There are several possible reasons for these differences.

The sub-constructs of functionality and usability (novelty, stimulating, perspicuity, and efficiency) were each surveyed using a sliding scale that provided no definition of terms. Furthermore, the sliding scale starting point was at the extreme left (negative term) side and could have affected reporting when combined with a lack of term definitions. IT support items, although not on a sliding scale, could have suffered from some of the same problems such as a lack of definition of terms. It is also less than ideal to have a major change in survey question type without warning or explanation. Each of these potential issues could have contributed to the discrepancies between Pearson correlations and SEM analysis.

The sixth key finding is that efficiency (exogenous variable) has a significantly negative (-0.492) influence on perceived ease of use. This disputes the hypothesized model in that efficiency is one of the two main sub-constructs of usability. As such, efficiency ought to have a positive, if not strongly positive, effect on perceived ease of use. The fact that SEM analysis shows the opposite, means there is likely something wrong with the survey items measuring efficiency or the usability construct itself.

Laugwitz et al. (2008) explain that efficiency can be defined as if a user can solve their task without unnecessary effort and in a quick manner while using a certain technology. The two survey items that measured efficiency were in the form of sliding scales between inefficient and sufficient along with obstructive and supportive. Respondents answering more closely to efficient and supportive indicate answers pointing towards efficiency. The mean score for efficient and inefficient was 4.34 and the mean for supportive and obstructive was 4.41. Both of these means are greater than 3.5 and indicate positive views towards the efficiency of the Google Classroom LMS. Additionally, these means are not dissimilar to the means for the other usability indicator (Laugwitz et al., 2008).

The directions given to respondents for the efficiency and supportiveness questions were the same as all of the sliding questions for functionality and usability. The directions stated, “Choose the term that best describes the Google Classroom LMS. Moving closer to the side of a term indicates a stronger agreement with that term.” One potential problem with these survey items is that there was no definition given for any of the terms associated with them. However, these words are not obscure are likely well understood by any teacher respondent. Barring any problem with the question type, survey item definitions, or directions, there may be an issue with the way the construct itself is measured. Further research should be completed on the usability construct and its constituent parts along the lines of the Burney et al. (2017) study that examines usability and the TAM. Burney et al. (2017) used the component parts of efficiency, memorability, effectiveness, and learnability to make up the usability construct. In fact, the study showed that efficiency loaded on perceived usefulness while learnability and memorability loaded on perceived ease of use. Additionally, the study results found only a small correlation between usability and the TAM constructs of perceived ease of use and perceived usability. It may be that usability, as currently measured in this study, is not specific enough to accurately reflect its influence on perceived ease of use and other TAM constructs (Burney et al., 2017).

The sixth key finding focuses on the two main problems experienced by teachers during the COVID-19 pandemic, and its associated period of emergency online learning, which were technology barriers and academic honesty concerns. Overall, 70 respondents stated that they encountered problems with academic honesty. Teachers specifically mentioned the inability to secure the testing environment, the inability to monitor students, and various other problems revolving around ensuring academic integrity. Technical problems were mentioned by 166 respondents as barriers to implementation and problems with assessment. These problems included access to technology, technical problems, and connectivity issues. Data collected from this study is in line with the studies of Ragpala (2022), Sari (2022), Francom et al. (2021), and Davidson-Shivers and Reese (2014). The problems encountered during the period of emergency online learning are well documented, especially in the upper grade levels (Ragpala, 2022; Sari, 2022; Francom et al., 2021; & Davison-Shivers, 2014).

These findings collectively underscore the complex dynamics of technology acceptance, including the Modified TAM, in the K-12 educational setting. Furthermore, findings illuminate the hardships encountered by teachers during the emergency period of online learning necessitated by the COVID-19 pandemic. They also highlight the need for tailored strategies that address specific barriers to technology acceptance and integration amongst K-12 teachers. The findings from this study produce important implications for educational leaders to consider.

Implications

The main focus of this study was to learn more about K-12 teacher technology acceptance with the additions of functionality, usability, and IT support to the original TAM written by Fred Davis (1989). The secondary focus of this study was to determine what problems K-12 teachers encountered to assess their students along with determining the barriers to implementation that teachers faced during the emergency period of online learning precipitated by the COVID-19 pandemic. Each of these topics were chosen because of their implications for educational leaders. Educational leaders from the building level to the district level can use the information gained from this study to inform future decisions in an effort to improve teacher support and student achievement.

Data from this study showed that the majority of teachers (63.5%) did not have LMS training prior to the emergency period of online learning. This is an important implication because it showed that teachers were not prepared to teach in the online setting and were forced to make do without training. Lack of LMS training likely contributed to some of the problems with assessment and implementation that teachers faced during the emergency online learning period. School principals and district level leaders should consider formal professional development opportunities for teachers to learn the intricacies of specific LMS such as Google Classroom. As shown by Hartman et al. (2019) study, professional learning opportunities are important facilitating conditions for technology use by educators and can increase their intention to use a technology. Professional development opportunities on how to apply the LMS to specific classes should follow general professional development on the LMS in order to increase teacher efficacy as shown by Ruggiero and Mong (2015). Professional development for teachers would be helpful not just in the event of another emergency, but also for improvement of online learning in general (Hartman et al., 2019; Ruggiero & Mong, 2015).

The second implication for educational leaders is that LMS usage may not be as applicable for each school level. For example, this study showed that elementary school teachers use the Google Classroom LMS less than their middle and high school peers. Additionally, middle school teachers use the Google Classroom LMS less than high school teachers. It appears that the Google Classroom LMS may be more applicable for older students. Educational leaders need to consider what level of learner is best for desired LMS and what tasks the expect their students to complete using the LMS. For example, an elementary school teacher mentioned an assessment issue they encountered by stating “for kindergarten, Google Classroom usage was difficult because some of the standards required verbal assessment.” Another elementary school teacher responded that a barrier to implementation was, “the kids did not understand google classroom and that it was not a great resource for lower grade students.” This implication is consistent with the Azzahra et al. (2022) study which showed that elementary students lacked digital literacy skills, learning tools, understanding of subject matter, and motivation (Azzahra et al., 2022).

It may be worthwhile for educational leaders to determine what features of a LMS are usable for elementary level students, train elementary school teachers to use those components, and allow secondary school teachers (middle and high) to use the LMS as a whole. Along with likely being better equipped to use a LMS, middle and high school students also bring their own challenges for teachers and educational leaders. Thomas (2023) found that there were marked differences in teacher perceptions across grade levels. Qualitative results of the Thomas (2023) study revealed that elementary school teachers felt that their students were too young to use a LMS and that they did not read well enough to make LMS usage worth-while. Other elementary school teachers mentioned that they only used specific parts of the LMS in their classrooms. Allowing elementary school teachers to choose applicable aspects of an LMS, and providing professional development opportunities on those aspects, could improve LMS usage by elementary school teachers (Thomas, 2023).

In furtherance of the suggestion to utilize only the most grade level appropriate aspects of LMS for elementary levels, personal learning environment (PLE) creation can potentially increase elementary level teachers' and students' acceptance and usage of LMS. According to Cejudo (2013), a PLE can be described as a self-defined collection of resources, tools, services, and devices used to help teachers and students shape learning. Using this definition, elementary level teachers can help create PLE that best serve their students. These PLE could incorporate the specific areas of LMS that best fit their students, along with other online grade-level resources. Under normal circumstances, teachers could create PLE with a mixture of online and in-person learning (Cejudo, 2013).

