NEW HORIZONS: DESIGNING AND MEASURING FOR MODERN LEARNING ENVIRONMENTS

By

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Submitted to the graduate degree program in the Department of Special Education and the Graduate Faculty of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Philosophy

A Dissertation Submitted to the Graduate School of Education

University of Kansas

In Partial Fulfilment of the Requirements of the Degree

of Doctor of Philosophy

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Date defended: July 12, 2017

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ABSTRACT

This dissertation consists of five chapters. The first chapter serves to introduce the Modern Learning Environment (MLE) by discussing the challenges of designing and measuring student performance in these novel environments. Chapter two of the dissertation reviews the current research base of studying self-regulated learning in the modern learning environment by identifying the common self-regulated frameworks that guide researchers and the assessments that have historically been used to measure student performance. The third chapter introduces an item reduction method that can be used to collect group level data. This method was designed for the MLE to take advantage of deploying measures through digital learning platforms and delivering assessment to students engaged in learning. The fourth chapter of this dissertation is a practitioner based article that outlines how to develop tools to support self-regulated learning in the MLE. This chapter discusses how tools fit in the design of MLEs and the importance of measuring self-regulated learning. Finally, chapter five ties all the chapters together to discuss the MLE and the challenges associated with designing instructional environments.

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CHAPTER 1: INTRODUCTION TO THE PROBLEM

Throughout the United States, blended learning in K-12 settings is shaping the lives of learners with disabilities and teachers on a daily basis. K-12 blended learning is growing faster than any other type of digital learning (Barbour, Archambault, & DiPietro, 2013; Graham, 2013; Picciano, Seaman, Shea, & Swan 2012). Blended learning is an appealing option for many school contexts because it affords new options to school leaders and educators in how they utilize various digital and traditional tools to support the desired learning outcomes. Specifically, they can determine the ratio of Internet versus face-to-face instruction and the places where different types of instruction occur—be it the classroom, home, or some other place (Horn & Staker, 2011).

Blended learning environments are defined as an education program where a student learns, in part, through digital technology in the brick and mortar setting, and gives students ownership of the path, place, and pace in which their learning occurs (Staker & Horn, 2012). While these environments give students unprecedented control over how their learning occurs, it also places new demands on the learners. As found in Basham, Hall, Carter, & Stahl (2016) the interworking of some of these blended learning environments can be extremely complex. For instance, as the researchers found, in these complex environments, the learning process can be distributed across various interactions with machines, adults, and peers. Overall, these environments can support improved academic outcomes by enhancing content area learning for students with and without disabilities (Basham et al, 2016). While learning through dynamic interactions rather than single-teacher directed content gives students immense opportunity to shape and be successful in their own learning, it also creates options for making mistakes, becoming distracted, and making the student vulnerable for failure. These gains are somewhat dependent on student on the developmental level of the student and the student's ability to use metacognitive strategies. Students will need varying levels of support to maximize the intended benefit of the blended/online design. To support student success in these environments, multiple researchers have both found and called for the need to support student self-regulated learning (Basham et al., 2016; Barbour & Mulcahy, 2004; Cavanaugh & Blomeyer, 2007). Self-regulated learning (SRL) is the internal process by which individuals manipulate their mental actions to acquire academic skills (Zimmerman, 2010). There are multiple mental processes of SRL, including forethought, performance control, and self-reflection (Zimmerman, 2008). Individuals use these processes to different degrees (Pintrich, 1990), therefore students that do not employ facets of SRL at high levels may experience challenges in blended and online learning environments.

To address this need, some researchers have suggested increasing student self-regulation and metacognitive skills would lead to more desirable completion outcomes (Barbour & Mulcahy, 2004; Cavanaugh & Blomeyer, 2007). Self-regulation of learning "involves cognitive, affective, motivational, and behavioral components that provide the individual with the capacity to adjust his/her actions and goals to achieve the desired results in light of changing environmental conditions" (Zeidner, Boekaerts, & Pintrich, 2000, p. 751). There are multiple models of SRL, but the one most often used in research comes from Zimmerman (1998a). Zimmerman's framework is a cycle consisting of three phases. Each phase in the cycle focuses on one of three skills: Forethought (planning); Performance (following the plan or modifying it to meet challenges), and Self-Reflection (determining whether the plan was successful and evaluating the product of the performance). Models of SRL assert that successful performance of a particular skill during each phase leads the learner to the next phase, ultimately to return to the first phase. Students excelling at self-regulated learning do so because they have mastered subskills for each phase and make adjustments to improve both learning depth and academic task completion efficiency.

Self-regulated learning has been studied in multiple contexts for many years, but has not been comprehensively examined in K12 online learning (Rice, 2006). The scientific community has not yet unanimously adopted a consistent framework to examine SRL. Self-regulation is sometimes conflated with self-directed learning, where mature individuals exercise personal autonomy over their learning (Candy, 1991). In addition, research in student approaches to learning is also sometimes brought together with self-regulation, although this research base is more focused on the reasons why the learner is taking the course and what a student thinks learning is (Entwistle, 1991). Both of these concepts have a bearing on self-regulation processes, but they are not synonymous ideas. Self-regulated learning, much like self-directed learning and student approaches to learning are rooted in work with adults (Schunk & Zimmerman, 2003). Further, the concept of SRL was introduced and developed in traditional environments rather than the digital ones that are increasing in prevalence. Nonetheless, researchers have been interested in using self-regulation constructs in online learning (e.g., Cho & Shen, 2013) and in applying them to K12 settings (Kim, Kim & Karimi, 2012).

Students of all abilities often experience challenges with self-regulated learning (Pilegard & Fiorella, 2016). The inability to self-regulate learning can lead to lower levels of achievement in key academic areas such as reading, mathematics, and writing. Students with lower level writing skills may experience lifelong issues with employment and university attendance (Taft & Mason, 2011). To address this challenge, researchers have developed self-regulation strategies that students with disabilities employ while engaging in learning tasks. As an example, Harris and Graham (2008) developed the Self-Regulated Strategy Development (SRSD). Research has shown, that students who use the SRSD strategy experience increases in strategic approaches to writing, knowledge, and behavior (Lane, Harris, Graham, Weisenbach, Brindle, & Morphy, 2008). Overall, this work has shown to be beneficial for students. This work has shown to be extremely useful in traditional teacher-centered and driven environments, however little to no research has been conducted on how strategies developed for the traditional classroom apply to modern, complex, and blended learning environments.

As previously stated, the design of blended learning environments gives students more autonomy of their learning which may not align with strategies that have been developed in the traditional classroom setting. Therefore, it is important to re-examine the role of self-regulated learning in these new complex learning environments. These environments require students to continuously self-regulate learning across all subject areas throughout the day. Improvement science pilot research has recently been conducted in a local school district wherein the teachers have determined the greatest need for support of self-regulated learning is with mathematics. Teachers feel this way due in part to the linear nature of traditional mathematics instruction as well as the emphasis on mathematics performance.

Dissertation Format

Following a department sanctioned, format for a concluding project, this dissertation will consist of five chapters. The alternative dissertation format requires an introductory chapter and culminating chapter. Chapters two, three, and four consist of individual manuscripts that highlight a review of literature and two supporting manuscripts. To comply with the graduate school of education, these chapters are woven around the same theme. Further descriptions of each chapter follows.

Chapter 2: Models, Methods, And Measures: What We Need To Know To Advance A Theory Of Self-Regulated Learning In K-12 Online Learning Environment

This literature review will highlight existing knowledge of self-regulated learning for students with disabilities and blended learning environments by discussing findings and conclusions from prior empirical studies. This review will include reviews of multiple models of self-regulated learning, including a review of the theories that led to the development of self-regulated learning. In addition, the methods that have historically been used to study self-regulated learning will be reviewed. The literature review will be formatted as a manuscript with a focus on submitting to the Journal Special of Education Technology (JSET) or another field-based research journal.

Chapter 3: Investigating an Item Reduction Procedure of Non-Cognitive Measures in Modern Learning Environments

This article will present findings from a simulation study using a planned sampling strategy. Planned sampling is a derivative of Matrix sampling (Shoemaker, 1981) which is a systematic procedure to reduce the number of items on an assessment while retaining statistical properties that are crucial for valid and reliable findings. Planned sampling differs from matrix sampling in that, matrix sampling has historically randomly assigned blocks of items to participants. The planned sampling procedure seeks to determine the fewest number of independent items that can be distributed to participants while retaining the statistical properties of the model including, whole score, variance, and distributive properties. This is achieved by choosing random items to distribute to random participants through planned design. Initial studies have been positive. In one pilot study the researchers replicated the results of a 288 non-cognitive assessment. The results showed that plan sampling predicted the whole score of the true data set (a=.05) with as few one question. Further, variance was predicted with as few as five items. Implications for this work include, creating assessments that require fewer items, items can be delivered while students engage in learning tasks, and items create real time data to measure the learning environment at group levels.

The researcher employed a Monte Carlo study to simulate a measurement with 56 items where there were 173, 500, 1000 and 2,000 participants. All items were in the same metric, for example, 0-50. True attitude of participants were generated from a standardized normal distribution. Item loadings were randomly generated from a uniform distribution ranging from 0.01 to 0.95. Error variances are randomly generated from a uniform distribution ranging from 0.5 to 1.5. The researcher replicated 500 times for reducing sampling errors.

Similar to other chapters in this dissertation, the final product for this chapter will be formatted as a manuscript with a focus on submitting to Computers & Education, Journal of Educational Computing Research, or the Journal of Special Education Technology.

Chapter 4: Using Self-Regulation Strategies to Help Students with Disabilities Engage in Blended Learning Environments

This chapter will consist of a manuscript written for a practitioner audience with a specific focus on submitting for Teaching for Exceptional Children. The manuscript will follow a vignette based on a hypothetical student and his teacher. In this manuscript, the student is being educated with his general education peers in a blended learning classroom. The student's teacher is experiencing challenges with meeting her students’ needs in this new environment. The manuscript will detail the blended learning context and models. Self-regulated learning will be presented as a means to support the student’s achievement. Strategies to support self-regulated learning will be presented to increase access to the blended learning environment for students with disabilities.

Chapter 5: Discussion

This chapter will follow a more traditional dissertation format by weaving together the other four chapters into a cohesive discussion section. The research questions will be restated followed by a discussion that evaluates and interprets findings from the new study. Further discussion will occur on how the chapters two and four support the findings of the new study. Conclusions of the findings will be discussed. This will include the significance of the study as well as statements of opinion based on analysis of data. In addition, this section will make recommendations based on the conclusion section. These recommendations will point to my future research trajectory. This section will be written in great detail due to the importance of clearly describing the future research I will conduct in this area.

INTRODUCTION TO CHAPTER 2

Modern learning environments (MLE) hold great promise to meet the educational needs of an ever-diversifying student population. Modern learning environments, such as blended learning, where students spend part of class time face to face with teachers and part of class time learning on digital platforms, increase the range of instruction. Students could potentially benefit from MLEs that are designed to incorporate technology rich materials in daily instruction. Further, when digital platforms are paired with innovative classroom designs teachers and students can engage with curriculum in new and novel ways.

The purpose of this dissertation was to identify emerging aspects of the MLE that could improve academic outcomes for students. The dissertation focused on measuring student performance and options for considering self-regulated learning (SRL) in the MLE. Chapter two of the non-traditional dissertation reviewed literature focused on the current understandings of SRL measurements and frameworks researched in MLE settings. The review of literature adds to the emerging knowledge base by identifying what disciplines have studied SRL in MLEs, as well as the frameworks that different disciplines use to define SRL.

Ultimately this chapter sets the stage for the dissertation by outlining what is known about promoting SRL in the emerging educational environments and gives an historical context for how SRL has been measured. This keeps with the theme of MLEs throughout the dissertation by reviewing the notion of preparing students to self-regulate their learning in the MLE while focusing on the importance of measuring SRL in the MLE. Subsequent chapters of the dissertation link new methods of measuring SRL in novel learning environments.

CHAPTER 2: MODELS, METHODS, AND MEASURES: WHAT WE NEED TO KNOW TO ADVANCE A THEORY OF SELF-REGULATED LEARNING IN K-12 ONLINE LEARNING ENVIRONMENT

Kindergarten through 12th grade (K12) fully online and blended virtual school enrollments have grown dramatically in the past 15 years (Watson, Pape, Murin, Gemin, & Vashaw, 2014). These modern learning environments (MLE) have the potential to combine digital learning with a data rich environment to provide personalized learning to students with disabilities (Friend, Patrick, Schneider, & Vander Ark, 2017). The Christensen Institute projects that 50% of all high school education will be available online by 2019 (Christensen, Horn & Staker, 2013). For students with disabilities and other diverse learning needs, these modern environments can offer new opportunities for growth as well as frustrations (Basham et. al, 2015). Often these new environments require knowledge and skills not associated with more traditional, teacher-centered classroom settings (Basham et. al, 2016). Students with disabilities experience more challenges than their peers in completing and passing their online courses (Ahn, 2011). For instance, Deshler, Greer & Rice, (2014) found that disability status was the only one of nine demographics that predicted low course grade in a virtual school program in a large virtual school program in the Midwest.

The Keeping Pace report (2016), an annual report detailing policy and practice of online learning, defines digital learning as any instructional practice in or out of school that uses digital technology to strengthen a student's learning experience and improve educational outcomes. The term is broad and not limited to online, blended, and related learning. Digital learning encompasses a wide range of digital tools and practices, including instructional content, interactions, data and assessment systems, learning platforms, online courses, adaptive software, personal learning enabling technologies, and student data management systems (Gemin, Pape, Vashaw & Watson, 2015). The International Association for K-12 Online Learning (iNACOL) reiterates this definition to state that digital learning is comprised of online or blended learning (Rose, 2014), with online learning defined as education in which instruction and content are delivered primarily over the Internet (Watson & Kalmon, 2005). Blended learning is defined as a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path, and/or pace and at least in part at a supervised brick-and-mortar location away from home (Staker & Horn, 2012).

As highlighted in Basham, Smith, Greer, and Marino (2013) these environments are often highly variable in design and implementation. While there are various models of online learning, arguably, one of the most a consistent design characteristics is the lack of teacher-centered instruction. The design of these learning environments includes a single computer and online system, but usually incorporates a combination of multiple devices, various online systems, peers, teachers, and more traditional materials (e.g., paper-based materials, books). In these learning environments, the distribution of information sharing, seeking, and demonstration of knowledge is highly reliant on the student. For example, some of these environments offer explicit and apparent support structures (e.g., stepwise instructions) delivered and mediated by a teacher. However, the distributed nature of MLE’s are vastly different from more traditional teacher centered environments wherein students are asked to be more autonomous in their learning with less reliance on teacher guidance. Student autonomy is increased by students that self-regulate their learning (Ryan, 1991) and students that successfully self-regulate their learning will have greater motivation toward academic tasks (Snodin, 2013).

Students being educated in MLE's may benefit from increased self-regulated learning and metacognitive skills (Cho & Shen, 2013, Sansone et. al, 2011). Self-regulated learning (SRL) refers to how students manipulate goals and actions to produce preferred results in dynamic environments (Zeidner, Boekaerts, & Pintrich, 2000, p. 751). Generally, SRL is regarded as an under researched area in K12 online learning (Rice, 2006). Further, self-regulated learning is sometimes conflated with self-directed learning, where mature individuals exercise personal autonomy over learning (Loyens, Magda, & Rikers, 2008). In addition, research in student approaches to learning often is conflated with SRL, although the student approach to learning research base is more focused on the reasons why the learner is taking the course and what a student thinks learning is (Entwistle, 1991).