Alserhan and Yohaha (2021) conducted a study on teacher perspectives of PLE through LMS. The study found that the highest reported role for teachers in PLE creation was the use of technology. This use of technology includes LMS usage. Technology usage was followed by planning, design, management, and administration. Likewise, Castañeda et al. (2016) conducted a literature review on PLE practices. Castañeda found that PLE helped improve the role of technology and educational resources in the field of education. Further findings were that PLE should support technology-based learning. From the student perspective, the ability to have discussion, an interactive experience, planning, and organizing abilities were important. The combination of PLE and LMS could be an appropriate avenue for elementary level schools to increase student and teacher engagement in the online learning environment (Alserhan & Yohaha, 2021; Castañeda et al. 2016).

Along with understanding the complexities of online learning in multiple school levels, it is also important for educational leaders to understand why teachers' actions may not properly align with their stated intentions. As noted previously, teachers' behavioral intention to use did not strongly correlate with their actual usage of the Google Classroom LMS. The study by Ebert-May et al. (2011) tested the actions of teachers based on their stated intentions. Teachers were offered professional development on student centered learning, causing 89% of teachers to declare that they were going to incorporate student-centered teaching strategies. However, when these teachers were observed in the classroom, 75% used lecture-based teaching. The Ebert-May study even found that only 20% of teachers moved toward a more student-centered approach in the two years after the professional development took place. In fact, a full 23% of teachers used even less student-centered teaching (Ebert-May et al., 2011).

Teachers in the Elbert-May study reported that time, implementation, student attitudes, and assessments were barriers that they faced while trying to implement student-centered learning. Another point of interest is that teachers perceived themselves to use student-centered learning more than they were observed to use it by administrators. When attempting to discover the reasons behind the discrepancy between intention to implement and actual implementation, the Elbert-May study discovered that teacher experience had a strongly negative correlation with actual implementation. These findings have implications on the Modified TAM survey results. Results showed that the average respondent teacher had roughly 17 years' experience. In accordance with the Elbert-May study, this high average experience may have been part of the disconnect between behavioral intention to use and actual usage (Elbert-May et al., 2011).

Along with teacher experience, teacher age is another variable that can affect technology acceptance and LMS usage. While it stands to reason that years' experience and age are quite similar, studies show that age may play an even larger role in technology acceptance. The study by MacFarland (2011), showed that age was a significant predictor of technology acceptance in educators. MacFarland found that older educators are less likely to use technology and questioned if e-learning would be discriminatory based on biological age. Furthering this line of research, Tarhini et al. (2016) found that increased age was associated with difficulty processing technological information (MacFarland, 2011; Tarhini et al., 2016).

The above findings show that teacher age and experience were negatively correlated with technology acceptance and usage may provide some insight on the results of this study. The combination of teacher respondents having an average of 17 years' experience, and a mean age of 45 years, may explain some of the differences that were shown in behavioral intention to use and actual usage. One of the findings in the Elbert-May study offers some guidance to educational leaders. The Elbert-May study found that staff members dedicated to implementation, such as instructional specialists, had a positive influence on staff implementation (Elbert-May et al., 2011).

School and district leaders would be wise to offer professional development along with dedicated staff to help older veteran teachers implement LMS usage. The study by Dindar et al. (2020) found that support was a significant predictor for LMS usage in both experienced and inexperienced teachers. The Dindar study explains that support can be especially impactful for teachers if it is in the form of training in the early stages of LMS implementation. Lochner et al. (2015) also found that teachers need continual support for a LMS to become a lasting part of educational institutions. Specifically, unless early concerns are addressed, teachers will not progress to higher levels of usage. Persistent professional training, along with dedicated IT support staff, may help close the gap between behavioral intention to use and actual usage (Dindar et al. 2020; Lochner et al. 2015).

Another implication for educational leadership is academic honesty in the online learning environment at large. Academic dishonesty is a well-documented issue with online learning and was shown in the assessment problems section of this study. In the qualitative analysis, there were 70 teachers who mentioned that cheating was a major issue with students in the online setting. Teachers mentioned students using google, blatantly copying, and one went so far as to call the academic dishonesty outrageous in nature. The data from this study mirrors the findings of Davidson-Shivers and Reese (2014) and Francom et al. (2021). Davidson-Shivers and Reese (2014), in a literature review, found that the most common types of academic dishonesty in the online setting were plagiarism and unauthorized searching for answers online. The Francom et al. (2021) study took place after the COVID-19 pandemic and surveyed teachers across Mississippi and North Dakota. The study found that over 40% of teachers were unable to hold their students accountable and monitor their progress (Davidson-Shivers & Reese; Francom et al., 2021).

Educational leaders will need to provide teachers with the necessary tools and training in order to adequately support teachers in their endeavors to fairly and accurately assess students in the online setting. For example, lockdown browsers can be used to ensure that students do not open new tabs on their web browsers. Spinks et al. (2023) stated that some teachers even used webcams to monitor students during exams. One of the more successful strategies was to make assessments more reflective in nature. District leaders, and building level leaders, would be wise to prepare their teachers in the event of emergency online learning. This study does not suggest any one solution. Educational leaders need to determine what will work best for their teachers and students (Spinks et al., 2023).

The final implication in this study that applies to educational leaders is that access to adequate technology and IT support is crucial for successful online learning. Over 150 respondents mentioned lack of technology, or general technology issues, as problems they encountered during emergency online learning. If students do not have access to adequate technology, neither teacher technology acceptance or efficacy will allow them to be successful. District leaders and, to some extent, building level leaders should be aware of the need for suitable technology for students who may not have personal devices. If the need for emergency online learning occurs again in the future, educational leaders should have a plan in place to help distribute devices to students, support internet connectivity, and provide support for families. The technological problems encountered by teachers and students during the COVID-19 pandemic can be mitigated with planning and proper execution by educational leaders. Studies by An et al. (2021), Cardullo (2021), and Seabra et al. (2021) specifically mention access to technology as a main barrier to student success.

Teacher IT support, especially personalized IT support, can also have effects on technology acceptance and eventually LMS usage. Venkatesh et al. (2003) found that facilitating conditions such as specialized instruction on technology increased technology acceptance and the likelihood that an individuals would use the technology. Furthermore, Alain Stockless (2018) found that teachers who were asked about educational features of LMS mentioned that they did not know how to take advantage of the different tools offered by the LMS. The research of Venkatesh (2003) and Stockless (2018) are supported by the findings in this study. Teacher specific problems were mentioned in both the assessment issues and barriers to implementation questions in this study. These findings, along with the previous studies by Venkatesh and Stockless show the need for content specific LMS training for K-12 teachers. For example, educational leaders can offer professional learning opportunities by subject area or grade level in order to better support the individual teacher for technology acceptance (Venkatesh et al., 2003; Stockless, 2018).

This study has produced diversity implications on the topic of equity. It has been found by this study that racial minorities, including Black or African American and Native Americans, consistently rated the Google Classroom LMS lower than non-minority teachers in the major constructs of the Modified TAM. With few exceptions, Black or African American and Native

American respondents reported the Google Classroom LMS to be less useful, less easy to use, and also had worse beliefs about IT support. The main area that these two groups reported higher scores in was functionality. Black or African American and Native American respondents view the Google Classroom LMS to be highly functional while also viewing the LMS to be less useful, less easy to use, and also view their IT support more negatively than their non-minority peers.

The definition of functionality for this study is the degree to which a system contains functions that are needed to complete tasks and the definition of usability is to be compatible with user perception, action, and cognitive skills. Functionality is made up of novelty and stimulating while the component parts of usability are perspicuity and efficiency. Results show, across grade levels, that minority teachers view the Google Classroom LMS to be new and stimulating, yet unclear and inefficient. These views appear to point to a lack of understanding of how to use the Google Classroom LMS.

Along with a lack of understanding, these facts indicate a disconnect between minority teachers and the Google Classroom LMS, between minority teachers and the Google Classroom LMS expectations of school leaders, or both. Because these minority teachers view the Google Classroom LMS to be highly functional while also viewing it as less easy to use, it is this author's opinion that outreach and professional development is necessary on the part of educational leadership. Professional development has been shown to increase teacher technology acceptance and may be able close the gaps that exist between minority and non-minority teachers.

Another diversity implication uncovered by this study involves equality of access to technology. It has been well documented that a major barrier to student success during the COVID-19 pandemic was access to acceptable technology (An et al., 2021). Students from lower socio-economic backgrounds are less likely to have access to their own technology, and would likely suffer again in the event of another emergency transition to online learning. According to Williams et al. (2016), racial minorities such as Blacks and Hispanics have over eight times less non-home wealth than their white counterparts. This wealth disparity will likely translate into an inequality of technology access for minority families, including some teachers who may only have access to district-provided technology (Williams et al., 2016).

In the name of equality of access in education, it is important for school systems and individual schools to have plans to assist families from lower socio-economic backgrounds. Programs such as computer lending and Wi-Fi assistance are important ways that leaders in education can assist diverse populations, improve access to technology, and help facilitate equitable outcomes for all students. In the event of another emergency transition to online learning, socio-economic inequalities are likely to hurt minorities unless district and school leadership provide assistance.

Future Research Directions

There remain areas of recommendation for future study, although this study is thorough in nature and covered many aspects of the TAM and Modified TAM. The first recommendation for future study lies within the construct of IT support. As mentioned previously, many of the sub-constructs that combined to make up IT support did not statistically significantly influence perceived ease of use or perceived usefulness. New research should be conducted into the IT support sub-constructs in order to determine if they accurately describe IT support and if they can be shown to influence perceived usefulness or perceived ease of use.

Much like the sub-constructs of IT support, several sub-constructs of functionality and usability deserve further research to determine their relevance to the Modified TAM and technology acceptance in general. The most enigmatic sub-construct of usability is efficiency. In this study, efficiency was shown to have a strongly negative correlation with perceived ease of use. This strongly negative correlation is something that was not anticipated to occur. It was expected that a high level of efficiency would result in a LMS being perceived as easy to use. Because this was not the case, it is necessary that further research be conducted to determine the efficacy of the efficiency sub-construct.

Another area for future research is the marked differences in technology acceptance between school levels. That is, elementary and middle school teachers were more likely to rate the Google Classroom LMS highly than their high school counterparts. High school teachers consistently rated the Google Classroom LMS as less functional, less usable, less useful, less easy to use, and also had lower views of IT support than their elementary and middle school peers. Contrary to these ratings, high school teachers reported higher levels of Google Classroom LMS usage than elementary and middle school teachers. Further research in in this area could help explain these inconsistencies.

The next identified area for future research is the actual system usage construct. This study found that behavioral intention to use only slightly correlated with actual system usage. It is clear that behavioral intention to use has a small effect on actual usage, yet it is highly likely that other factors also exert influence on actual usage. The systematic exploration of what those factors are, and what level of influence they have on actual system usage is a worthy avenue of research that can improve the original TAM as well as the Modified TAM. In fact, a clearer understanding of actual system usage may be the most important area for future technology acceptance research.

The final area identified for future research is on the topic of academic honesty that relates to both assessment problems and implementation. While this study identified cheating as a major problem that teachers faced during the COVID-19 pandemic, and also offered ways to help mitigate traditional academic dishonesty, the advent of artificial intelligence (AI) has created a new challenge for K-12 teachers to overcome when administering online assessments. Hadi et al. (2023) explains large language models (LLM) are technologies that have the ability to learn complex patterns and model the likelihood of word sequences based on probability. The fourth, and most recent, stage of LLM is the generative pre-trained transformer (GPT). GPT such as ChatGPT process large amounts of information from the internet and can be used to complete language tasks (Hadi et al., 2023).

The Hadi et al. (2023) study further explains that ChatGPT and other AI have created both opportunities and problems in the realm of education. ChatGPT has been used to help create PLE, analyze student performance, and also create assessment questions for teachers. However, ChatGPT can also hurt online education outcomes by hindering the development of student skills when students rely too heavily on it. Likewise, Kasneci et al. (2023) stated that AI is a key to future educational innovations. Kasneci et al. further stated that ChatGPT can be used to assist in the development of reading and writing skills for elementary school students, subject-specific writing styles for secondary school students, and even lesson plans for teachers. Educational problems noted in the Kasneci et al. study included copyright issues, potential for bias, student and teacher over-reliance on AI, along with teacher difficulty in distinguishing AI generated content from student created content. There remain areas of recommendation for future study in the context of the technology acceptance model. One tentative area of exploration in future studies can be to assess the influence of AI based Chat-GPT on TAM constructs such as behavioral intentions to use and actual usage along with if demographic variables like age and years of teaching experience modulate the LMS usage levels. (Hadi et al., 2023; Kasneci et al., 2023).

Dissemination of Findings

Technology acceptance is an ever-evolving concept that changes as quickly as technologies are updated and replaced. This study added to the body of research by incorporating functionality, usability, and IT support to the original TAM. This study was particularly strong in its data collection and interpretation. This study incorporated composite means, Pearson correlations, path analysis, confirmatory factor analysis, and structural equation modeling to better understand the relationships between the Modified TAM constructs. Another strength of this study was that it expanded upon a meticulously validated model in the TAM. A weakness of this study was that constructs were not defined in advance to potential respondents. As a work in progress, the Modified TAM can be further refined and added to as more research is conducted on its various constructs. The Modified TAM should be considered a stepping stone to a more perfect model of technology acceptance, one that will improve again in its turn.

This study will be shared with district leadership in the district in which the data was collected. Findings from this study will be shared with the associate superintendent of curriculum and learning, the director of professional development, and building level principals. The findings of this study may also be presented, in the form of professional development, at future principals' conferences where school principals will have the opportunity to learn and ask questions of the researcher. The district in which this research study took place offers opportunities throughout the year for leaders to conduct professional development opportunities, and this study would be an ideal candidate for presentation. The data collected in this study will be especially pertinent for that district and can be used to increase online learning efficacy for teachers and students. Future plans for this study are to find a suitable journal for publication to the wider world of academia. Findings in this study add to the body of research in a significant way and can be used as a basis for future research.

REFERENCES

Ajzen, I. (1985). From Intentions to Actions: A Theory of Planned Behavior. *SSSP Springer Series in Social Psychology*, 1(1), 1-29. https://doi.org/10.1007/978-3-642-69746-3_2

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I., & Fishbein, M. (1975) A Theory-based intervention: The theory of reasoned action in action. (2015). *The Theory of Reasoned Action*, 211–232. https://doi.org/10.4324/9780203769621-17

Akram, H., Abdelrady A., Al-Adwan, A., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology, 13*(1), 1-9. https://www.frontiersin.org/journals/psychology#editorial-board

Allison, P. D. (2009). Missing data. *The SAGE Handbook of Quantitative Methods in Psychology*. 72-89.

Alshira'h, M., Al-Omari, M., & Igried, B. (2021). Usability evaluation of learning management systems (LMS) based on user experience. *Turkish Journal of Computer and Mathematics Education (TURCOMAT*), *12*(1), 6431-6441.

Alenezi, A. (2017). Obstacles for teachers to integrate technology with instruction. *Education and Information Technologies, 22(*4), 1797-1816. 10.1007/s10639-016-9518-5

Alharbi, S., & Drew, S. (2014). Using the technology acceptance model in understanding academics' behavioral intention to use learning management systems. *International*

Journal of Advanced Computer Science and Applications, 5(1), 143-155. 9c881e6228723b0e6975abc190b30926d1ef.pdf (semanticscholar.org)

Alserhan, S., & Yahada, N. (2021). Teacher perspective on personal le https://doi.org/10.3991/ijet.v16i24.27433arning environments via learning management systems platform. *iJET, 16*(24), 57-73.