Self-regulated learning, much like self-directed learning and student approaches to learning are rooted in work with adults (Schunk & Zimmerman, 2003). Further, the concept of SRL was introduced and developed in traditional rather than digital environments. Nonetheless, researchers have been interested in using SRL constructs in online learning (Cho & Shen, 2013) and in applying them to K12 settings (Kim, Kim & Karimi, 2012). The prevalence of MLE's have increased and will continue to increase as states look for novel ways to meet the needs of an ever-diversifying student population. Therefore, the challenge of preparing students to self-regulate their learning in MLE's is crucial. The purpose of this review of literature is to map the conceptualization of SRL and document how it has been studied thus far in order to determine how to apply understandings about SRL optimally in an era of online learning.

Modern Learning Environments

In 2015, the International Association for K-12 Online Learning (iNACOL) released a report detailing the emergence of MLE's (blended/online) from 2008 to 2015 (Powell, et. al, 2015). The report detailed the evolution of blended learning models and presented case studies of schools adopting blended learning initiatives, however the report noted the lack of research on student outcomes in blended learning settings. The limited research on student outcomes in blended learning settings presents a challenge for students, teachers, and administrators implementing blended learning as required by Every Student Succeeds Act (ESSA). This new law represents a commitment to educational technology in that it replaces the Enhancing Education through Technology Program by inserting a block grant program into Title IV, Part A, which will receive funding of 1.65 billion dollars annually. In addition, states will have increased freedom in how they spend educational dollars. One way that states can spend these dollars is to increase access to digital learning through development of blended learning. Experts note that blended learning environments have the potential to proliferate (Patrick, Worthen, Frost, & Gentz, 2016) under ESSA legislation.

Adoption of MLE's

The blended learning environment places new demands on teachers and students. Teachers in a blended learning environment must design their classrooms in ways that are student centered (Horn & Staker, 2012). Moreover, teachers will need to understand how personalized learning platforms (PLPs) support students in the blended learning environment. These digital platforms support how students can vary in a learning environment across path, place, and pace (Staker & Horn, 2011). While understanding new technologies, like digital platforms, place new demands on teachers, they also afford teachers new and exciting opportunities including, increasing the role of technology into instructional design, assume leadership roles in district technology, and guide students to deeper learning experiences (NETP, 2016).

Students educated in MLEs must be autonomous learners. One way to support student autonomy is to use a station rotation model where student time is divided between an independent digital learning station and small group instruction with a teacher. In this model, students will spend a portion of the class in small group instruction with their teacher. Students will then rotate to an independent digital learning station, where they will engage with an online learning platform to continue instruction. Large (i.e., whole) group debriefings are also scheduled to allow students to demonstrate their learning to peers and the teacher. When the students move through these stations, they must self-regulate their learning to successfully complete academic tasks. This represents a departure from traditional educational models where a teacher would stand and deliver instruction while monitoring student behavior.

Models of Self-Regulated Learning

Self-regulated learning extended from Flavell's work on cognitive monitoring, including metacognitive knowledge, metacognitive experiences, goals/tasks, and actions (Flavell, 1979). This early worked inspired researchers to focus on the role of metacognitive processes on how individuals approached goals and tasks. Pintrich is recognized as the preeminent psychologist of self-regulated learning research (Schunk, 2005). Pintrich (2000) identified four primary assumptions of self-regulated learning: (1) active construction, (2) learner control, (3) assumption of goals, and (4) preeminence of self-regulation. The active constructive model assumption is that students are active participants in learning. As active participants, learners have the ability to determine their own meaning, goals, and strategies. This behavior is a product of both environmental factors and inherent learner autonomy. Self-regulation models contain the assumption that potential exits for learner control (Pintrich, 1995). This assumption addresses the belief that learners have the ability to monitor, and regulate aspects of their learning. The aspects that can be regulated include cognition, motivation and behavior. If learners have the ability to control these aspects of learning then opportunity exists to increase self-regulatory behaviors and improve efficiency through the use of strategies and environmental factors (Pintrich, 2000).

The third assumption that Pintrich (2000) established posits that learners use goals, criterion, or standards to guide self-regulated learning. This assumption describes learners as assessors of their own learning that continually judge their work against predetermined goals, criterion, or standards. This constant self-assessment will not only guide the learner through academic tasks but will also serve as an indicator of the appropriateness and quality of the strategies the student is using to engage with the learning task (Zimmerman, 2013). Thus, self-regulated learners adapt and adopt new strategies if the strategies currently in use are insufficient for the task at hand. Finally, self-regulation activities mediate social and academic performance (Pintrich, 2000). Models of self-regulation, in this view, should assume that personal characteristics such as demographics, culture, or personality are not the only independent determinants of academic achievement, nor are the characteristics of the classroom. In this assumption Pintrich (2000) argues that internal factors, such as motivation, self-regulation, and persistence are important mediators of self-regulation between the learner context and achievement.

Pintrich influenced scholars of SRL by developing a conceptual framework for SRL, research on motivation, development of strategies to promote SRL, and development of measures of SRL (Schunk, 2005). The conceptual framework developed by Pintrich focused on interactions between students and their environment, which is evident in multiple frameworks of SRL put forth by researchers. In addition, Pintrich's work on strategy development influenced SRL scholars by describing the three types of strategies that are applied to SRL promotion;

planning, monitoring, and regulating (Pintrich, 1999), which cover aspects of goal setting, comparisons to goal criterion, and regulating to meet the goal criterion. Lastly, Pintrich and Degroot (1990) developed the Motivated Strategies for Learning Questionnaire (MSLQ) which has been widely used by scholars in studies of SRL. These influences have been drawn upon by scholars to continue developing frameworks of SRL.

One of the most often cited models for SRL was developed by Zimmerman (1998a). Zimmerman's cyclical framework consists of three phases: Forethought, Performance, and Self-Reflection. The forethought phase prepares the student for learning by assessing a learning task and thinking about the demands of the learning task. Students then set or develop specific goals towards the academic task. A student will think about strategies for engaging in learning recall strategies for engaging in learning tasks that they have successfully used to complete academic tasks. The forethought phase describes student's beginning to think about which strategies will be important to a particular learning task. As illustrated above, Zimmerman posits that forethought is divided into goal setting and strategic planning. Further, Zimmerman breaks these two groups into sub processes. Zimmerman attributes goal orientation, intrinsic interests, and outcome expectations as integral pieces of the forethought phase. Within the forethought phase is self-efficacy that builds on Bandura's (1993) model of self-efficacy.

The performance control phase describes the processes that students engage in while learning. Zimmerman (1998b) divides performance control into two distinct sub processes: self-control and self-observation. Under self-control he identifies self-instruction and imagery as key behaviors. Under self-observation, he identifies attention focusing and task strategies as key behaviors. Self-control is the act of engaging in the learning task. Learners employ learning strategies they have prepared during the forethought phase by acting on plans to meet goals.

During this phase, learners use self-observation strategies to ensure adhesion to their learning plan including self-monitoring of performance which has a direct relationship to their plan. Highly effective self-regulated learners use strategies to remain on task throughout the academic task. Learners use self-instruction to control learning while engaged in academic tasks, therefore, self-instruction guides learning. Self-reflection is the final phase in the Zimmerman (1998b) model of self-regulated learning. Zimmerman divides self-reflection into two categories, self-judgments and self-reactions. Self-judgment is then further reduced to self-evaluation and causal attributions. The sub processes of Self-reactions include level of satisfaction and adaptive inferences. Learners in the self-reflection phase judge their performance against the specified criterion or goal and reflect on the satisfaction of the task (Zimmerman, 2002).

Zimmerman's (2002) framework for SRL posits that SRL is not based of mental acumen, or academic performance, instead SRL is a series of processes that guide independent learning to academic performance. The forethought phase of Zimmerman's framework aligns with Pintrich's active, constructive assumption in that, students construct expectations for their learning internally. Student self-efficacy determines how students approach learning and how they believe they will perform on academic tasks. In addition, students will set goals for learning in the forethought phase. Students actively construct goals for learning and make plans to meet these goals. The performance phase of Zimmerman's framework, suggests that students will use strategies to meet academic goals. The performance phase aligns with Pintrich's assumption of control that posits that students regulate their cognition, motivation, and behavior to meet their learning goals. In Zimmerman's framework, students use self-control to regulate their academic performance, through strategy use, self-instruction, and imagery. The self-reflection phase of Zimmerman's framework states that students will internally evaluate their work based on a standard, such as peer performance or the student's individual performance. The self-reflection phase, directly aligns with Pintrich's Goal, criteria, standards assumption, where students will continually assess their performance while engaging in academic tasks.

Winne and Hadwin (1998) proposed a model that shares characteristics with previous SRL models but focuses on information processing that occurs in each phase. Winne and Hadwin's model consists of four phases: task definition, goal setting and planning, enactment, and adaptations. The authors describe their model of SRL as recursive, which indicates that what an individual produces in a stage informs the subsequent stage. The authors us the acronym COPES to describe their model. COPES stands for conditions, operations, products, evaluations, and standards. Conditions affect how students will approach a task. Operations are cognitive process, tactics, and strategies that a student will use to address the task. Products are the information that is created by the operations using the strategies. Students evaluate products using either internal or external forces. The standards are the criteria that the internal/external forces use to evaluate the product.

Task definition prepares students to begin learning. Students determine available resources and set goals. Many variables affect how individuals engage in task definition that rely both on personal characteristics (cognitive and non-cognitive) and conditional differences like time constraints. The learner that successfully leverages resources and engages in planning in the task definition stage is much more likely to be successful in enactment. Enactment centers on production. Plans and study tactics are brought together in order to do the task, which is similar to Zimmerman's (1998b) concept of performance. Support for performance lies within the student, yet is easily monitored by teachers because of the production of a tangible artifact.

The evaluative feedback that a student obtains, either from a teacher or through self-reflection processes cause metacognitive adaptations according to Winne and Hadwin (1998). Students make judgments about the products they have generated based on what they have seen peers construct (Bandura, 1997). Ideally, these judgments are based on standards that were set and communicated to the students prior to when they began the task. These standards come from the teacher in terms of stipulated goals and objectives, or from external sources, such as formal standards, or from the students' own goals that were set in the task definition phase.

Boekaerts (1998) argued that most models (above) are top-down models of self-regulation. By top-down, she describes that students will be motivated to self-regulate their learning based on personal interests, expectation of outcomes, and rewards. Top-down regulation states that students use goals to drive self-regulation, Zimmerman (1998a) and Winne and Hadwin (1998) models. The students anticipate, make goals, apply strategies, and evaluate their work. Top-down self-regulation assumes that students and teachers can come to consensus or agreement about goals, and what tasks should be in pursuit of the goal. Boekaerts describes that goals in top down regulation remain static and do not easily respond to environmental changes that impact goal achievement.

By contrast, bottom-up self-regulation holds no such assumption that students will accept the goal (or one similar) to what the teacher intended. This type of self-regulation focuses on students' self-preservation goals. Boekaert's model is helpful for thinking about what students do when there is friction between what students are intended to do and what they think they are capable of doing. When under threat, Boekaerts (1998) noted that students are likely to switch to or switch between preferred tasks rather than engage in the necessary behaviors to maintain engagement on a task they find challenging or threatening. Essentially, students have to determine if they identify with the aim of a specific task or assignment. The adaptive nature of bottom up SRL can result in the creation of an entirely new goal once the previous goal is no longer preferred. The interpretation of a new goal is based on performance. Students complete their interpretation of the task, and appraise their product as well as whether they met the goal that emerged through the identification process.

Boekart's model of SRL aligns with Pintrich's assumptions of SRL in multiple ways. First, Boekaerts discussed the role of environment as a determinate in emotional wellbeing which aligns with Pintrich's assumption of active construction. Students are active in the process of learning and in Boekaerts model, this action is predicated on environmental cues that alter the student's wellbeing. Environmental cues align with Pintrich's potential for control assumption in that, students have some control of their cognition through aspects of the environment. Students seek to restore wellbeing, when compromised, by shifting attention to (e.g., entertainment and belongingness). The shift of student focus impacts self-regulation but assumes that students have control of learning and strategies to increase SRL. Students use coping strategies to regain wellbeing and resume self-regulation. If students do not regain wellbeing, continuation toward goals remains secondary. Pintrich viewed goals as criterion based, with the student altering processes to meet goals.

SRL in MLEs

Access to lower cost technology (NETP, 2016), experimentation with new measurement standards (ESSA, 20 USC, 1204), and federal investment in educational technology (ESSA, 20 USC, 4104) have set the stage for increased access to technology for diverse learners. If MLEs are to be designed and implemented with a focus on success, it is thought that more understanding is needed on SRL in MLEs. With this in mind, Chen (2014) called for research on the role of SRL in MLE's. Multiple models have been presented in this article to describe the role of SRL in learning environments. It is thought these models hold promise in the design and implementation of MLEs but these models have been primarily studied in traditional learning environments. Currently little is known about how these models apply to MLEs. The purpose of this review of literature is to identify research that has occurred on SRL in MLE settings. Specifically, the following research questions will be answered:

RQ1: What SRL models have researchers studied across modern learning environments?

RQ2: What methods and demographics have been included in SRL research in modern learning environments?

Method

A comprehensive review of the literature was conducted using the electronic databases ERIC and PsycINFO. The search terms included "blended," "online," "modern," and "hypermedia" as keywords to encompass technology-rich environments. Hypermedia describes digital learning that is more interactive than controlled system digital learning (Scheiter & Gerjets, 2007). These terms were searched for in conjunction with "self-regulated learning." The term self-regulated learning was searched for with and without the hyphen to ensure inclusion of relevant articles. The date range of the electronic search was intentionally unrestricted to identify as many relevant articles. Although, modern learning environments are relatively novel, researchers have begun to focus on what supports students will need to succeed in these environments.

Article inclusion criteria included: (a) publication in a peer-reviewed journal, (b) inclusion participants the age of those typically in K-12 settings, (c) reference to a conceptual framework or model of self-regulated learning that guided the intervention, (d) report on an intervention comprised of procedures intended to increase SRL or validity of a measure of SRL, and (e) utilization of a measure of SRL as an outcome. Articles were excluded if the purpose was an examination of literature associated with self-regulated learning or served as position articles that were predominantly conceptual, rather than empirical. Further, only the term self-regulated learning was searched to prevent confounding SRL with self-regulation from other environments (e.g., early childhood, medical field).

The rationale for limiting the age range of participants to those typically in K-12 settings was twofold. First, self-regulated learning has typically been examined in the post-secondary context. For the purposes of this review and its intention to examine self-regulated learning in the school environment, the parameter of K-12 was chosen. Second, as previously described, the ability to self-regulate learning evolves as individual's transition to various stages (i.e., childhood, adolescence). Therefore, the age parameter imposed allowed for the examination of self-regulated learning within various developmental stages.

Inclusion, Ancestral Search, Hand Search, and Article Coding

The initial title search yielded 426 studies that were screened for inclusion. After eliminating duplicates, a total of 296 articles were assessed for their alignment with the inclusion criteria and those that meet the criteria based on their abstracts were selected for further review (n = 39). Full-text records of the 39 articles were independently examined and coded based on the inclusion criteria by the researcher. The researcher determined that 12 total articles met inclusion criteria. Of the 27 excluded articles, 26 did not include participants from K-12 settings (e.g., Chen, 2014), and 1 was a position article that was predominantly conceptual, rather than empirical (e.g., Winne, 1997).

An ancestral search of the references lists of the included articles was conducted to find potential articles that were missed during the initial search. The ancestral search yielded two potential articles that were not obtained during the initial electronic search. Neither of the new articles met the inclusion criteria of K-12 settings. A manual search was conducted to identify additional articles that may not have been found through the initial and ancestral searches or were published recently and not yet indexed. The manual search resulted in the identification of one additional article that did not meet inclusion criteria. Further, the reference lists of the newly identified articles was crosschecked with the previous search. Thus, 12 articles met inclusion criteria and were subjected to analysis (marked with * in the references).

The author coded 12 articles that met inclusion criteria in two domains: relevant study information and procedures and features of interventions intended to aspects of self-regulated learning. The included variables associated with study design and the participants involved in each study including: (a) sample size, (b) participant age(s), (c) disability categories, and (d) the inclusion of students without disabilities, and (e) research design.

Results

The findings are presented according to three categories. First, the prevalence of models of self-regulated learnings are described. Second, the methods used to study self-regulated learning are presented that also includes demographic information of participants and settings. Lastly, the measures used to assess SRL will be reported. See Table 1 for comprehensive results.

Table 1

Results related to self-regulated learning in the selected studies

Reference	Framework	Measure of SRL used	Experimental design	Setting	
				Country	Grade level(s)
Azevedo et al., (2008)	Winne and Hadwin	Pre-/post-test	Between group design	United States	Middle and high school
Berger & Karabenick, (2016)	Zimmerman/Pintrich	MSLQ	NA	United States	High school
Chang et al., (2013)	Latham and Locke/Zimmerman	SRL Questionnaire	Quasi-experimental with control group	United States	Vocational high school
Chen & Huang, (2014)	Zimmerman/Pintrich	Effort sustained/ Attention Index	Between group design	Taiwan	Middle school
Chen et al., (2014)	Zimmerman	Reading Comprehension scores	Between group design	Taiwan	Middle school

Greene & Azevedo, (2009)	Winne and Hadwin	SRL Questionnaire, SRL MicroLevel	NA	United States	Middle and high school
Greene et al., (2010)	Zimmerman/ Winne and Hadwin	Pre-/post-test	NA	United States	Middle school/Hypermedia
Greene et al., (2008)	Pintrich	Pre-/post-test	Pre-/post-test	United States	Middle school/Hypermedia
Kramarski & Mizrachi, (2006a)	Winne and Hadwin	Pre-/post-test SRL measure	Between group design	Israel	Middle school
Kramarski & Mizrachi, (2006b)	Schunk & Zimmerman	Pre-/post-test Online task assessment and SRL Questionnaire	Between group design	Israel	Middle school

Pieschl et al., (2014)	Winne and Hadwin	COPES Questionnaire	Repeated measures design	Germany	High school
Sha et al., (2012)	Boekaerts	SRL Questionnaire	Between group design	Singapore	Elementary school

Note: COPES = Conditions, Operations, Products, Evaluations, and Standards; MSLQ = Motivated Strategies for Learning Questionnaire (Pintrich & Degroot, 1990); NA = Not Applicable; SRL = Self-Regulated Learning.

Models

Six of the 12 studies used Zimmerman's model of self-regulated learning as the applied framework (Berger & Karabenick; 2016, Chang, et.al, 2013; Chen et al., 2013; Kramarski & Mizrachi, 2006; Greene et al., 2010). Five of the articles reviewed used Winne and Hadwin's model of self-regulated learning as the applied framework for their study (Kramarski & Mizrachi, 2006; Pieschl, Stallman, & Bromme 2014; Azevedo, Moos, Greene, Winters, & Cromley, 2008; Greene & Azevedo, 2009; Greene, Bolick, & Robertson, 2010). These studies were associated with the search term "hypermedia". Three of the articles reviewed used Pintrich's model of self-regulated learning. In addition, one study used Boekert's model of SRL as the theoretical framework. This study was associated with the search term "online". Although each study centered on major applied models, additional models were presented in the reviewed articles to support the main theory. For example, Chen et al. (2013) investigated the role of SRL and goal setting in online learning environments. Although Zimmerman's framework of SRL was central to the study, the authors supported this framework with Latham and Locke's theory of goal setting. Of the 12 articles reviewed five used multiple models to guide the study. In all cases, Zimmerman's framework was paired with related models. These models included Pintrich (1990) (n = 3), Latham and Locke (1991) (n = 1), Schunk (1990) (n = 1) and Winne and Hadwin (2006) (n = 1).

Of the 12 articles reviewed, seven used a between groups design (Chang, Tseng, Liang, & Liao, 2013; Chen, Wang, & Chen, 2014; Kramarski & Mizrachi, 2006 (a); Kramarski & Mizrachi, 2006 (b); Sha, Looi, Chen, Seow, & Wong, 2012; Chen & Huang, 2014; Azevedo, Moos, Greene, Winters, & Cromley, 2008). These studies looked at differences between two classrooms. The remaining five studies used pretest/posttest. The included studies represented K

12 students varying from age 12-18. The mean age of participants across studies was 13.99 years. Importantly, four studies reported grade level instead of participant. Seven studies were conducted in middle school settings and six in high school settings. Two studies were conducted in middle and high school settings. One study reported participant race (Azevedo et al. (2008) conducted a study that included 128 participants. Of these participants, 73 were white, 26 were African American, 20 were Hispanic, and 9 were Asian American. No study included information on students with disabilities.

Half of the studies occurred in the United States, two studies were conducted in Taiwan and two studies were conducted in Germany. In addition, two studies were conducted in Israel and one study occurred in Singapore.

Seven articles used SRL measures, but instrumentation varied. Specifically, six used an SRL questionnaire (Berger & Karabenick, 2016; Chang, Tseng, Liang, & Liao, 2013; Kramarski & Mizrachi, 2006 (a); Kramarski & Mizrachi, 2006 (b); Sha, Looi, Chen, Seow, & Wong, 2012; Greene & Azevedo, 2009). One used an adapted form of the MSLQ (Pintrich & Degroot, 1990), and one study used the COPES questionnaire (Winne, 2006). In addition, one study used a measure of effort to analyze increase in student effort while engaging with a hypermedia platform (Chen & Huang, 2014). Six studies used a pre-posttest design to study differences in individual student performance. These measures were most often associated with students learning in hypermedia environments.

Discussion

This review of literature was undertaken to determine the frameworks, models, and measures that were most prevalent in research on SRL in MLEs. The findings from the literature suggested that there is a paucity of research dedicated to understanding SRL in MLE's. Further, no studies were found that discussed preparing students with disabilities (SWD) to self-regulate their learning in MLE's. This finding is of great concern due to the challenges that SWD experience with SRL in any learning environment. Students with disabilities experience challenges with organizing, goal setting, and planning (Harris & Graham, 1999), skills essential in MLEs.

The review of literature included studies from multiple fields of research including education, learning sciences, and computer science. The field of education represented the largest number of included studies, while the field of computer science was also represented in the included studies. Findings from the review of literature revealed that multiple frameworks have been introduced, by researchers, to investigate SRL. The frameworks shared some commonalities however, the frameworks addressed different aspects of SRL (e.g. environment). The findings indicated a division between the field of study and the framework used to study SRL in the MLE. To expand, researchers from the field of education Zimmerman's (1998a) framework of SRL in all studies but one (Boekaerts, 2003). By contrast, all researchers from the field of computer science used Winne and Hadwin's (2000) to frame their studies. This finding signals that there is no one framework that is comprehensive enough to study all aspects of SRL in MLE's. Nevertheless, the finding illustrated a disconnectedness between fields that were investigating like concepts in similar environments.

A potential explanation for the division between fields and frameworks used to study SRL is that educators more strongly associate with Zimmerman's framework of SRL. The Zimmerman SRL framework (1998a) was based on Social Cognitive Theory and Social Learning Theory (Bandura & Walters, 1977; Bandura, 1991). A tenant of Social Learning Theory is that individuals learn through observation of behaviors of others. Historically, the field of education has described this as modeling. Teacher's model target academic behaviors to students, who in turn exhibit the appropriate behavior when needed to complete academic tasks. An example of this is the I do, we do, you do strategy (George, George, Kern, & Fogt, 2013) that has been used to teach target behaviors by first, teaching the skill in isolation, and then embedding the strategy in the curriculum. This type of strategy use is found in the performance phase of Zimmerman's framework for SRL

To better prepare students to self-regulate their learning in MLE's the field needs to revisit the traditional frameworks that are currently being used to study SRL in MLE's. Research on new frameworks to promote SRL should focus on what we currently know about frameworks on SRL. The existing research on SRL is crucial to preparing students to self-regulate their learning however, traditional learning environments and MLE's, are distinct enough in design to warrant new frameworks for introducing, teaching, and maintaining SRL strategies. The focus of new frameworks to prepare students to self-regulate their learning should focus on introducing strategies, modeling strategies, and maintaining strategy use in MLE's.

This literature review found studies that included participants from multiple countries. In fact, half of all included studies occurred outside of the United States. This finding suggests that the field of education, in the United States, has been slow to investigate the role of SRL in MLE's. Results of the literature review indicate that outside of country of origin, very little diversity of participants was reported in studies. Moreover, only one study noted the race of participants in the study. Most studies occurred in middle school environments, while zero studies occurred in elementary school environments. The relative homogeneity of participants, from included studies, identifies a need to expand studies to include individuals from diverse racial, socioeconomic, and students with disabilities.

The included studies overwhelmingly used between group designs to study SRL in

MLE's. The studies most often were small scale studies that introduced the intervention in one setting and placed the counterpart classroom on a waitlist. The studies that employed between group designs used two classrooms in the design. The remaining studies occurred in singular classrooms that analyzed change at the student level. Future studies should expand the number of participants as well as the number of environments in the research design. The MLE affords researchers new opportunities for research design. The personalized learning platform (PLP) has the capability to deploy and collect data on interventions to individual participants. Designs could include delivering interventions to participants that are learning in the same learning environments. Further, interventions can be delivered to participants learning in online learning environments. The PLP gives researchers unprecedented access to participants. This being said, while researchers can distribute interventions to students learning through PLP's, new threats to validity and reliability will emerge. Further study is needed to determine the impact of measuring student performance in MLE's.

The measures used, from the included studies, mainly used self-report measures of self-regulated learning. These measures were adaptations of the MSLQ (Pintrich & Degroot, 1990). The MSLQ measures two constructs, motivation and strategy use. When the focus was on the study was on ancillary aspects of SRL (e.g. goal setting). None of the included studies measured across all phases of a framework. As an example, Zimmerman's (1998a) framework of SRL includes three phases; forethought, performance, and self-reflection. The included studies measured aspects of forethought (motivation) and performance (strategy use), however no study included a measure of self-reflection. Future studies should include measures that assess across the framework to determine which phase of SRL presents the most challenges to participants.

In addition, the measures used to assess students in MLE's are susceptible to threats to reliability and validity. The field has minimal knowledge of the effect of students being assessed in MLE's. Reliability is called into question by being unsure if the target participant is taking the assessment. Students that are educated in the online learning environment have increased access to supporting materials during assessment (e.g. internet, notes, etc.) Further, participants assessed in the online learning environment have access to other individuals (e.g. parents, friends, etc.) to assist with assessments. These threats to reliability are easily controlled for in a traditional learning environment, however, little is known about how students take assessments in MLE's.

The validity of assessments in MLE's is central to measuring student performance. Threats to validity in MLE's include; student understandings of expectations and delivery of appropriate items. The validity of assessments in MLE's requires teachers to have a firm understanding of current levels of their students' performance. In addition, teachers need to have open communication with students. Currently, there is little understanding of how these communications occur. As an example, some states have set caps for online teacher to student ratios at 1:150 (North Carolina) which creates large workloads for students and lessens the amount of access students have to teachers. Teacher tools built into the online platform provide teachers daily information on student performance conversely, teachers have limited understandings of their students changing academic needs while learning in the online environment. Further research is needed to determine how to increase reliability and validity of assessments in MLE's.

Limitations

The review of literature presented provided current understandings of self-regulated learning in modern learning environments. However, the limitations of this review must be accounted for. First, the search followed specific search criteria. Expansion of search criteria would yield different results. Second, this literature review focused on three major frameworks of self-regulated learning that were reflected in the included studies. Finally, the exclusion criteria excluded many studies due to participant age. Many studies reported the participants as adolescent, however, the participants were in post-secondary settings.

Conclusion

The emergence of MLEs provide new opportunities to increase access to curriculum for all students. The MLE offers multiple classroom designs that afford flexibility to teachers and technology that supports student learning. The MLE represents a shift from teacher centered learning environments to student centered learning environments. Student centered learning environments require the learner to be more autonomous in their learning. To maximize success in MLEs, students need to self-regulate their learning in the modern environment. Preparing students to anticipate what they will need to complete an assignment, use strategies to complete assignments, and reflect on the successes and challenges of an assignment, is crucial to positive academic outcomes in MLEs.

This review of literature identified frameworks of SRL that are prevalent in studies of self-regulation in MLEs. The results of the literature review suggested that more research is needed to fully examine the role of SRL in modern learning environments. In addition, the literature collected findings on the methods that have been used to study SRL in the modern learning environment. The results suggest that SRL, in these environments, has been studied on a small scale.

INTRODUCTION TO CHAPTER 3

Modern learning environments (MLE) hold great promise to meet the educational needs of an ever-diversifying student population. These environments, such as blended learning, wherein students spend part of class time face to face with teachers and part of class time learning on digital platforms, increase the range of instruction. Students could potentially benefit from MLEs that are designed to incorporate technology rich materials in daily instruction. Further, when digital platforms are paired with innovative classroom designs teachers and students can engage with curriculum in new and novel ways.

The purpose of this dissertation was to identify emerging aspects of the MLE that could improve academic outcomes for students. The dissertation focused on measuring student performance and researching options for self-regulated learning (SRL) in the MLE. The third chapter of this dissertation presents a measurement procedure to reduce the number of items needed to maintain viable group level statistics. The procedure was designed to accommodate the MLE, wherein multiple measures occur throughout the school day via digital platforms that are used by students as part of their curriculum. To test this procedure, a measure of SRL was analyzed by simulating a true data set and reducing the number of items needed to recover the statistical properties of a true score.

The MLE represents a shift in how we educate students. This shift represents an opportunity to rethink the role of assessment and how assessments are deployed. Assessments that measure SRL are but one of many crucial measures that are impacted by MLEs. While this chapter focuses on non-cognitive measures, a similar process might also be investigated for academic, cognitive measures. This chapter stays with the theme of this dissertation by pairing a novel item reduction method with a means to assess students in the MLE.