An, Y., Kaplan-Rakowski, R., Yang, J., Conan, J., Kinard, & W., Daughrity, L. A. (2021). Examining K-12 teachers' feelings, experiences, and perspectives regarding online teaching during the early stage of the COVID-19 pandemic. *Educational Technology Research and Development, 69*(5), 2589–2613. https://doi.org/10.1007/s11423-021-10008-5

Asamoah, M. (2014). Re-examination of the limits associated with correlational research. *Journal of Educational Research and Reviews, 2*(4), 45-52. http://sciencewebpublishing.net/jerr/archive/2014/July/pdf/Asamoah.pdf

Barbour, M. (2018). The landscape of k-12 online learning: What is known. *Touro University of California, 1*(1), 1-23. https://d1wqtxts1xzle7.cloudfront.net/58152280/barbour-handbook-4th-libre.pdf?1547088262=&response-content-disposition=inline%3B+filename%3DBarbour_M_K_2019_The_landscape_of_K_12_o.pdf&Expires=1678743923&Signature=aen2lCJYowgyd8RHRWRA8D4tNwBMAVuIyaNQlme~7KC6nhLtELH3wsUXBYZ1kdCvQTFM6N8rNSZIxSAl~8nic6TM9uDR5IfadZPG5wSGsSWojfDb~exHpq-w9VPsEf2-oc1Jafjpk7QXQvyFFsLiIcITd41vzfvvF2jBXHLir~aeuxaTnrkXDTJuv~yL6tRGdzT7iXHLwehsk07~HcMkyO2YpWEkN1TP0VjVWcFcFWdFvFA0Pzr72BfMi3JchB2~iQzAqrm

GwWQnseYYEUnMzkAasMNfrHQ2fUmWfLORI-YAipYJdY-wbPzP2w1kKyhlF~ZxRKwUizEf4WTiFGQP3Q__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88, 588−606. https://psycnet.apa.org/doi/10.1037/0033-2909.88.3.588

Burney, S., Siddiqui, F., & Asim, S. (2017). Discovering the correlation between technology acceptance model and usability. *IJCSNS International Journal of Computer Science and Network Security, 17(*11), 53-61. *https://www.researchgate.net/publication/321883220_Discovering_the_Correlation_between_Technology_Acceptance_Model_and_Usability?enrichId=rgreq-213a66c5d92efbe2c8b8601b09ca7506-XXX&enrichSource=Y292ZXJQYWdlOzMyMTg4MzIyMDtBUzo1NzI5ODUwNTM5ODY4MTZAMTUxMzYyMTY5MDQwNA%3D%3D&el=1_x_2&_esc=publicationCoverPdf*

Burton-Jones, A., & Hubona, D. (2002). Individual differences and usage behavior: Revisiting a technology acceptance model assumption. *The Data base for Advances in Information Systems, 36*(2), 58-77. https://doi.org/10.1145/1066149.1066155

Butler, D., & Sellbom M. (2002). Barriers to adopting technology for teaching and learning. *Educause Quarterly, 2*(1), 22-28.

Brezavšček, A., Šparl, P., & Žnidaršič, A. (2016). Factors influencing the behavioral intention to use statistical software: The perspective of the slovenian students of social science.

*EURASIA Journal of Mathematics Science and Technology Education, 13(*3), 953-968. DOI 10.12973/eurasia.2017.00652a

Cardullo, V., Wang, C., Burton, M., & Dong, J. (2021). K-12 teachers' remote teaching self-efficacy during the pandemic. *Journal of Research in Innovative Teaching and Learning, 14*(1), 32-45. https://doi.org/10.1108/JRIT-10-2020-0055

Castañeda, L., Dabbagh, N., & Torres-Kompen, R. (2017). Personal learning environments: Research-based practice, frameworks and challenges. *Journal of New Approaches in Educational Research, 6*(1), 1-2. DOI: 10.7821/naer.2017.1.229

Cejudo, M. (2013). Assessing personal learning environments (PLEs): An expert evaluation. *New Approaches in Educational Research, 2*(1), 39-44. DOI: 10.7821/naer.2.1.39-44

Centers for Disease Control and Prevention. (2022, August 16). *CDC Museum COVID-19 Timeline*. CDC.gov. https://www.cdc.gov/museum/timeline/covid19.html

Chen, W., Sanderson, N., Nichshyk, A., Bong, W., & Kessel, S. (2023). *Usability of learning management systems for instructors: The case of canvas*. Oslo Metropolitan University. Usability of Learning Management Systems for Instructors – The Case of Canvas.pdf (adobe.com)

Cheema, J. (2014). A review of missing data handling methods in educational research. *Review of Educational Research, 84*(4), 487-508. DOI: 10.3102/0034654314532697

Chou, C.-P., & Bentler, P.M., (1996). Application of AIC with the Wald and Lagrange multiplier statistics: Model modification in covariance structure analysis. *Multivariate Behavioral Research, 31*(1), 351–370. https://doi.org/10.1207/s15327906mbr3103_5

Curran, P. J., West, S. G, & Finch, J. F. (1996). The robustness of test statistics to non-normality and specification error in confirmatory factor analysis. *Psychological Methods*, 1, 16−29. https://psycnet.apa.org/doi/10.1037/1082-989X.1.1.16

Davidson-Shivers, G., & Reese, R. (2014). Are online assessments measuring student learning or something else? In P. R. Lowland, C. S. York and J. C. Richardson (Eds.), *Online learning: Common misconceptions and benefits and challenges* (pp. 137-152). Nova Science Publishers, Inc.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319. https://doi.org/10.2307/249008

Dennie, D., Acharya, P., Greer., D., & Bryant, C. (2019). The impact of teacher-student relationships and classroom engagement on student growth percentiles of 7th and 8th grade students. *Psychology in Schools, 56*(1), 765-780.

Dincher, M., & Wagner, V. (2021). Teaching in times of covid-19: Determinants of teachers' educational technology use. *Education Economics, 29*(5), 461–470. https://doi.org/10.1080/09645292.2021.1920000

Dimitrijevic, S., & Devedzic, V. (2020). Usability evaluation in selecting educational technology. *International Conference on Information Technology and Development of Education, 1*(1), 1-8. 1https://www.researchgate.net/publication/346403516_Usability_Evaluation_in_Selecting_Educational_Technology?enrichId=rgreq-cb5af7c64afc037218221795c429b926-XXX&enrichSource=Y292ZXJQYWdlOzM0NjQwMzUxNjtBUzo5NjIyMjE2MDE0NTYxMzBAMTYwNjQyMjkxNTI0OQ%3D%3D&el=1_x_2&_esc=publicationCoverPdf

Dindar, M., Suorsa, A., Hermes, J., Karppinen, P., & Näykki, P. (2021). Comparing technology acceptance of K-12 teachers with and without prior experience of learning management systems: A COVID-19 pandemic study. *Journal of Computer Assisted Learning*, 37(6), 1553–1565. https://doi.org/10.1111/jcal.12552

Dolenc, K., Šorgo, A., & Ploj Virtič, M. (2022) The difference in views of educators and students on forced online distance education can lead to unintentional side effects. *Education and Information Technologies, 26*(6), 7079–7105. 10.1007/s10639-021-10558-4

Dorn, E., Hancock, B., Sarakatsannis, J., & Viruleg, E. (2020). COVID-19 and student learning in the United States: The hurt could last a lifetime. *Public Sector Practice, 1*(1), 1-9. https://www.childrensinstitute.net/sites/default/files/documents/COVID-19-and-student-learning-in-the-United-States_FINAL.pdf

Eadens, D. W., Maddock, D., Thornburg, A. W., & Abernathy, D. F. (2022). K-12 teacher perspectives on the pandemic pivot to online teaching and learning. *Journal of Pedagogical Research, 6*(1), 131-151. https://dx.doi.org/10.33902/JPR.2022175776

Elbert-May, D., Derting, T., Hodder, J., Momsen, J., Long, T., & Jardeleza, S. (2011). What we say is not what we do: Effective evaluation of faculty professional development programs. *Bioscience, 61*(7), 550-558. doi:10.1525/bio.2011.61.7.9

Fathema, N., Shannon, D., & Ross, M. (2014). Expanding the technology acceptance model (tam) to examine faculty use of learning management systems (LMS) in higher education institutes. *MERLOT Journal of Online Learning and Teaching, 11(*2), 210-232. Microsoft Word - 04 Fathema.docx (merlot.org)

Francom, G. M. (2016). Barriers to technology use in large and small school districts. *Journal of Information Technology Education. Research, 15*, 577.