CHAPTER 3: INVESTIGATING AN ITEM REDUCTION PROCEDURE OF NON-COGNITIVE MEASURES IN MODERN LEARNING ENVIRONMENTS

The inclusion of 1.65 billion dollars in block grant funding, annually, in the Every Student Succeeds Act (ESSA) to increase access to technology as a means to improve student learning, denotes a commitment from lawmakers, and the field, to the importance of technology in meeting the needs of an ever-diversifying learner population. Technological hardware and software are integral to ESSA's stance on technology, so too are pedagogic designs that have emerged to better support student use of technology in classroom settings. This is evidenced by the inclusion of blended learning in ESSA. Blended learning is a classroom design that mixes face to face instruction with digital instruction in classrooms by designing classrooms that allow for students to learn through multiple modes (traditional and digital), and give students some control over their path, place, and pace of learning (Staker & Horn, 2012). Online learning shares aspects of of blended learning however, online learning occurs entirely outside of a brick and mortar educational setting. Students that are educated in online learning settings will learn entirely through a digital platform (Watson, 2010). Blended learning and online learning represent modern learning environments which include students learning in digitally rich settings.

Personalized learning is also included in the new law. Within ESSA, personalized learning focuses on providing learning experiences with technology by mainly addressing the needs of Local Education Agency (LEA) including; providing technical assistance to the LEA, identifying technology readiness, capacity building, and providing staff development to school professionals (ESSA, 20 USC, 4104). It is important to note that the best description of personalized learning in ESSA, is found in section 4104, the state fund application section.

Personalized learning introduces a host of both practical and theoretical challenges to the traditional education system. On a practical stance, there is the challenge of preparing teachers to implement platforms to support personalized learning, provide maintenance to the platform, and analyze data that emerges from the platform. Students will also need to be prepared to engage with digital learning tools and pedagogical practices.

The issue of student academic outcome data and how these data can inform student academic programming is simultaneously one of the most exciting opportunities to rethink how we educate students and one of the biggest unknowns. Theoretically, personalized learning should be the goal of education. Providing instruction to students at their current levels and needs has been difficult if not impossible at scale. Now access to new technologies (e.g. new instructional frameworks such as Universal Design for Learning, online learning platforms, student-centered data systems) that can support personalized learning (Basham, Hall, Carter, & Stahl, 2016). Within personalized learning environments, students have the autonomy to set their own goals, incorporate their learning interests, and learn in multiple physical spaces (Patrick, Kennedy, & Powell, 2013). However, the adoption of personalized learning leads to new challenges.

One major challenge associated with personalized learning is assessment. ESSA introduced concepts that can provide personalized learning environments and put forward a pilot program that has the potential to investigate more meaningful as well as personalized data collection tools. Under the new act, up to seven states can participate in designing cutting edge assessments that will meet the testing requirements put forth by ESSA. Assessments described as “Innovative Assessment Systems”, can focus on; competency based assessments, instructionally embedded assessments, cumulative year assessments, or performance based assessments (ESSA, 20 USC, 1204). Potentially, a combination of these assessments would be combined to determine student growth over the course of the school year. Further, these assessments would allow students to show mastery based on readiness and provide support to student based on determined needs (Basham et al., 2016).

Personalized Learning

The adoption of new technologies by schools has created new opportunities to present instruction and support students in blended learning settings. Innovative tools and platforms provide services that focus on personalizing learning by delivering content that is engaging, relevant, and meaningful to students (Walkington, 2013). Personalized learning focuses on providing instruction that tailors instruction to student motivation, abilities, cognitive styles and expectations (Yalcinalp & Gulbahar, 2010). Personalized learning. Further, the potential exists for personalized learning to positively impact education due to increased student ownership of learning and fostering a sense of collaboration in the learning community (Greller & Drachsler, 2012). Personalized learning provides a structure for students to engage in learning on an individualized trajectory that takes into account student performance and student interests.

Personalized learning is supported through personalized learning platforms (PLP). At present, there are multiple PLPs that school districts can choose from to provide to students. These platforms have some commonalities, including, content delivery, collaboration tools, and collection and storage of student responses. Some PLP expand technological tools to better support learner variability by using analytics to guide student progress, predict schedules for optimal learning, and allowing teachers to generate multimedia content that is accessible to the learner. Central to the benefits of PLPs is the unprecedented access to student learning that digital learning platforms have the potential to provide. When students interact with PLP's to complete assignments, communicate with teachers and peers, and access instruction they are leaving data that may or may not support better learning outcomes. The collection of new forms of data is perhaps one of the greatest benefits as well as one of the most unnerving potentials of PLPs that require both research as well as new ethical guidelines. For instance, data is collected on student academic performance, time spent on an assignment, resources accessed, and communications to peers and teachers are housed potentially indefinitely in data repositories (Stables, 2013). A study of a large online program that used a digital platform that to examine barriers to interpreting student data in online learning environments (Connell, Johnston, Hall, & Stahl, 2017) found that the digital learning platform were not structured to maximize data analysis nor focused on personalizing student learning. The absence of a structure to collect data prevented researchers from analyzing student performance, progress, and completion rates. As a result, the researchers call for clearly understood data tracking practices as well as data tracking systems to be built into future digital learning platforms that are focused on a vast array of student focused learning data.

Assessment

Blended learning, personalized learning, and data tracking systems have the potential to increase what we know about student performance as well as radically shift how we measure student success. Perhaps more importantly, with the unprecedented access to technology and federal support through pilot programs, the potential exists to reduce the burden of assessment by using new methods that makes assessment more efficient at measuring students while they engage in learning activities. For this to occur, LEA’s need access to reliable and valid measures that incorporate traditional cognitive assessments as well as non-cognitive assessments. As aforementioned, researchers have already begun to discuss the characteristics of next generation assessments. These future assessments will be embedded in learning, universally designed, adaptive, deployed in real time, and digitally enhanced (NETP, 2016).

Traditionally, assessments in education have focused on the academic or cognitive performance of students. These assessments provide a snapshot of student performance at a given time in what is generally focused on skills not associated with what is required for a successful life beyond school (Zhao, 2012). Yet, cognitive assessments are deeply entrenched in education. Since the introduction of the No Child Left Behind (NCLB), cognitive assessments have become even more valued for not only student outcomes, but to funding structures of LEA's. The emphasis placed on assessment has been controversial. Some scholars have spoken critically against the emphasis placed on cognitive testing in the time associated with testing students, and more importantly, the ethical concerns of outcomes of assessment to students, educators, and parents (Zhao, 2014). Another concern is that traditional forms of assessments are primarily static, in that they are designed to measure change over large spans of time rather than moment to moment growth. Reimagining the role of assessment in education and learning is primary to the establishment of personalized learning. For instance, as will be discussed, within personalized learning there is need to focus more holistically on student growth and development with great need to focus on non-cognitive assessments (Basham et al., 2016). Specifically, this type of assessment would increase understanding of student performance in learning environments that place more emphasis on student autonomy.

Personalized learning environments require educators to increasingly rely on data that students generate on digital platforms to assess performance. The data are designed to give educators insight into academic performance, however the importance of non-cognitive assessment remains largely unexplored. The collection of meaningful non-cognitive data can follow the characteristics of future assessments set forth by the 2016 NETP by creating assessments that are embedded in technology enabled learning platforms, delivered when the student is engaged with the learning assignment, consists of fewer but more appropriate items, and increases efficiency to students and educators.

A focus on non-cognitive assessments is particularly important due to the shifting nature of the learning environment which demands that the student be more autonomous in their learning. By design, students in these shifting learning environments spend less time in face to face learning situations with their teacher, and increased time interacting with digital platforms that extend learning opportunities. In this scenario, concepts such as grit (Duckworth, 2008), persistence (Hanson & Kim, 2007), and self-regulated learning (Zimmerman, 2008) to name a few, become even more crucial to positive student outcomes because these skills lead to independent goal setting, problem solving, and reflection. The challenge facing educators is to monitor student cognitive and non-cognitive performance when the design of the environment reduces face to face interaction. Historically, teachers have delivered instruction face to face while monitoring student performance and mediating learning strategies, however whole group instruction is often less effective (Reis, McCoach, Little, Muller, & Kaniskan, 2011) that more personalized approaches with effective data use

In order for personalized learning to be successful there is need to investigate new ways to develop a comprehensive assessment approach. A learner centered assessment should be focused on setting forth new ethical practices while also overcoming pragmatic challenges such as burdening the students with tons test items. Never before has education been granted an opportunity to use the best of instructional technology intermixed with a means to collect and analyze student data. For a long time, researchers have understood a few ways to overcome some of the barriers associated with student assessment, but with new technology and these emerging environments, it is critical to start new lines of inquiry.

Overcoming the Barriers to Learner Centered Assessment

As demand for learner centered assessment increases in school settings and work settings (Egalite, Mills & Greene, 2016), more efficient methods of measuring group cognitive and non-cognitive traits are needed. Historically, researchers have used matrix sampling to reduce the amount of time students spend on assessment and reduce the cost associated with testing. When samples of items are administered to a sample of subjects, data generated can be summarized by a matrix (Lord, 1965). The resultant matrix represents responses from all subjects under two conditions: (1) subjects responding to the items have been drawn randomly from the entire population of identified subjects, and (2) administered items were drawn at random from all possible items (Wilks, 1963). Such a sampling technique—random for both subjects and items— has been used in a variety of applications (Poggio & Glasnapp, 1973). Matrix sampling has been employed in multiple states testing programs dating back to the mid 1990's (Childs & Jaciw, 2003). The states used matrix sampling to reduce the time students spent being assessed. Previous attempts to incorporate matrix sampling into state testing programs used blocks of common items, called anchor items that every student received. The remaining items are randomized and distributed to students.

Planned Sampling

Previous research in this area has focused primarily on supporting the analysis of data relative to missing data (Enders, 2010). Interestingly, the design and implementation of personalized learning platforms and environments support reason to reinvestigate these measurement techniques. Specifically, these platforms can support the necessary conditions in situ rather than after data collection. For instance, meeting a primary design characteristic these digital platforms, can deploy random items and students. As aforementioned, if shown to meet the needed measurement properties, this technique can potentially decrease student time needed for assessment, increase efficiency in administering measures, support the design of better and more comprehensive in situ measures, and even further decrease the cost of assessment. Nonetheless, this potential supports the need for further research to be conducted, especially as it relates to the number of items needed to look the potential for new technique using matrix sampling to reduce the items necessary for PLPs to deploy to students during the learning process. Given the generally overlooked lack of focus on non-cognitive assessments, it is thought a primary starting point would be on these assessments. Moreover, given a somewhat historically entrenched understanding of cognitive assessments, working toward newer non-cognitive assessments is more readily adoptable if successful. Following a basic research trajectory, initial research in this area should support the proof-of-concept in the use of a planned sampling technique on non-cognitive measures that could be used in blended learning environments.

Research Questions

The purpose of this study was to investigate a planned sampling procedure on a widely used non-cognitive assessment of motivation containing 56 items. The researchers sought to determine if the planned sampling procedure could approximate group parameters of the non-cognitive measure. As has been discussed, findings from such research may suggest that using a matrix sampling procedure can reduce the number of items needed to estimate group level scores, while increasing efficiency of non-cognitive assessments in K-12 blended learning environments.

The research questions that guided this study were:

1. Can a planned sampling procedure be used to reduce the number of items that would be required on a learner-centered test while recovering the mean statistic?
2. Can a planned sampling procedure be used to reduce the number of items that would be required on a learner-centered test while recovering the variance statistic?

Method

Measure

To conduct this simulation, a measure of student motivation and student strategy use was selected. The Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich & Degroot, 1990) is designed to measure the relationship between student motivation and their use of learning strategies in the educational environment. A version of the MSLQ adapted for middle school students was selected to simulate participants from a K-12 learning environment. This measure consists of 56 items that are measured with a 7 point Likert scale (1= not at all true of me, to 7= Very true of me). Coefficient alphas for subscales ranged from .75 to .89.

Simulation

To execute this study a Monte Carlo simulation was conducted. The study analyzed three different methods of item reduction; 1) traditional matrix sampling, 2) planned sampling, and 3) planned sampling with the parameter that each item be used at least once. Traditional matrix sampling deploys blocks of items to participants. The blocked items can be chosen by the researcher, or deployed at random. Regardless of how items are chosen, participants are given all items in the block to complete. The matrix sampling design for this study allowed the items to be random within the model. The planned sampling procedure distributed random items from the item pool to random participants. No constraints were introduced into the plan sampling model.

The third method, was planned sampling with the constraint that each item be used at least once. This method ensured that all items were answered at least once as population samples became smaller. First, true responses were generated via a confirmatory factor analysis (CFA) model (Joreskog, 1969). The CFA model was conducted to assess the internal structure of the measurement. Figure 1 shows a CFA model with 4 items: latent trait, item response, and residual are represented by letters η,y, and ε respectively. The unidirectional arrows pointing from η to y are factor loadings, where the arrows pointing from ε to y are fixed to 1. Mathematically, in a general CFA model a person's response to an item can be represented as:

$$y_{ji} = \tau_j + \lambda_j * \eta_i + \varepsilon_i \ \ where\ \varepsilon_i \sim N(0, \sigma_j^2) \tag{1}$$

Response y is predicted by latent trait η, where τ is the intercept and ε is the residual term. Subscripts j and i are the identifiers for item and person respectively. The latent trait η_i is assumed to follow a standard normal distribution whose mean is 0 and variance is 1. On the other hand, the residual term ε_i is assumed to follow a univariate normal distribution whose mean is 0 and variance is σ_j^2.

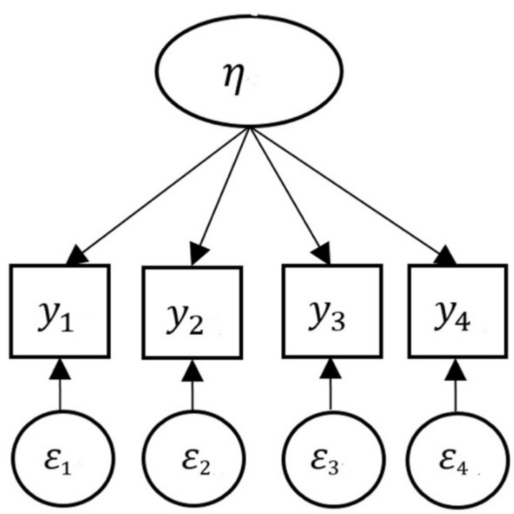

Figure 1. *CFA model.*

Given that Coefficient alphas for subscales ranged from .75 to .89, the CFA loading for each item was randomly generated from a uniform distribution [0.75, 0.89], where the error variance was randomly produced via a uniform distribution [0.10, 0.50]. Three levels of participant number were used [100, 173, 500, 1000, 2000].

The first simulation of the planned sampling procedure used 173 participants. This number was chosen to replicate an administration by the developers of the measure (Pintrich & Degroot, 1991) where 173 middle school students (M=12.6 years old), 100 girls (57.8%) and 73 boys (42.2%) answered the questionnaire. This version of the MSLQ consisted of 56 items and was distributed to 7th grade students. This simulation represented the lowest number of items and participants that have been simulated using this procedure to date. The second planned sampling procedure of the MSLQ used 500 participants to simulate responses at a school wide level. The third planned sampling procedure of the MSLQ used 1000 participants

This set was used to compare following analyses. This research was concerned with the minimal number of items needed to recover statistical properties of the true composite score. These statistical properties included 1) mean and 2) variance. This study used 3X3 conditions to analyze the difference between three different sampling approaches with truncation levels set to n_tr (number of items the participants receive). First, every participant receives subtest containing n_tr items. Second, every participant receives n_tr out of 56 items completely at random. Third, every participant receives n_tr out of 56 items where the condition that all items were used at least once. Generated responses were truncated by the aforementioned sampling approaches. The statistical properties of the truncated dataset, 1) mean 2) variance and 3) the probability distribution of the composite score, were compared with that of the true dataset. For each given condition, the simulation was replicated 1000 times.

Analysis

To analyze the outcome variable of mean comparison, this study used a Welch T-Test. This method was chosen due to unequal variance between groups. Further, the Welch T-Test provides more control of Type 1 error when homogeneity of variance is violated (Delacre, Lakens, & Leys, 2017). To analyze variance, the researchers conducted a Levene's test. The Levene's test measures the equality of variance between groups (Olkin, 1960). To measure probability distribution of scores, the researchers used a Kolmogorov-Smirnov test.

Results

The results of the planned sampling procedure varied across all conditions, a) traditional matrix sampling, b) planned sampling, and c) planned sampling with a parameter across the five population samples. See the Appendix for associated plots. To replicate the statistical properties of the simulated true data set of 2000 participants, the traditional matrix sampling procedure required 18 items to recover variance and five items to recover mean score. This procedure resulted in a 38-item reduction for variance and a 51-item reduction to recover mean score. Simulation of the planned sampling procedure required 11 items to recover variance and 4 items to recover mean statistics. The planned sampling procedure resulted in a 47-item reduction to recover variance and 52 item reduction to recover mean score. The planned sampling procedure with the parameter that all items be used at least once resulted in a 44-item reduction to recover variance and 52 item reduction to recover mean score. The planned sampling procedure required the fewest items to recover variance while the planned sampling and planned sampling with the parameter that each item be used at least once required the fewest items to recover the mean score. Similar results can be found in Table 2.

The results of subsequent population simulations found that as smaller populations were simulated, fewer items were needed to recover variance and mean score. Across all populations, the planned sampling procedures required the fewest items to recover variance. The items needed to recover mean scores stabilized at a single item as the population decreased to 173 and below. The trajectory of the data suggested that planned sampling required fewer items as the population increased, where lower populations like the 173 from Pintrich & Degroot (1990) needed comparable items from the three methods to recover statistical properties.

Table 2

Item Reduction

Number of Participants	Matrix Sampling	Planned Sampling	Planned with Parameter
100			
KS	1	1	1
Levine	4	3	3
173			
KS	1	1	1
Levine	5	4	4
500			
KS	3	3	3
Levine	10	7	8
1000			
KS	4	4	4
Levine	11	9	9
2000			
KS	5	4	5
Levine	18	11	12

Discussion

The purpose of this study was to examine a planned sampling technique for item reduction on a non-cognitive measurement of SRL. The benefits of planned sampling, as a missing data design include; fewer assessment items, reduced cost, and data efficiency (Graham, Taylor, Olchowski, & Cumsille, 2006). The planned sampling technique used a random item distribution to identify the fewest items needed to recover the statistical properties (variance, mean) of a simulated true data set. To further analyze the planned, sampling technique, three methods of item sampling were simulated; traditional matrix sampling, planned sampling, and planned sampling with the parameter that each item be used at least once. The results of each of the three procedures were compared to the mean and variance of the true whole score of simulated data sets from five different populations (n=2000, n=1000, n=500, n=173, and n=100). Results indicated that as population decreased, the number of items to recover mean score and variance of scores decreased. These findings suggest that valid and reliable measures can be distributed to students with as few as one item to recover whole score mean, and as few as three items to recover variance from a true data set.

The planned sampling technique required fewer items to recover the statistical properties of the true data set, of each population tested, than traditional matrix sampling or planned sampling with parameters. In fact, as the simulated population increased, traditional matrix sampling required considerably more items to recover the statistical variance of the true data set, than the planned sampling procedure put forth in this article. This finding suggests that randomly assigning items to random participants reduces the number of items needed to recover the statistical properties of a true data set more efficiently than traditional matrix sampling. Further, the planned sampling technique that included the parameter of every item must be used once, required more items than the planned sampling procedure. This finding suggests that when any parameter was placed on item distribution, the items needed to recover statistical properties increased.

The results of this study indicated that the planned sampling procedure significantly reduced the number of items needed to recover statistical properties of the true data set across all populations simulated. The measure used for this study consisted of 56 items and has been widely used in the field of education. Through planned sampling, the researchers were able to reproduce mean score of a simulated true score data set with as few as 1 item and reproduce variance with as few as three items. To this end, planned sampling has potential to be a design that increases efficiency of assessment, by reducing the items necessary to obtain group level data and reduce the class time needed for students to take assessments.

It is important to note that these results are intended to represent group level data. This study focused on replicating Pintrich & Degroot's (1990) findings of a validation study with 173 participants. In the study, every participant answered each item with no missing data. The data were used to make student level inferences. The purpose of this study was to determine if an item reduction method could be used to generate meaningful group level data, though further research could yield item reduction methods to generate meaningful student level data.

Assessments

The findings of this study have implications for designing and administering assessments for modern learning environments. Assessment is ingrained in schools across the world. However, the role of assessment in MLEs is unclear. Educators have the ability to deliver assessment through PLP'S that students interface with on a daily basis. The PLP is a tool that can be utilized to not only deliver assessment, but collect data on assessments, analyze data, and promote collaboration between students and teachers. Teachers that have access to these data, and are prepared to analyze the data, can make informed decisions on student academic and non-academic performance. Educators that want to collect group level data on student performance would benefit from the planned sampling procedure that reduces the number of items that students need to answer to generate group level statistics. An example of this is, is deploying the MSLQ to 1000 seventh grade students in a school district. Traditionally, the MSLQ would be administered to all 1000 students. In addition, each student would answer all 56 items to produce the true data set that produced data on how students rated motivation and strategy use in their learning environments. Planned sampling would allow the 56 item MSLQ to be reduced to four items to replicate the mean of the whole score and nine items to replicate variance of the true data set. The reduction of 56 items to nine items has the benefit of reducing the amount of time students spend being assessed, which increases time in the learning process.

Measures

The benefits of planned sampling include measuring student performance on academic and nonacademic tasks, however the quality of the measurement is central to actualizing these benefits. In a pilot study, the researchers determined that item quality was key to determining the number of items needed to recover statistical properties. The item quality of the MSLQ was determined to be high, therefore, the planned sampling procedure produced desired results. A great deal of research and resources have been devoted to the development of measurements, however, most measures have been developed to be administered in traditional environments (e.g., proctored exams, observational protocols, etc.).

Researchers have put forth variations of matrix sampling. One such variation of matrix sampling is partial matrix sampling. The partial matrix sampling method ensures that all items are distributed to students, while having a set of unique items that all students complete. The partial matrix sampling procedure reduces items that are distributed, however partial matrix sampling has parameters associated with the procedures. The planned sampling method removes the parameters of item distribution to students, resulting in completely random items to random students. The findings of this study suggest that the planned sampling method is superior to matrix sampling in item reduction. Once researched further this technique could be integrated into the way assessments are both designed as well as distributed.

Modern Learning environments

The MLE dynamic environments to educate students in novel ways. Teachers have increased flexibility in how they design classrooms, instruction, and supports. ESSA provides guidance to educators in regards to aspects of the MLE including blended learning and personalized learning. On the other hand, the field lacks guidance on the role of assessment in MLE's. As previously stated, the MLE provides educators an opportunity to reimagine the role of assessment, capture new types of data, and increase flexibility of assessment delivery. Moreover, the MLE creates new challenges for assessment that must be considered.

The reliability and validity of assessment in MLE's has been largely unexplored. The initial questions that have been asked concern administering assessments to students in online learning environments. The ability for assessments to produce consistent results in online K-12 learning environments is unclear. In addition, it is unclear whether students in online learning environments take assessments without the aid of parental or learning coach support. Educators have introduced time limits on assessment to curtail student use of unlimited resources to answer test items, however, it is unclear if this practice inhibits student from using disallowed resources to complete assessments. Planned sampling has the potential to create assessments that are built into learning, creating ongoing assessment that aligns with state standards and student goals. Further, academic goals can be measured alongside non-academic goals such as persistence and grit. To be more specific, reducing the number of items needed to measure constructs increases the number of constructs that can be measured simultaneously.

In addition to the questions of reliability in MLE's, little is known about the validity of assessment in these learning environments. The initial challenge with validity of assessments in online learning includes, student understandings of expectations and alignment with student goals and objectives. Validity in online learning environments is predicated upon teacher knowledge of student performance. Monitoring student performance is essential to ensuring that students are prepared for assessments. Planned sampling may provide a means to assess students on an ongoing basis without taxing learners with countless items. Planned sampling could be used to provide short embedded assessments that track student progress throughout the school day, week, and year. Teachers could have access to multiple data points that can be used to determine student performance towards goals, and monitor student performance. Equally, planned sampling could be a procedure to inform state assessments. As mentioned above, lessening the time students spend in assessment would increase instructional time. Yet another benefit of planned sampling for state assessment could include continual assessment aligned with competencies instead of the traditional standards based assessment. Further studies are needed to determine how planned sampling could inform state level assessment.

Limitations

The planned sampling approach used for this study showed promise for reducing the number of items needed to measure group level data on a measure of SRL. However, there are limitations to the study. First, the data for this study was simulated to create a true data set. Future studies should include using the planned sampling procedure with participants in an authentic educational environment. Second, the highest simulated population in this study was 2000 participants. A population of 2000 participants would be adequate for many grade-level or even some school-level based measurement applications, however, district wide or statewide applications could involve larger populations. Thus, there is need to further investigate the potential of developing a means to distribute and conduct assessment a group larger than X thousand students; it is thought this is likely though localized subgroups. For instance, implementation would be focused on 8th grade at X district as compared to an entire state.

The planned sampling method requires more research in real world settings. The simulation used a favorable error variance that potentially could be larger with real participants. Further, the measure that was replicated was given in 1990 which could impact the item alphas that were inserted into the simulation. Item quality would impact the results of the simulation. School districts that are implementing blended learning settings using PLPs should be the next environments the planned sampling procedure is tested in. The planned sampling procedure should be tested on cognitive and non-cognitive measures within these environments to ensure that the procedure is applicable across multiple domains. Further research is warranted due to the limitations of the current method which provides only group level information which may be misused for making educational decisions for students.

Conclusion

The planned sampling procedure, put forth in this article, has the potential to increase efficiency, lower costs, and provide timely assessment opportunities to individuals that are educated in MLE’s. In order to realize the potential of planned sampling, further studies are needed to test the procedure in MLE’s through PLP’s. In addition, further research is needed to determine the viability of planned sampling with large scale applications.

INTRODUCTION TO CHAPTER 4

Modern learning environments (MLE) hold great promise to meet the educational needs of an ever diversifying student population. Modern learning environments, such as blended learning, where students spend part of class time face to face with teachers and part of class time learning on digital platforms, increase the range of instruction. Students could potentially benefit from MLEs that are designed to incorporate technology rich materials in daily instruction. Further, when digital platforms are paired with innovative classroom designs teachers and students can engage with curriculum in new and novel ways.

The purpose of this dissertation was to identify emerging aspects of the MLE that could improve outcomes for students. As was discussed in Chapter 2, SRL has been widely researched and advocated as a means to design successful learning environments. Chapter four of the dissertation is focused on supporting teachers in the design and implementation of SRL in the MLE.

This chapter stays with the theme of measuring and designing for the MLE by outlining how teachers can create tools to support students engaging in the MLE. Teachers can integrate these tools into the design of their classrooms to support and promote student usage of SRL strategies. Further, this chapter provides understanding of the importance of SRL in the MLE and effective and efficient ways to measure SRL.

CHAPTER 4: USING SELF-REGULATION STRATEGIES TO HELP STUDENTS WITH DISABILITIES ENGAGE IN BLENDED LEARNING ENVIRONMENTS

Rodrigo is a student with a specific learning disability attending third grade in a public elementary school that is in the process of adopting blended instruction. The Special Education teacher, Mrs. Quarter, works with Rodrigo in an inclusion classroom. While collaborating with Rodrigo's teacher, Mrs. Quarter learns that his class is going to compose biographies of famous people where students will embed sounds, images, and other links into shared Internet documents. Mrs. Quarter is excited about Rodrigo's opportunity to use technologies and make choices about his learning, but she is also concerned about the multiple steps, careful planning, and independent performance this assignment requires. When she looks at recent assessment data, she learns that indeed, Rodrigo is less focused on his work when a teacher is not working directly with him. Mrs. Quarter faces a challenge—what support can she suggest so that Rodrigo can be a more independent learner?

Throughout the United States, blended learning in K-12 settings is shaping the lives of learners with disabilities and teachers on a daily basis. Online learning, in general, has grown dramatically in the past 15 years (Watson, Pape, Murin, Gemin, & Vashaw, 2014). In fact, some form of online learning is taking place in every school district across the nation (Watson, 2014). Blended learning is growing faster than any other type of online or digital learning experience in K-12 schools (Barbour, Archambault, & DiPietro, 2013; Graham, 2013; Picciano, Seaman, Shea, & Swan, 2012). Moreover, blended learning has been introduced in the Every Student Succeeds Act (ESSA) which will increase the prevalence of blended learning in K-12 schools.

Blended learning is a formal education program in which a student receives some percentage of the curriculum through a digital platform. While engaged with digital learning platforms, there is some element of student control over time, place, path, or pace. In addition to digital-based instruction, different from fully online learning, blended learning requires that some instruction take place in a brick and mortar location away from home (Horn & Staker, 2012). Within our experience, most blended learning is established to take place between the formalized classroom and home environment. For example, in the popular flipped model, the explicit instructional component of the lesson takes place via video at home. The following day, students come to the classroom to participate in further instruction and activities that bolster their understanding of the content. For more information on blended instruction, including the most common models, readers are encouraged to visit Blended Learning Universe (http://www.blendedlearning.org/) . The integration of blended learning provides new avenues for teaching and learning. For learners, blended learning provides an environment that can and should be tailored to individual needs and interests, but in exchange, it increases the expectations for students to monitor and manage their own learning. Thus, for students with disabilities and other diverse learning needs, these new models bring forth new solutions to engage in the learning, acquire knowledge and skills, as well as new ways to demonstrate understanding of content. However, these new models also present challenges, such as how to manage new forms of learning and how to self-monitor progress. One challenges is self-regulated learning in the blended learning environment. The design of the blended learning classroom requires Rodrigo to increase ownership of his learning. Rodrigo will spend more time learning through digital platforms and group work. To be successful in the blended learning environment, Rodrigo will need to improve skills associated with self-regulated learning (SRL).

Blended learning models are relatively new, however, long-standing research in encouraging involvement and regulation in one's own learning is widely accepted in education and learning sciences. Specifically, planning, monitoring, and evaluating one's own learning is referred to as self-regulated learning (SRL). Several models of SRL have emerged in research. Well-known, researched frameworks describing self-regulation come from Zimmerman (1998a), Boekaerts (2007), and Winne and Hadwin (2008). Of these frameworks, Zimmerman's framework is most often associated with K-12 learning (see Figure 2).