Francom, G. M., Lee, S., & Pinky, H. (2021). Technologies, challenges and needs of K-12 teachers in the transition to distance learning during the covid-19 pandemic. *TechTrends, 65(*1), 589-601. https://doi.org/10.1007/s11528-021-00625-5

García-Morales, V. J., Garrido-Moreno, A., & Martín-Rojas, R. (2021). The transformation of higher education after the Covid Disruption: Emerging Challenges in an online learning scenario. *Frontiers in Psychology, 12*. https://doi.org/10.3389/fpsyg.2021.616059

Ghorbani, H., (2019). Mahalanobis distance and its application for detecting multivariate outliers. *Mathematics Subject Classification, 34*(3), 583-595. https://doi.org/10.22190/FUMI1903583G

Ghosh, A., Nafalski, A., Nedic, Z., & Wibawa, A. (2019). Learning management systems with emphasis on the Moodle at Unisa. *Bulletin of Social Informatics Theory and Application, 3*(1)*,* 13-21. https: doi.org/10.31763/businta.v3i1.160

Goodwin, N. (1987). Functionality and usability. *Communications of the ACM, 30*(3), 229-233. https://dl.acm.org/doi/pdf/10.1145/214748.214758

Health Behavior and Health Education. Upenn.edu. Retrieved October 11, 2023, from https://www.med.upenn.edu/hbhe4/part2-ch4-theory-of-reasoned-action.shtml

Hadi, M., Al-Tashi, Q., Qureshi, R., Shah, A., Muneer, A., Irfan, M., Zafar, A., Shaikh, M., Akhtar, N., Wu, J., & Mirjaliili, S. (2023). A survey on large language models:

Applications, challenges, limitations, and practical usage. *Techrxiv, 1*(1), 1-34. DOI: 10.36227/techrxiv.23589741.v4

Hartman, R., Townsend, M., & Jackson, M. (2019). Educators' perceptions of technology integration into the classroom: a descriptive case study. *Journal of Research in Innovative Teaching and Learning, 12*(3), 236-249. DOI 10.1108/JRIT-03-2019-0044

Holden, H., & Rada, R. (2011). Understanding the influence of perceived usability and technology self-efficacy on teachers' technology acceptance. *Journal of Research of Technology in Education, 43*(4). 343-367. https://doi.org/10.1080/15391523.2011.10782576

Hu, L., & Bentler, P. (1995). Evaluating model fit. In R. H. Hoyle (Ed.), *Structural equation modeling. Concepts, issues, and applications* (pp. 76−99). London: Sage

Hussein, Z. (2017). Leading to intention: The role of attitude in relation to technology acceptance model in e-learning. *Procedia Computer Science*, 105, 159–164. https://doi.org/10.1016/j.procs.2017.01.196

Inbal, T., & Blau, I. (2021). Facilitating emergency remote K-12 teaching in computing-enhanced virtual learning environments during COVID-19 pandemic: Blessing or curse? *Journal of Educational Computing Research*, *59*(7), 1243–1271. https://doi.org/10.1177/0735633121992781

Ioannidis, JPA. (2022). The end of the COVID-19 pandemic. *European Journal of Clinical Investigation*, *52*(6), 1-12. https://doi.org/10.1111/eci.13782

In ‘Nami, Y., & Koizumi, R. (2013). Structural equation modeling in educational research: A primer. In M. S. Khine (Ed.), *Application of Structural Equation Modeling in Educational Research and Practice* (pp. 23-51). Boston: Sense Publishers.

Joo-Nagata, J., Martinez Abad, F., García-Bermejo Giner, J., & García-Peñalvo, F. J. (2017). Augmented reality and pedestrian navigation through its implementation in M-learning and e-learning: Evaluation of an educational program in Chile. *Computers & Education*, 111, 1–17. https://doi.org/10.1016/j.compedu.2017.04.003

Joo, Y. J., Park, S., & Lim, E. (2018). Factors influencing preservice teachers’ intention to use technology: TPACK, teacher self-efficacy, and technology acceptance model. *Journal of Educational Technology and Society*, *21*(3), 48–59.

Jöreskog, K. G., & Sörbom, D. (1981). LISREL V: Analysis of linear structural relationships by maximum likelihood and least squares methods (*Research Report 81−8*). Uppsala, Sweden: University of Uppsala, Department of Statistics

Jöreskog, K. G., & Sörbom, D. (1989*). LISREL 7 user's reference guide*. Chicago: SPSS Publications

Jöreskog, K. G., & Sörbom, D. (1993). *Structural equation modeling with the SIMPLIS command language*. Chicago: Scientific Software

Kasneci, E., Sessler, K., Kuchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Gunnerman, S., Hullermeier, E., Krusche, S., Kutinyiok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., Stadler, M., Weller, J., Kuhn, J., & Kasneci, G. (2023). Chat GPT for good? On opportunities and challenges for large language models in education. *ELSEVIER, 103*(1), 1-9. DOI: 10.36227/techrxiv.23589741.v4

Kaplan, D. (2000). *Structural equation modeling: Foundation and extensions*. Thousand Oaks, CA: Sage Publications

Keengwe, J., & Kidd, T. (2010). Towards best practice in online learning and teaching in higher education. *Journal of Online Learning and Teaching 6*(1), 533-541.

Laugwitz, B., Schrepp, M. & Held, T. (2008). Construction and evaluation of a user experience questionnaire. *European Journal of Clinical Investigation. 52*(6), 1-12. http://dx.doi.org/10.1007/978-3-540-89350-9_6

Lobos Peña, K., Bustos-Navarrete, C., Cobo-Rendón, R., Fernández Branada, C., Bruna Jofré, C., & Maldonado Trapp, A. (2021). Professors' expectations about online education and its relationship with characteristics of university entrance and students' academic performance during the COVID-19 pandemic. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.642391

Lochner, B., Conrad, R., & Graham, E. (2015). Secondary teachers' concerns in adopting learning management systems: A U.S. perspective. *TechTrends, 59*(5), 62-70. https://doi.org/10.1007/s11528-015-0892-4

MacFarland, D. (2011). The role of age and efficacy on technology acceptance: Implications of e-learning. U*S Department of Education,* 1-8. https://files.eric.ed.gov/fulltext/ED466607.pdf

Marikyan, D., Papagiannidis, S., & Stewart, G. (2023). Technology acceptance research: Meta-analysis. *Journal of Information Science, 1*(1), 1-22. DOI: 10.1177/01655515231191177

Marsh, H. W., Hau, K-T., Balla, J. R., & Grayson, D. (1998). Is more ever too much? The number of indicators per factor in confirmatory factor analysis. *Multivariate Behavioral Research, 33*(1), 181−220. https://doi.org/10.1207/s15327906mbr3302_1

Mayes, J., & Fowler, C. (1999). Learning technology and usability: A framework for understanding courseware. *Interacting With Computers, 11*(1), 485-497. https://doi.org/10.1016/S0953-5438(98)00065-4

McDonald, R. P., & Marsh, H. W. (1990). Choosing a multivariate model: Non-centrality and goodness-of-fit. *Psychological Bulletin*, 103, 391−411. https://psycnet.apa.org/doi/10.1037/0033-2909.107.2.247

Mondiana. Y., Pramoedyo, H., & Sumarminingish, E. (2018). Structural equation modeling on Likert scale data with transformation by successive interval method with no data transformation. *International Journal of Scientific and Research Publications, 8*(5), 398-405. http://dx.doi.org/10.29322/IJSRP.8.5.2018.p7751

Muthén, L. K., & Muthén, B. O. (2002). How to use a Monte Carlo study to decide on sample size and determine power. *Structural Equation Modeling, 4*(1), 599−620. https://doi.org/10.1207/S15328007SEM0904_8

Morrison, L., & Jacobsen M. (2023). The role of feedback in building teaching presence and student self-regulation in online learning. *Social Sciences & Humanities Open, 7(*1), 1-8. https://doi.org/10.1016/j.ssaho.2023.100503

Nafsaniath, F., Shannon, D., & Ross, M., (2015). Expanding the technology acceptance model (TAM) to examine faculty use of learning management systems in higher education institutions. *Merlot Journal of Online Learning and Teaching, 11(*2), 210-232. https://jolt.merlot.org/Vol11no2/Fathema_0615.pdf

National Center for Educational Statistics, (2023, July 2). *District directory information*. NCES. https://nces.ed.gov/ccd/districtsearch/district_detail.asp?ID2=1301410

Newsom, J. (2005). Practical approaches to dealing with nonnormal and categorical variables [PDF Document]. Retrieved from Lecture Notes Online Web site: http://www.upa.pdx.edu/IOA/newsom/semclass/

Nguyen, J., Keuseman K., & Humston, J. (2020). Minimize online cheating for online assessments during COVID-19 Pandemic. *Journal of Chemical Education, 97*(1), 3429-3435.

Ni, A. (2013). Comparing the effectiveness of classroom and online learning: Teaching research methods. *Journal of Public Affairs Education, 19(*2), 199-215.

Ogange, B., Agak, J., Okelo, K., & Kiprotich, P. (2018). Student perceptions of the effectiveness of formative assessment in an online learning environment. *Open Praxis 10(*1), 29-39. https://doi.org/10.5944/openpraxis.10.1.705

Philipsen, B. (2018). *Teacher professional development for online and blended learning in adult education and training* (Doctoral dissertation, Vrije Universiteit Brussel, Brussels, Belgium).

Ragpala, E. (2022). K-12 online education during covid-19 pandemic: A private school perspective. *International Research Journal of Science, Technology, Education, and Management, 2(*2) 139-152. https://doi.org/10.5281/zenodo.6951513

Rai, N., & Thapa, B. (2015). A study on purposive sampling method in research. *Kathmandu: Kathmandu School of Law*, *5(1)* 1-12. A_Study_on_Purposive_Sampling_Method_in_Research-libre.pdf (d1wqtxts1xzle7.cloudfront.net)

Reid, P. (2012). Categories for barriers to adoption of instructional technologies. *Education and Information Technologies, 19*(1), 383-407. https://doi.org/10.1007/s10639-012-9222-z

Rhode, J., Richter, S., Gowen, P., Miller, T., & Wills, C. (2017). Understanding faculty use of the learning management system. *Online Learning*, *21*(3) 68-86. Doi: 10.24059/olj.v%vi%i.1217

Richardson, H. A., Simmering, M. J., & Sturman, M. C. (2009). A tale of three perspectives: Examining post hoc statistical techniques for detection and correction of common method variance. *Organizational Research Methods, 12*(4), 762–800.

Ruggiero, D., & Mong, C. J. (2015). The teacher technology integration experience: Practice and reflection in the classroom. *Journal of Information Technology Education, 14(*1), 161-178. http://dx.doi.org/10.28945/2227

Ryu, E. (2011). Model fit evaluation in multilevel structural equation models. *Frontiers in Psychology, 5*(81), 1-9. DOI:10.3389/fpsyg.2014.00081

Sari, M. (2022). A case study on online teaching during the covid-19 pandemic perceived by primary school teachers. *International Journal of Psychology and Educational Studies, 9(*2), 440-449. https://dx.doi.org/10.52380/ijpes.2022.9.2.705

Scherer, R., Howard, S.K., Tondeur, J., & Siddiq F. (2021). Profiling teachers' readiness for online teaching and learning in higher education: Who's ready? *Computers in Human Behavior, 118*(1), 1-16. https://doi.org/10.1016/j.chb.2020.1066754

Schermelleh-Engel, K., Moosbrugger, H. & Miiler, H. (2003). Evaluating the Fit of Structural Equation Models: Tests of Significance and Descriptive Goodness-of-Fit Measures. *Methods of Psychological Research, 8(2)*, 23-74. https://www.stats.ox.ac.uk/~snijders/mpr_Schermelleh.pdf

Schumacker, R. E., & Lomax, R. G. (1996). *A beginner's guide to structural equation modeling. Mahwah*, NJ: Lawrence Erlbaum Associates

Seabra, F., Teixeira, A., Abelha, M., & Aires, L. (2021). Emergency remote teaching and learning in Portugal: Preschool to secondary school teachers' perceptions. *Education Sciences, 11*(7), 349. https://doi.org/10.3390/educsci11070349

Songkram, N., & Osuwan, H. (2022). Applying the technology acceptance model to elucidate K-12 teachers' use of digital learning platforms in Thailand during the COVID-19 pandemic: *Sustainability 14*(1). 1-12. https://doi.org/10.3390/su14106027

Stockless, A. (2018). Acceptance of learning management system: The case of secondary school teachers. *Educational Information Technology, 23*(1), 1101-1121, DOI 10.1007/s10639-017-9654-6.

Stone, D., Zheng, G. (2014). Learning management systems in a changing environment. *Handbook of Research on Education and Technology in a Changing Society, 1(*1), 165-177. http://www.igi-global.com/chapter/learning-management-systems-in-a-changing-environment/111885

Tarhini, A., Elyas, T., Akour, M., & Al-Salti, Z. (2016). Technology, demographic characteristics, and e-learning acceptance: A conceptual model based on extended technology acceptance model. *Higher Education Studies, 6*(3), 72-89. http://dx.doi.org/10.5539/hes.v6n3p72

Thomas, E. (2023). The adoption of a learning management system by k-8 teachers. *Concordia University Irvine ProQuest Dissertations & Theses,* 1-180. https://www.proquest.com/docview/2833416528/fulltextPDF/CC7027C4526B44D4PQ/1?accountid=73745&sourcetype=Dissertations%20&%20Theses

Thuseethan, S., Achchuchan, S., & Kuhanesan, S. (2014). *Usability evaluation of learning management systems in Sri Lankan universities.* Sabaragamuwa University of Sri Lanka. https://doi.org/10.48550/arXiv.1412.0197

Turner, M., Kitchenham, M., Brereton, P., Charles, S., & Budgen, D. (2010). Does the technology acceptance model predict actual usage? A systematic literature review. *Information and Software Technolgoy, 5(*2), 463-479, doi:10.1016/j.infsof.2009.11.005

Ullman, J. (2006). Structural equation modeling: Reviewing the basics and moving forward. *Journal of Personality Assessment.*

United Nations Educational, Scientific and Cultural Organization. (2021). *Education: from school closure to recovery.* UNESCO. https://www.unesco.org/en/covid-19/education-response

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, *11*(4), 342-365. https://doi.org/10.1287/isre.11.4.342.11872

Venkatesh, V., & Davis, F. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186-204. https://www.jstor.org/stable/2634758?seq=1&cid=pdf-reference#references_tab_contents

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Towards a unified view. *MIS Quarterly, 27*(3), 425-478. https://doi.org/10.2307/30036540

Veronika, P. (2015). (rep.). *Informational and technological support of foreign language training in high school.* (pp. 1–5). Taganrong, Russia: IEEE Xplore.