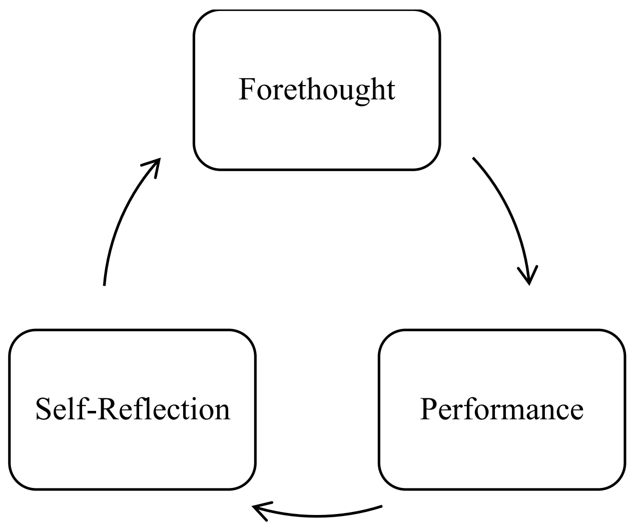

Figure 2. *Zimmerman's Framework of Self-Regulated Learning.*

Zimmerman's framework is a cycle of SRL, consisting of three phases. Each phase in the framework focuses on one of three skills: Forethought, Performance, and Self-Reflection. Zimmerman's framework of SRL asserts that successful performance of a particular skill during each phase leads the learner to the next phase, ultimately to cycle back to the first phase. Students that excel in SRL will do so because they have mastered subskills for each phase and make adjustments to improve both learning depth and academic task completion efficiency.

At times, teachers have concerns about whether students, especially students who have identified disabilities or other exceptionalities can automatically self-regulate their learning (Roeser, Skinner, Beers, & Jennings, 2012). However, recent research on SRL in young children with disabilities has demonstrated the display of skills and motivation to self-regulate dependent on both situation and context (Lichtinger & Kaplan, 2014). The implication is that students with disabilities can self-regulate their learning, but it also means that teachers should be strategic and intentional about preparing contexts that nurture student self-regulation success.

Understandings of the Blended Learning Context

The blended learning classroom can be designed as one of many models. As an example, in the station rotation model of blended learning, students rotate throughout class time on a preset schedule or with teacher discretion (Staker & Horner, 2012). Students will split time between small group teacher instruction, learning on digital platforms and group projects such as project based learning. Notable differences exist between student expectations to self-regulate learning in the traditional classroom and the blended learning classroom setting. The most striking differences consists of stations in the classroom, where teachers spend less face to face time instructing and modeling to students. Therefore, the opportunities to model self-regulation strategies during whole class instruction or small group instruction are reduced. For example, in a traditional classroom setting, the teacher prompts the entire class to think about what they need to begin an assignment (forethought phase). When the class moves onto the assignment phase, the teacher again provides whole class instruction by providing models and reminders of strategies for successful completion of assignments (performance phase). Finally, after the assignment the teachers encourage students to reflect upon their successes and challenges with the assignment (self-reflection phase). Conceptually, modeling and reminding students of appropriate academic strategies to use are made easier when all students are receiving the same or highly similar instruction to meet teacher-identified learning objectives during class time. Ironically, within this scenario, teachers have a much greater responsibility for carrying out student self-regulation. They deliver instruction, provide prompts, and continually encourage the class to self-regulate.

Learning environments that are designed to incorporate computers and digital learning platforms make it possible for students to do multiple simultaneous diversified learning tasks. Thus, these highly digital learning environments support greater personalization while shifting the roles of teacher and student. Teachers provide opportunities for students to learn subject matter, however they have greater opportunity to work with smaller groups in focused instructional times. Teachers in digital based learning environments move from teacher centered classroom designs to student centered classroom designs. A teacher in student centered classrooms will work with smaller groups of students to learn subject matter, while other students are asked to self-regulating their own learning, which may include receiving explicit instruction through digital platforms, participating in peer-instruction, forming their own small groups to complete a collaborative task, using methods and strategies for expressing their learning, or even troubleshooting issues with the technologies.

The blended learning environment places new demands on the student to succeed in daily learning tasks. The student should attend to the demands of the station independently. For example, students should decide what they need to begin an assignment at that station (forethought phase). When the students begin to engage with the academic task, they should remind themselves of strategies to use while working or have skills to solicit strategies from classmates or use other resources to determine a strategy to use on their own (performance phase). Finally, once the student has completed the assignment they reflect upon their successes or challenges with the assignment itself as well as how they made and executed plans for the assignment (self-reflection phase). Further self-reflection is captured via technology as an additional data point.

Applying strategies for helping Rodrigo develop Self-Regulation Skills

Changing expectations for teachers require new strategies to prepare students to be independent learners. These new strategies need to generate useful and meaningful data, encourage student engagement, as well as be educative. To be educative, an activity should attend to standards, but also leave space for curriculum where students are able to learn the information or practice the skills articulated in the goals, but that they also have the chance to learn much more. Blended learning, by design, gives some level of control to students over how they will learn, which increases student ownership and engagement, (Staker, 2011) To maximize student access to curriculum in blended learning, students will need be prepared to employ SRL strategies. Examples of the types of strategies needed include classroom organizational strategies, forethought strategies, and self-reflection strategies.

Classroom Organizational Strategies: Target Tracker

Mrs. Quarter realized that Rodrigo needs a strategy for linking his daily, or weekly, goals to his online learning. Rodrigo and his teacher can collaborate on goals expressed in “I Can” statements. An example of a goal might be: *By the end of the week, I can identify three appropriate Internet resources about my settler for my project*. Rodrigo now has a concrete goal that will lead him towards accessing necessary resources for his long-term goal, which is to complete use the resources to develop a product that communicates information about the settler. If Mrs. Quarter feels Rodrigo needs additional support in achieving his goal, she can create a visual called a target tracker to display in the classroom. The target tracker is an environmental support that ties the other two phases together. By making this physical display for the classroom, the target tracker serves as an important cognitive bridge between the virtual learning environment and the physical one and opens space for Rodrigo's teacher to provide modeling critical for students with disabilities to learn how to participate in classroom routines.

The target tracker is designed to serve as the hub of information in the blended learning classroom. Students that are prepared to use the target tracker will assess progress toward their goals throughout instructional time. The target tracker should be visible to both the students and the teacher. Students will determine a code to retain anonymity and be given a reusable sticker to place on the target tracker to indicate progress toward their goals. As Rodrigo places his coded sticker on the chart two things are made possible: First, he is afforded the opportunity to think about how he is progressing toward his goal. Second, he is making Mrs. Quarter aware of his perception of his progress. Mrs. Quarter can view the target tracker throughout the day and gain insight as to how Rodrigo and his classmates perceive their performance.

In addition, target trackers provide a record of the many different goals that students are working toward. Transparent indicators of student progress allow Mrs. Quarter to be more efficient in her decision-making about where students should focus their attention on academic tasks. Students that become comfortable with using the tracker might desire to publicly offer or enlist peer support. This is accomplished with a two-sided sticker. One side of the sticker shows the students code, as we have discussed before, and the other side indicates that the student feels confident to act as a peer mentor to other students working on similar goals. Teachers can generate these examples as they collaborate with students to determine objectives.

However, many teachers are expected to strictly align objectives to national or state standards. In this case, standards can be translated to "I Can" statements. Examples of standards and their translations into "I Can" statements for Rodrigo's specific task are provided in Table 3. In Rodrigo's case, it is also crucial to align target tracker goals to IEP goals that accomplish many purposes. First, it ensures that Rodrigo is working on goals relevant to him in a classroom with his typically developing peers. Second, this ensures his goals are relevant to the work occurring in the classroom while remaining focused on his individual needs. Finally, the target tracker will serve as a daily reminder to the teacher, or other provider, that Rodrigo is making progress toward his goals and the goals remain appropriate for him and his education.

Table 3

Translating State Standards into "I Can" Statements for Target Tracker

Sample State Standard	Translated "I Can" Statement
Use text features and search tools (e.g., key words, sidebars, hyperlinks) to locate information relevant to a given topic efficiently.	I can use a search engine to find information about a famous settler.
Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).	I can answer the 5W questions using information I learn from pictures and words in a text.
Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).	I can explain how I use both pictures and words to learn from a text.
Read on-level text with purpose and understanding.	I can quickly decide if a text helps me learn about my settler.
Create—both independently and collaboratively—technical, non-print, digital, and multimodal versions of text types.	I can create products using resources from the internet by myself, or with a partner.
Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.	I can find information from books and the internet and decide if the information is reliable about my settler.

The target tracker is a tool for increasing transparency and accountability in the classroom. The target tracker can be paired with other strategies to create a system to promote self-regulation in the blended learning environment as well as capture data of student performance towards their self-regulated learning performance. The target tracker can be used in conjunction with easily generated digital products to capture student progress in the forethought phase, performance phase, and self-reflection phase. Teachers can analyze these data and use them to make decisions about Rodrigo's education. Once the target tracker is created, a teacher could turn her or his attention to generating digital tools that guide student performance and generate data on that performance. In Zimmerman's model of self-regulation, forethought is the first phase of self-regulation. In the forethought phase, students will begin to think about what resources they need to complete an assignment. Students may determine if they have the appropriate resources to begin an assignment, have the appropriate prerequisite skills to complete an assignment, or if they have the time to complete the assignment. The forethought phase is generally an internal dialogue a student will have, however, an interactive chart can be developed to assist students with preparation to completing an assignment.

Displayed on the target tracker are Rodrigo's and his classmates "I Can" statements. Rodrigo will use his sticker to display progress toward his "I Can" statement. Rodrigo will have three options to choose from on the target tracker; (Red= working on it, but not there comfortable, Yellow= I almost have it, Green= I understand this). After Rodrigo begins his work, he can post his level of progress toward his goal. Rodrigo can determine if he is on pace with his peers and based on this decision, can seek assistance with his assignments.

Forethought Strategy: Ready Chart

Rodrigo will be more responsible for self-regulating his learning in the blended learning environment than in a traditional classroom. To assist Rodrigo in independent digital learning, Mrs. Quarter can generate a ready chart that Rodrigo can follow to ensure he is prepared to start the task. The ready chart asks important questions that will benefit Rodrigo as he begins to engage in virtual learning. These questions prompt Rodrigo to think about if he has a good understanding of the demands of the assignments, if he has the correct resources to begin the assignment, if he has an idea of how long the assignment is going to take to complete, and if he understands why he is being asked to complete this assignment.

Further, these questions afford an opportunity for students to think about the strategies they may use going into a learning tasks. These questions are representative of questions students determine before beginning an assignment. The teacher should have the discretion to create questions that meet the needs of Rodrigo and align with his IEP goals. The purpose of creating a digital forethought document is two-fold. Digital forethought strategies will capture important aspects of student learning as they begin to engage in a learning task. These data provide Mrs. Quarter a better idea of how students, like Rodrigo, are approaching learning tasks, and collect data to support decisions on how to better prepare students to begin learning tasks.

As mentioned previously, Rodrigo has historically been educated face to face with the teacher as a deliverer of subject matter and student as receiver of subject matter. These opportunities are still present in the blended learning, however there is also a new focus on Rodrigo becoming a more autonomous learner by receiving subject matter through different means such as digital instruction and projects. To best serve Rodrigo, as he performs a learning task, both he and the teacher will benefit from self-regulation support built into the classroom. Moreover, Rodrigo will benefit from access to strategies that he can use to engage in a learning task. To make these strategies more accessible to Rodrigo, an interactive guide to strategies can be created to guide appropriate choices of strategies to use. With this information, Rodrigo can ensure he is using appropriate strategies to engage in learning tasks and he will generate the data that Mrs. Quarter can use to determine if Rodrigo is using the appropriate strategy and if not, determine how best to teach the appropriate strategy to Rodrigo. Rodrigo is skilled in self-reporting data, however, not every student performs this task at the level of Rodrigo. It is important to note that some students will need assistance with self-reporting data. See Figure 3 for a summary of forethought strategies.

Performance Strategy: Walkaround

Digital learning environments, such as those that include blended learning offer teachers the opportunity to collect incredible amounts of data. Mrs. Quarter will benefit from a means to collect data to assess student performance as the students engage in digital, or problem-based learning. In order to do this, Mrs. Quarter could use a walkaround tool that allows her to monitor and assess the progress students are making toward their goals. The walkaround tool is like Walkthrough protocols (Stout, Kachur, & Edwards, 2013) that administrators use for brief classroom visits, only instead of walking through one classroom and into another, teachers can walk around their own classrooms and monitor students for an extended period.

The walkaround tool should be aligned to the students' "I Can" statements with a scale to determine the progress the student is making toward their goal while engaging in the task. The walkaround tool can be used by Mrs. Quarter to start meaningful conversations with students about their learning. In addition to monitoring progress towards assessment goals, these conversations allow teachers to maintain relationships with students that is crucial for the teacher in continually gauging students' present levels of performance. See Figure 3 for a summary of performance strategies.

Reflection Strategy: Success Check

Self-reflection is the third and final phase of Zimmerman's (1998a) model of self-regulation. Rodrigo will benefit from a tool that that prompts him to self-reflect on his performance on academic tasks. The success check tool provides self-reflection prompts that Rodrigo can ask himself questions that engage the self-reflection phase of SRL. For Rodrigo to maximize SRL, he should reflect by asking himself questions about his performance on the academic assignment he has just completed. Rodrigo can ask himself several different questions, "Did I make a plan for this assignment?", "Did I follow through with the plan I created?", "Did I give my best effort on this assignment?". Eventually, Rodrigo should be able to ask himself questions on his own, but it is likely that he will need to be prompted initially.

When Rodrigo asks himself these questions he begins to reflect on how he approached the academic assignment, if his plan to approach the assignment was successful, and if he exerted appropriate effort to complete the assignment. If Rodrigo asks these questions to himself every time he completes an assignment he will see patterns develop in how he approaches assignments. He will see if the approaches he is incorporating lead to better performance on the learning assignments and he can reflect on how the amount of effort he exerts toward the academic assignment promotes better academic performance for him.

When Rodrigo uses a digital based self-reflection tool like the Success Check, Mrs. Quarter can monitor Rodrigo's progress in the curriculum. With this information, Mrs. Quarter can see how Rodrigo feels he is approaching tasks and to what extent he believes he is putting forth the effort to achieve his goals. She can also use the Success check as a talking point for conferencing with Rodrigo or other stakeholders about IEP goals. See Figure 3 for a summary of reflection strategies.

Forethought Strategy: Ready Chart

- Engage in questions about...
  - understanding of demands.
  - access to appropriate resources.
  - estimate of length of assignment.
  - rationale behind assignment.

Performance Strategy: Walkaround

- Align with "I Can" statements.
- Embed a scale to determine the progress students make thoward their goals while engaging in tasks.
- Take advantage of the opportunity to start meaningful conversations with students about their learning.

Reflection Strategy: Success Check

- Provide self-reflection prompts that student can ask himself or herself related to academic performance.
- Fade prompts to allow for student autonomy in self-reflection strategies.
- Use self-reflection assessment as a measure of student progress in the curriculum and a talking point for student conferencing.

Figure 3. *Strategies to help self-regulated learning.*

Additional Consideration for Implementing Self-Regulation Support in Blended Learning

Implementing every part of the self-regulation data collection system at the same time can appear daunting. For this reason, we suggest staggering implementation over the course of weeks or months. In most cases, beginning with the target tracker serves to bring transparency to student learning occurring in the classroom. The target tracker will prepare students for self-regulation and self-assessment in regards to their learning goals or objectives.