Weng, F., Yang, R., Ho, H., & Su, H. (2018). A TAM-based study of the attitudes towards use intention of multimedia among school teachers. *Applied System Innovation, 1*(3), 1-9. https://doi.org/10.3390/asi1030036

West, S. G, Finch, J. F., & Curran, P. J. (1995). Structural equation models with non-normal variables: Problems and remedies. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 56−75). Thousand Oaks, CA: Sage.

Weston, R. (2006). A brief guide to structural equation modelling. *The Counselling Psychologist 34*(1), 719-751. DOI:10.1177/0011000006286345

White, A., Liburd., L., & Coronado, F. (2021). Addressing racial and ethnic disparities in COVID-19 among school-aged children: Are we doing enough? *Preventing Chronic Disease: Public Health Research and Policy. 18*(55), 1-11. https://doi.org/10.5888/

Williams, J. (2023, September 9). *LMS usability: The foundation for impactful teaching and learning.* Infrastructure. https://www.instructure.com/resources/blog/lms-usability-foundation-impactful-teaching-and-learning

Wood, M. J., & Brink, P. J. (1998). Correlational designs. *Advanced design in nursing research*. SAGE Publications.

Yang, Z., Jun, M., & Peterson, R. (2004). Measuring customer perceived online service quality: Scale development and managerial implications. *International Journal of Production and Production Management. 24*(11), 1149-1174. DOI 10.1108/01443570410563278

Yaro, A., Maly, F., & Prazak, P. (2023). Outlier detection in time-series receive signal strength observation using z-score method with s_n scale estimator for indoor localization. *Applied Sciences. 13*(1), 1-17. https://doi.org/10.3390/app13063900

Zheng, P., Lin, T.-J., Chen, C.-H., & Xu, X. (2018). A systematic design approach for service innovation of Smart Product-Service Systems. *Journal of Cleaner Production, 2(1)*, 657–667. https://doi.org/10.1016/j.jclepro.2018.08.101

Zheng, Y., Wang, J., Doll, W., Deng, X., & Williams M. (2018). The impact of organizational support, technical support, and self-efficacy on faculty perceived benefits of using learning management system. *Behavior and Information Technology, 37(*4), 311-319. https://doi.org/10.1080/0144929X.2018.1436590

Zins, A., Bauernfeind, U., Del Missier, F., Venturini, A., & Rumetshofer, H. (2011). *An experimental usability test for different destination recommender systems.* Vienna University of Economics and Business administration. http://dx.doi.org/10.1007/978-3-7091-0594-8_22

Zou, B., Chen, X., & Sun, W. (2022). K-12 teachers' perceptions of the effectiveness of online efl teaching and learning during the covid-19 pandemic. *Journal of China Computer-Assisted Language Learning 2*(1), 45-68. https://doi.org/10.1515/jccall-2022-0003

Appendix A

District Research Approval

[redacted]

Research Request Form

Instructions: *Once form is completed, it must be signed by the Associate Superintendent prior to collecting data and conducting research in the* [redacted] *County School District. When seeking approval at the school level, a copy of this form, signed by the Associate Superintendent, must be emailed. Submit completed form to* [redacted]

Research Project Title: K-12 Teacher Technology Acceptance: Post COVID-19 Pandemic

Researcher Last Name: Carraway Researcher First Name: Michael

Street Address: 4765 Fairfield Estates West City: Evans State: GA Zip: 30809

Phone: 706-755-0887 Fax:

Current District Employee ☑ Yes ☐ No

University/Agency: Columbus State University

Degree Sought: Doctorate in Educational Leadership

Advisor's Name: Dr. Parul Acharya

Advisor's Street Address: 1127 Broadway City: Columbus State: Ga Zip: 31901

Advisor's Phone: 706-507-8523 Advisor's Email: acharya_parul@columbusstate.edu

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State the primary research question and/or purpose.

The purpose of this study is to determine the technology acceptance of K-12 teachers in the years after the COVID-19 pandemic. The vehicle for data collection will be an adapted survey including elements from the original technology acceptance model (perceived ease of use / perceived usefulness / actual usage), functionality and usability, information technology (IT) support, and two qualitative questions about assessment and implementation issues. To accomplish this, teachers will be surveyed about their experiences with the Google Classroom learning management system (LMS).

The overarching research question: Is the Google Classroom LMS accepted by K-12 teachers in the post COVID-19 era.

Additionally, the researcher will answer the following questions:

Quantitative Research Questions:

Page 1 of 3

Describe research activities that directly affect participants (e.g., interviews, observations, surveying, pre-post testing, coaching/training, etc.)

The sole research activity that will take place is a survey that I hope to send out to teachers and administrators throughout the school district. I would like to send this survey out to each school in the district. The people effected would simply need to fill out the survey and it would be completely voluntary.

Indicate the number of participants, the targeted schools, and the amount of time anticipated to complete research activities on the chart below.

	Number of participants	Time required (days/hours, etc.	Specify/describe items needed (grades, observations, interviews, etc.)	List schools and grade levels
Teachers	~1200 (attempted)	25 minutes	Completion of Survey	[redacted]
Administrators	~15 (attempted)	25 minutes	Completion of Survey	[redacted]
Parents	0	N/A	N/A	N/A

List the data elements that will be requested (that are not publicly available). Be specific.

No data elements will be requested. I simply want applicable teachers and administrators to fill out my survey about their experiences.

List the names of the instrument(s) (tests, surveys, observation forms) that will be used to collect data and attach copies of your instrument(s).

Adapted K-12 Teacher Technology Acceptance Survey

Describe benefits to school district.

The [redacted] School District will be able to see teacher self-reported feelings about the Google Classroom LMS, IT support, and also receive valuable information about the struggles that teachers went through during the period of emergency online learning. The information about the Google Classroom LMS, and the IT support provided by the district, will be valuable knowledge for district leaders. Furthermore, the information gathered about assessment and implementation problems with online learning will be extremely valuable for district leaders in the event of another pandemic. This information is also applicable to use for the [redacted] Virtual Academy and future online learning initiatives.

Describe how all participants' privacy will be protected

This survey will be completely anonymous. It will be conducted through the Qualtrics platform. This platform allows for an anonymous option where emails and IP numbers are not collected. Furthermore, no mention of the [redacted] County School District is made in my research.

Anticipated Research Start Date: 2/1/24 End Date: 5/21/24

Indicate which attachments, if any, are included with this application:

☑ Instrument(s)

☐ Other

I understand and will abide by the laws related to protection of human subject rights and privacy. I will maintain confidentiality of all records, and I will destroy and eliminate any reference to school, district, or individual identity.

Researcher Signature: Michael W. Carraway II Date: 12/12/23

FOR OFFICE USE ONLY

☑ Granted ☐ Pending ☐ Denied

Associate Superintendent Signature: Kellye Booch Date: 12-14-2023

Appendix B

Columbus State University IRB Approval

Re: Exempt Approval - Protocol 24-038

Michael Carraway [STUDENT] carraway_michael@students.columbusstate.edu

Fri 3/1/2024 3:37 PM

To:IRB <irb@columbusstate.edu>

Cc:Parul Acharya <acharya_parul@columbusstate.edu>;Institutional Review Board <instituional_review@columbusstate.edu>

On Mar 1, 2024, at 2:46 PM, IRB <irb@columbusstate.edu> wrote:

Institutional Review Board

Columbus State University

Date: 3/1/24

Protocol Number: 24-038

Protocol Title: K-12 Teacher Perceptions of Online Learning and Information Technology

Support Post COVID-19 Pandemic

Principal Investigator: Michael Carraway

Co-Principal Investigator: Parul Acharya

Dear Michael Carraway:

The Columbus State University Institutional Review Board or representative(s) has reviewed your research proposal idented above. It has been determined that the project is classified as exempt under 45 CFR 46.101(b) of the federal regulations and has been approved. You may begin your research project immediately.

Please note any changes to the protocol must be submitted, using a Project Modification form, to the IRB before implementing the change(s). Any adverse events, unexpected problems, and/or incidents that involve risks to participants and/or others must be reported to the Institutional Review Board at irb@columbusstate.edu or (706) 507-8634.

If you have further questions, please feel free to contact the IRB.

Sincerely,

Amber Dees, IRB Coordinator

Dr. Amber Dees

Deputy Title IX and State Authorization & Academic Compliance Coordinator

Office of the Provost and Executive Vice President

Appendix C

Survey Recruitment Emails

Dear educator,

My name is Michael Carraway, and I am currently a doctoral student in the College of Education at Columbus State University.

I am leading a research project, and mixed-methods study, on K-12 teacher technology acceptance in the years after the COVID-19 pandemic. This project is in partial fulfillment of the requirements set forth by Columbus State University to complete a Doctorate in

Educational Leadership. You are receiving this email because you are a teacher, or administrator, within the School District, and I invite you to participate in this survey supporting my investigation into strengthening technology usage and online learning.

Link to the survey: LINK

This online survey, using Qualtrics, will be kept anonymous, and you will be asked questions related to your experiences using the Google Classroom learning management system (LMS) during the COVID-19 pandemic. Your participation in this survey is voluntary. Participants have the opportunity to ask questions about the survey, or opt out of the survey. Participation in this survey has minimal risk, no more than those associated with using a computer or smart phone. All data collected is anonymous and will remain confidential. Any data collected will only be shared with my research committee at Columbus State University. All results will be compiled and presented as generalized findings.

As a participant in this study, you have the right to ask questions and to have each question answered. If you have any questions or concerns regarding this study, please contact the principal investigator, Michael Carraway, at 706-755-0887 or Carraway_Michael@students.columbusstate.edu.

The survey window is from DATE – DATE.

Thank you in advance for participating in this important research on technology acceptance.

Sincerely,

Michael Carraway

Doctoral Student

Columbus State University

Dear educator,

Approximately 1 week ago, an invitation to participate in a survey on the topic of K-12 teacher technology acceptance was sent you via email.

In an effort to complete this study and to have a robust research sample, I am sending this email as a reminder to please participate in this study

I am seeking the input of a variety of educators who experienced the emergency shift to online learning during the COVID-19 pandemic.

To complete this brief survey, please click the link below.

LINK TO STUDY

I sincerely thank you for participating in this research.

If you have already completed the survey, you have my gratitude for your help.

Sincerely,

Michael Carraway

Doctoral Student

Columbus State University

Dear educator,

Approximately 2 weeks ago, an invitation to participate in a survey on the topic of K-12 teacher technology acceptance was sent you via email.

In an effort to complete this study and to have a robust research sample, I am sending this email as a reminder to please participate in this study

.

I am seeking the input of a variety of educators who experienced the emergency shift to online learning during the COVID-19 pandemic.

To complete this brief survey, please click the link below.

LINK TO STUDY

I sincerely thank you for participating in this research.

If you have already completed the survey, you have my gratitude for your help.

Sincerely,

Michael Carraway

Doctoral Student

Columbus State University

Appendix D

Modified Technology Acceptance Survey

Demographic Questions:

1. Which level of K-12 school do you teach?
    - Elementary (K-5)
    - Middle (6-8)
    - High (9-12)
2. How many years of experience in teaching do you have? (User input)
3. Did you experience online teaching during the COVID-19 pandemic?
    - Yes
    - No
4. What is your age in years? (User Input)
5. What is your gender?
    - Male
    - Female
    - Transgender
    - Nonbinary
    - Prefer not to answer
6. What is your ethnicity?
    - Hispanic or Latino
    - Not Hispanic or Latino
7. What is your race?
    - American or Alaskan Native
    - Asian
    - Black or African American
    - White
    - Native Hawaiian or other Pacific Islander
8. How many years of experience do you have using the Google Classroom learning management system (LMS)? (User input)
9. Do you have experience with any other learning management system?
    - Yes
    - No
10. How many years of experience with another LMS do you have? (User input)
11. Have you received previous training in LMS usage?
    - Yes
    - No
12. Please select the LMS you have received training on.
    - WebCT

- Moodle
- Blackboard
- Google Classroom
- Lotus Notes

Perceived Usefulness: (5-point Likert scale, strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, strongly agree)

1. Using the Google Classroom LMS in my job enables me to accomplish tasks more quickly.
2. Using the Google Classroom LMS improves my job performance.
3. Using the Google Classroom LMS increased my productivity.
4. Using the Google Classroom LMS enhances my effectiveness on the job.
5. Using the Google Classroom LMS makes it easier to do my job.
6. Overall, I find the Google Classroom LMS useful in my job.

Perceived Ease of Use: (5-point Likert scale, strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, strongly agree)

1. Learning to operate the Google Classroom LMS is easy for me.
2. I find the Google Classroom LMS to be flexible to interact with.
3. My interaction with the Google Classroom LMS is clear and understandable.
4. I find it easy to get the Google Classroom LMS to do what I want it to do.
5. It would be easy for me to become skilled at using the Google Classroom LMS.
6. I find the Google Classroom LMS easy to use.

Functionality and Usability: (7-point Sliding scale) I find the Google classroom LMS to be…

1. obstructive ------- supportive
2. complicated ------- easy
3. inefficient ------- efficient
4. confusing ------- clear
5. boring ------- exciting
6. not interesting ------- interesting
7. conventional ------- inventive
8. usual ------- leading edge

Information Technology (IT) Support: (5-point Likert scale, strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, strongly agree)

1. My organization's IT support performs services correctly the first time.
2. My online IT support transactions are always accurate.
3. My organization keeps my records accurately.
4. I receive prompt responses to my requests by email or other means from my organization's IT department.
5. My organization quickly resolves IT problems I encounter.
6. My organization's IT department gives me prompt service.

7. My organization's IT department has the knowledge to answer my questions.
8. My organization's IT department properly handles any problems that arise.
9. My organization's IT department complies with my requests.
10. My organization’s IT department will not misuse my personal information
11. I feel safe with my organization's online applications.
12. I feel safe in providing sensitive information online to my organization.
13. I feel the risk associated with my organization's online transactions is low.
14. All my service needs are included in the Google Classroom LMS menu options.
15. The Google Classroom LMS provides wide ranges of product packages.
16. The Google Classroom LMS provides services with the features I want.
17. The Google Classroom LMS provides most of the service functions that I need.

Behavioral Intention to Use: (5-point Likert scale, strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, strongly agree)

1. I intend to use the Google Classroom LMS assuming I have access to the system.
2. I predict that I will use Google Classroom LMS given that I have access to the system.
3. The easy availability of the Google Classroom LMS will help me to use it.

Attitudes Toward Use: (5-point Likert scale, strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, strongly agree)

1. Using Google Classroom in my class is good.
2. My using Google Classroom in my class is favorable.
3. It is a positive influence for me to use Google Classroom in my class.
4. I think it is valuable to use Google Classroom in my class.
5. I think it is a trend to use Google Classroom in class.

Actual usage: (User input)

1. Please specify (estimate) how many hours each week you normally spend using the Google Classroom LMS.

Assessment and Implementation Issues in Online Learning: (Extended response)

1. Did you experience any assessment problems with online learning during the COVID-19 pandemic? If so, what were those problems?

2. What are the different types of barriers (technology, process, administration, faculty, lack of training, and environment) teachers faced while using the Google Classroom LMS during the pandemic?