Zimmerman's (1998a) model is cyclical, which means each phase of the blended learning process occurs in relation to each other. Therefore, teachers should determine which tool to implement based on the needs of their classroom. If the teacher feels that the students are experiencing challenges with beginning academic tasks, the teachers may introduce the Decision Chart (forethought phase) to promote appropriate strategies for starting tasks. If teachers notice that students are starting tasks appropriately but are not progressing towards their goals, they may decide to implement the walkaround tool (performance phase) to monitor student engagement with the material and learning from the subject matter presented. When teachers determine that students are engaging with the subject matter appropriately and producing desired evidence of learning, but are not making connections to past goals or future goals they may want to implement the self-reflection tool (self-reflection phase) to promote student understanding of how past goals are related to current goals and how future work will build on what they have just done.

Conclusion

Mrs. Quarter's class represents a classroom that teachers may be educating students in presently or will in the near future. Rodrigo's transition into this blended learning environment may present challenges and Mrs. Quarter may experience challenges with this transition as well. The potential for challenges underscores the need to carefully design blended learning classrooms to maximize the potential of the new learning environment as well as Rodrigo's potential as a learner. To most effectively address challenges and experience benefits, Mrs. Quarter can implement tools to support and promote self-regulation for the students in her classroom. These tools, which include classroom organization tools and tools to promote self-regulated learning can be designed into the classroom environment. Students simultaneously increase their capacity to use self-regulation strategies and generate data to support their understanding of how and why to use them, which assists teachers in using data to draw implications and maximize their time with the children doing things that computers and other technology are unable to do. One of the major goals of blended instruction practices to increase the pleasure of the learning and teaching experience. As teachers use data effectively they can have experiences where every day, or even multiple times per day they can feel like they truly helped a student grow.

CHAPTER 5: DISCUSSION

The purpose of this non-traditional dissertation was to add to current understandings of modern learning environments (MLE). To investigate MLEs, this dissertation presented findings from two areas related to MLEs. First, findings from a review of literature focused on the frameworks, methods, and measures that have been used to study self-regulated learning (SRL) in MLEs was presented. Second, findings from a study that tested a planned sampling technique, to reduce the number of items needed to assess students in MLE's was presented. In addition, the non-traditional dissertation format allowed the author to present an article tailored for practitioners that wanted to incorporate tools in their MLE that promote self-regulated learning (SRL). The central theme of MLE's was defined as learning environments that are technology rich and may mix face to face instruction with online instruction (blended learning) or instruction that occurred completely online (online learning).

Current Understandings of MLE's

The MLE describes emerging learning environments in which students are being educated. The MLE consists of multiple environments including blended learning and online learning. The environments can be delineated by where the instruction occurs. Blended learning instruction occurs in a brick and mortar learning environment as well as at home. Further, the design of blended learning environments gives students some level of control over their path, place, and pace of learning (Horn & Staker, 2012). Online learning occurs completely at the home. Students that are being educated in fully online learning environments receive all of their instruction outside of a brick and mortar learning location. The online learning curriculum is delivered through a digital learning platform that students access to receive curriculum and communicate with teachers and peers. Regardless of environment, technology is central to the

MLE. A student being educated in the MLE will most likely have access to a platform that supports access to the curriculum. On the low end, students will access a learning management system that houses student assignments, grades, communication, etc. Increasingly, students will have access to personal learning platforms (PLPs). The PLP expands technological tools to better support learner variability by using analytics to guide student progress, predict schedules for optimal learning, and allow teachers to generate multimedia content that is accessible to the learner. The PLP is groundbreaking in that it affords educators new ways to deliver content, catalog student performance, and analyze data that can be used to guide student instruction.

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The MLE incorporates tools, such as the PLP to support student learning, however, students being educated in the MLE are responsible for being more autonomous in their learning due to reduced teacher monitoring of academic behavior. The PLP, by design, provides supports that teachers are unable to do in the traditional classroom (e.g. instant data analysis, learning analytics). Conversely, the PLP is not a substitute for the historic role of a teacher. Teachers build relationships with students and use this relationship to instruct, monitor student academics and behavior, consult students on challenges with content, and offer support to keep students on pace. Yet another crucial role of the teacher is to mediate strategies that students use to engage with learning tasks. Teachers introduce learning strategies to students, model the strategy, and monitor student use of the strategy. Over time, students acquire skills associated with SRL and apply these skills while engaging in academic tasks. The performance phase of Zimmerman's framework (1998a) for SRL is aligned with academic strategy use. Students that effectively use academic learning strategies increase their autonomy (Zimmerman, 2008).

Multiple frameworks have been put forth to promote SRL in traditional learning environments (Zimmerman, 1998a); (Winne & Hadwin, 1998); (Boekaerts, 2003), of which, Zimmerman's framework is the most often cited. Zimmerman's framework for SRL is broken into three phases; forethought, performance, and self-reflection. This framework is based on social cognitive theory (Bandura, 1989) which focuses on learners observing others to acquire and maintain new skills. Traditional learning environments afford learners many opportunities to observe behaviors of teachers and peers. However, MLE's provide fewer opportunities for students to observe appropriate behaviors. The blended learning environment grants students opportunities to observe teachers and peers, however students have fewer opportunities to interact with teachers in whole group due to the design of the classroom. As an example, in a 60-minute class, a student will spend a fraction of that time in face to face interactions with the teacher. The student will split time between face to face instruction and other stations within the classroom such as digital learning. The decreased face to face instruction, limits opportunities for students to observe appropriate academic strategies and reduced time for teachers to monitor if students are using the strategies appropriately. To this end, frameworks that promote SRL through modeling have been instrumental in developing SRL in traditional learning environments. Future models of SRL should account for preparing students to use SRL strategies through methods that rely less on teachers to introduce and maintain SRL strategies.

Online learning environments present a challenge for preparing students to self-regulate their learning. Students being educated in the online learning environments have limited interactions with teachers. Interactions between teachers and students most often occur through scheduled meetings. Teachers are available to students, however, the teacher may or may not be available to that student when the student needs assistance. Further, the teacher has minimal understanding of student performance outside of assignments completed by the student. Further research is needed to determine how to prepare students to appropriately use SRL strategies in online learning models. In addition, further investigation is needed on how teachers monitor student SRL strategies. The combination of the promoting SRL and monitoring SRL is critical to preparing learners to be autonomous in their learning. Investigating how these concepts apply to online learning outcomes could lead to better outcomes for students learning in MLE's.

Assessment in MLE's

The role of assessment in MLE's is a relatively new query. The field of education has invested considerable resources in the development and validation of assessments for the traditional learning environment (Tippens, 2013). However, little is known about how assessments apply to MLE's. Though little is known about assessment in the online learning environment, potential benefits exist. First, the PLP's allow teachers to deliver assessments to students in novel ways. Assessments can be delivered directly to the student at any time. Further, students can take assessments in multiple learning environments and teacher can build the resources the student will need to take the assessment into the PLP (Bakerson, Trottier, & Mansfield, 2013). The teacher can upload an assessment that can be taken when the student is away from the school. The assessment can be automatically scored, and the student receives immediate feedback and guidance to resources that provide information on items that were answered incorrectly. Students could communicate concerns to the teacher through the PLP, while the PLP documents these interactions. This type of assessment is commonplace in post-secondary, yet little is known about how these assessments are used in MLE's.

Assessments in MLE's present challenges as well. Currently, digital learning platforms that support learning in MLEs, are not fully designed to support the capture and analysis of relevant student data (Connell, et al., 2017). Data that supports understanding of student performance in the MLE include, test results, time spent on assignments, resources accessed, and student communication. Independent of each other, these data do not give an accurate picture of student performance, however, when these data are collected and analyzed as a whole, the data can be used to drive instruction and support students to produce improved academic outcomes. The design of the PLP is crucial to maximizing the benefit of data in the MLE. The PLP should pair student performance data with student demographic data. Currently, it is unclear the number of available platforms that have the capability to merge performance and demographic data. In addition, little is known on how data collected in PLP's are analyzed. The findings from a study of a large fully online school suggested that data analyzation was inefficient due to the data tracking system (Connell, et al., 2017). The researchers described that relevant data needed were not collected in the data tracking system. Further study is needed on the design of PLPs and the data tracking systems that support data collection and analysis.

Overall, the PLP offers new opportunities to reimagine the role of assessment. At present, assessment is an integral aspect of education. Notwithstanding, the current state of assessment in education is not uniformly held as beneficial to student outcomes. An example of criticisms leveled on assessment is the high stakes associated with testing to students, teachers, and districts (Herman, 2008). Assessments not only affect the student, but extends to impact teacher evaluations and district funding (Peterson, 2013). Yet another criticism of assessment is the amount of time students spend in assessment. It is not uncommon for state assessments to last multiple weeks in schools, where the emphasis on assessment impacts instructional time.

This dissertation puts forth a potential method to reduce the burden of assessment on students, teachers, and administrators. A planned sampling procedure was tested to replicate the results of a measure on motivation and academic strategy use. The planned sampling procedure sought to determine the minimum number of items needed to recover the statistical properties of a true data set from a validation study of the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich & Degroot, 1990). The MSLQ was chosen because it is a measure of SRL that has been used in multiple studies of self-regulation. In addition, the quality of items on the MSLQ was acceptable. As described in chapter three, the planned sampling procedure was compared against two additional item reduction methods (traditional matrix sampling and planned sampling with an additional parameter). The results of the study found that all methods were effective in reducing items needed to recover the statistical properties of the true data set from the Pintrich and Degroot study. Interestingly the planned sampling procedure was superior to the traditional sampling procedure. Even more, the planned sampling procedure outperformed the planned sampling procedure with the parameter that each item be used at least once. This finding suggests that any parameter added into the simulation model increased the number of items needed to recover the statistical properties of the true data set than if the all items were distributed completely at random as in the planned sampling procedure.

The planned sampling procedure has potential to inform assessments that are designed to collect data on student cognitive and non-cognitive performance. The planned sampling procedure can be paired with the PLP to deliver assessments to students in an array of intervals. As an example of this, the 56 item MSLQ could be distributed to 173 participants that answer all items. Conversely, using planned sampling, the MSLQ could distribute four items at random to 173 participants. The results of this study suggested that the four items would recover the mean and variance of the full 173 participant data set. One practical application for this finding is using planned sampling to distribute the MSLQ through the PLP. The planned sampling procedure would determine the number of items needed to recover the statistical properties of the MSLQ to the population to be assessed. In this model students would receive four items through the PLP throughout the school day. Student responses are then aggregated to determine group level scores. The planned sampling method reduced the number of items needed to recover the statistical properties by 52 items. The reduction of items represents significantly less time students spend in assessment. As a result, the planned sampling procedure has potential to deliver assessment items efficiently and collect assessment data daily. The collected data could be helpful in the study of developing effective data tracking systems that are embedded in PLPs. Therefore, planned sampling should be considered as a means of data collection that adds structure to data tracking systems.

SRL Tools for the Blended Classroom

As discussed in chapter two, the blended learning classroom affords teachers flexibility in classroom design. Teachers augment access to curriculum by designing classrooms that are technology rich to meet the needs of learner variability. The blended learning classroom presents curriculum to students in multiple ways and can provide additional small group instruction with a teacher, dependent upon design. At the same time, the blended learning classroom requires students to learn independently through PLPs and group projects. During individual work, students are expected to self-regulate their academic performance in multiple learning environments. As discussed in chapter two, Zimmerman's framework of SRL consists of three phases; forethought, performance, and self-reflection. The three phases detail skill that students need to successfully self-regulate their learning in blended learning environments. The field of education is experiencing an increase number of blended learning environments (Staker, 2011). Yet, little is known about how teachers are prepared to teach SRL skills to students. The purpose of this chapter was to outline tools that that teachers can implement to support the promotion of student SRL in blended learning classrooms.

Tools that support student SRL are crucial to student success in the blended learning environment. As previously stated in this dissertation, the blended learning environment reduces the amount of time teachers should mediate student SRL. Therefore, tools that support student SRL may serve to replace the absence of teacher mediation. Tools that support SRL can be embedded in the learning environment, with traditional materials and digital formats. Chapter four presented four tools that promote and collect data on student SRL; target tracker, forethought tool, teacher walk around tool, and self-reflection tool. The tools aligned with phases of Zimmerman's model of SRL (1998a). In addition, students that use these tools, generated data on each phase of SRL. These data could then be used to analyze student performance in each phase to identify challenges the student may be experiencing. Moreover, teachers can use the results of these data to conference with the student about performance in the classroom. Yet one more potential benefit is, student ability to interpret their own data. Students that analyze their own data could potentially lead to better performance in independent learning.

The collection of data is a central theme of this dissertation. Data can be collected in new and innovative ways, through PLPs that deliver curriculum to students. Further, MLEs require measurement of new skills that students need to be successful in these emerging environments. The data that is collected in MLEs can inform student academic performance provided that PLPs are structured to collect and analyze data. Moving forward, research should be dedicated to pairing academic performance data to data on student SRL. The two sources of data could potentially give researchers and educators, a more comprehensive look at student performance in the MLE.

Implications for Future Research

This dissertation focused on supporting students in MLEs. The dissertation reported findings of the role of SRL in MLEs and tested a sampling technique to collect data in technology rich learning environments. In addition, this dissertation reported on tools that promote SRL in the blended learning classroom. The MLE presents new and exciting opportunities to better serve diverse learners through innovative designs and instruction provided through PLPs. However, much research is needed on how to best design learning environments and digital learning platforms that capture the nuances of student learning.

It is thought students in MLEs will benefit from increased SRL. To better understand the role of SRL in these environments, research is needed to determine how closely existing frameworks of SRL apply in modern learning environments. Chapter two of this dissertation describes current SRL frameworks and the challenges with how they align with the MLE. Future research is needed to expand SRL frameworks to account for the shift from the traditional teacher centered, to the student-centered learning environment. At the same time, research on SRL in modern learning environments should focus on introducing and maintaining self-regulation strategies that students use in and outside of the classroom.

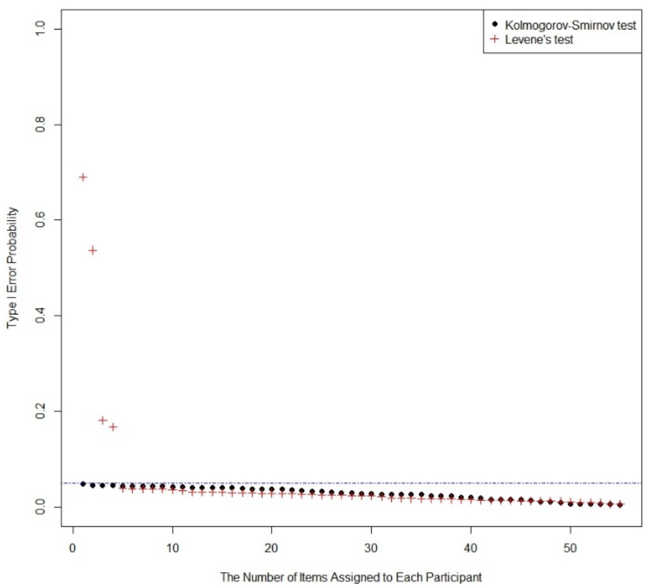
The role of assessment in K-12 schools remains a controversial topic in education, due in part to the numerous assessments that students complete throughout the school year. This dissertation presented findings on a planned sampling procedure that sought to reduce the number of items that are needed to measure student performance. The study used a non-cognitive measurement, however, previous studies on traditional matrix sampling (Poggio & Glassnap, 1973; Shoemaker, 1971) suggest that cognitive measures can be distributed through the planned sampling procedure with similar results. For this reason, the planned sampling procedure should be applied to cognitive measures to further study the viability of the planned sampling procedure with cognitive assessments. Ultimately, the planned sampling procedure should be administered to students in authentic education settings.

APPENDIX

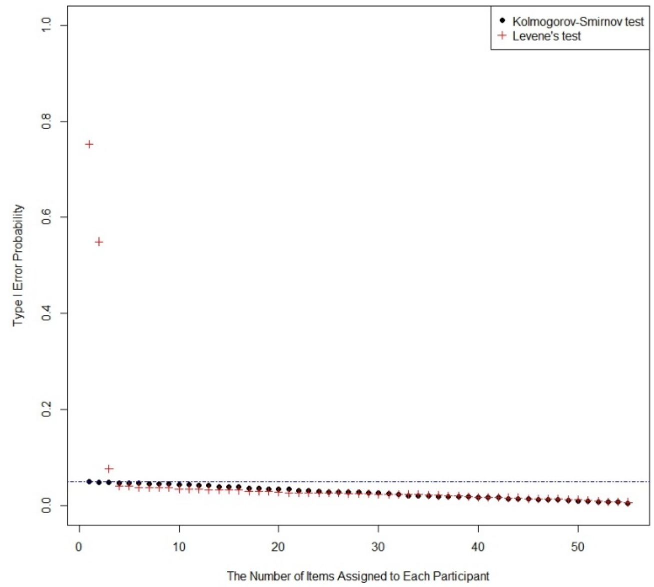
The appendix section contains plots related to chapter three. These plots represent the breakdown of items needed to recover statistical properties of a simulated true data set. The plots are organized by the item reduction method used, and the population that was sampled.

Sampling approaches for 173 participants

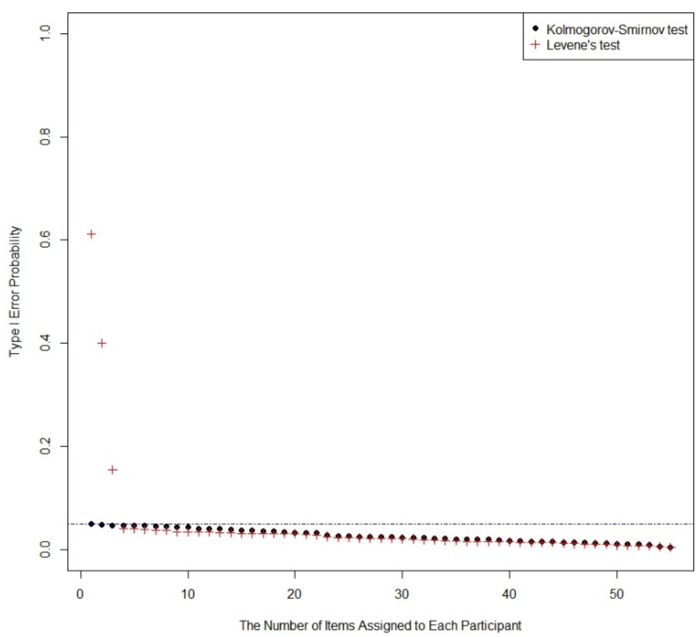
Matrix sampling



Planned sampling

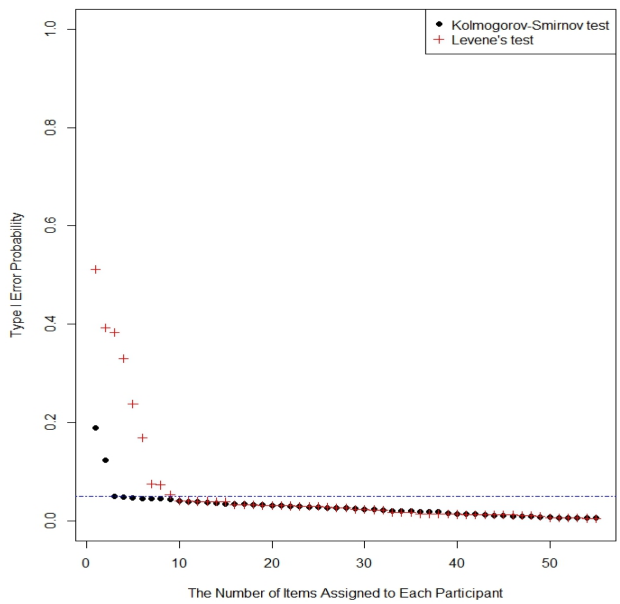


Planned sampling with parameter

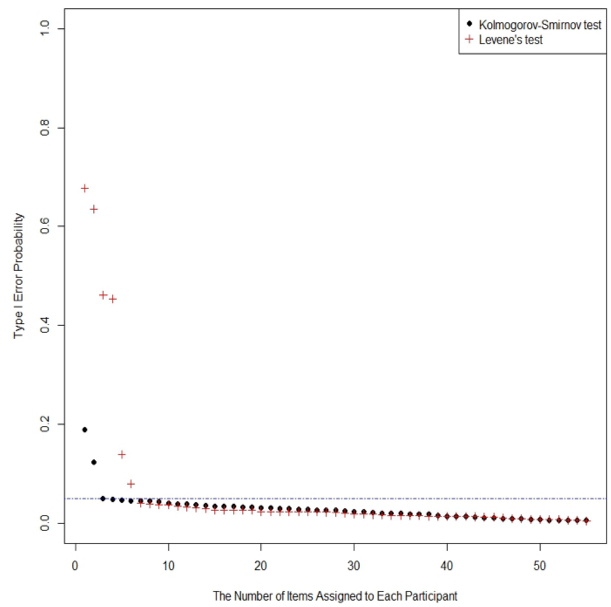


Sampling approaches for 500 participants

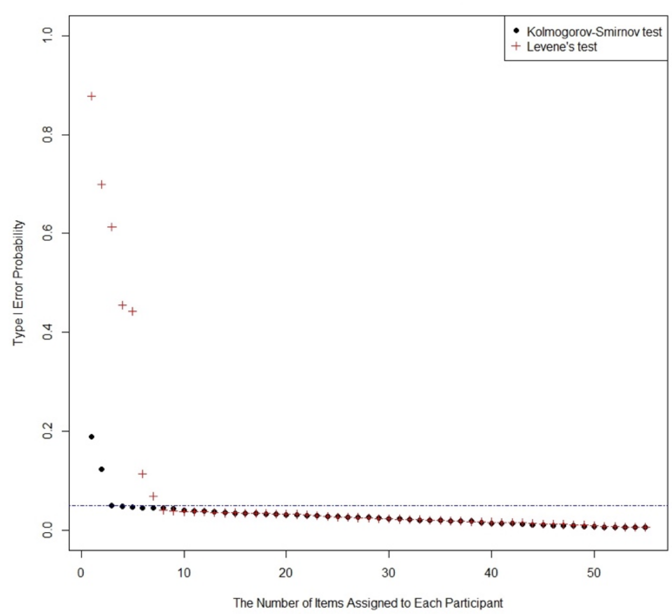
Matrix sampling



Planned sampling

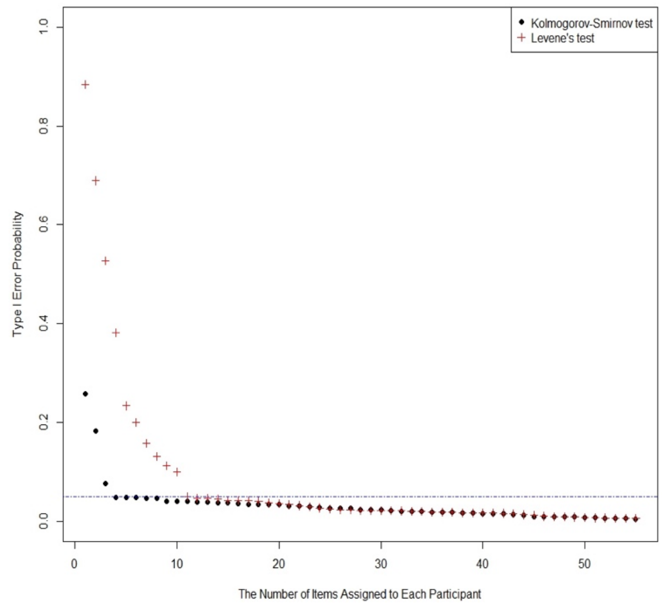


Planned sampling with parameter

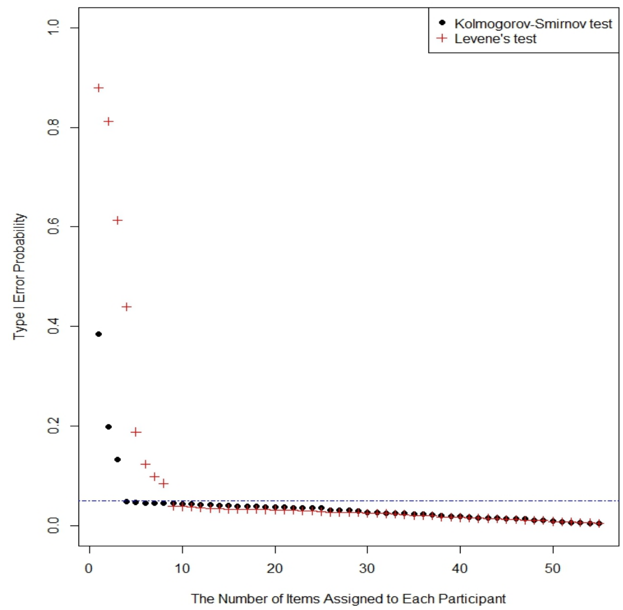


Sampling approaches for 1,000 participants

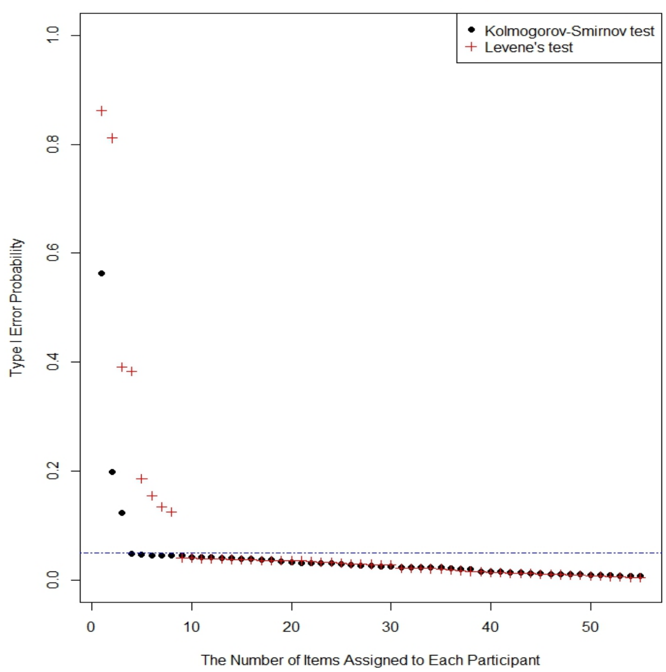
Matrix sampling



Planned sampling

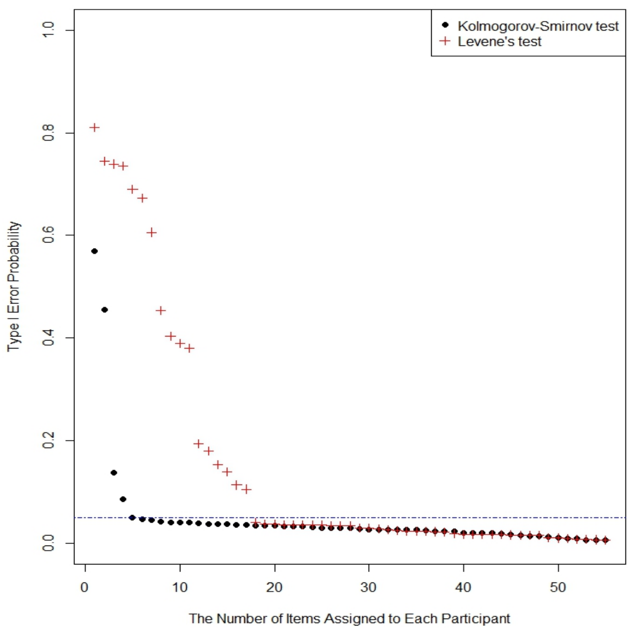


Planned sampling with parameter

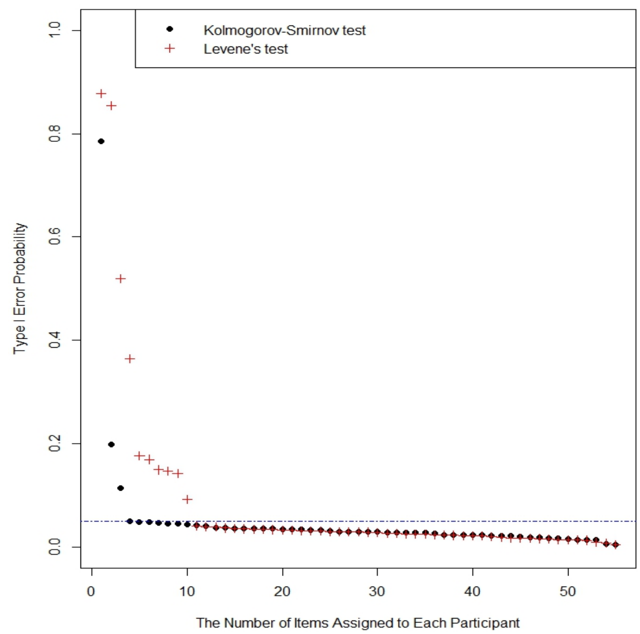


Sampling approaches for 2,000 participants

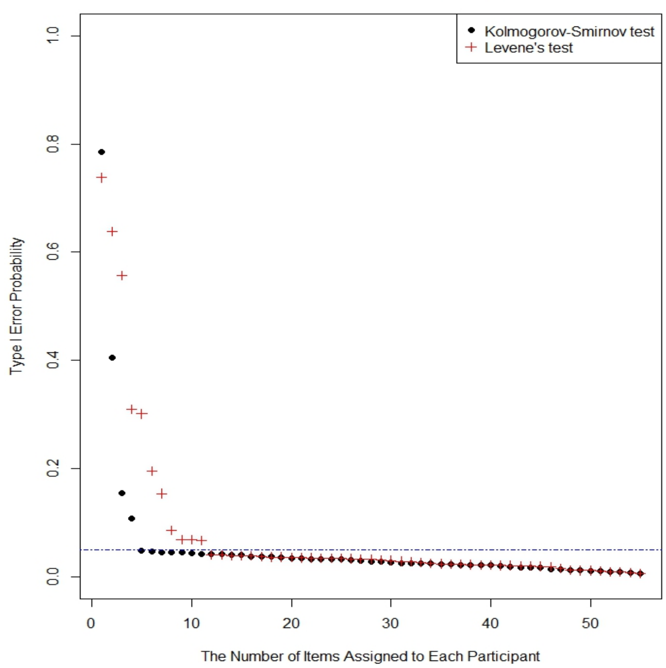
Matrix sampling



Planned sampling



Planned sampling with parameter



REFERENCES

Allen, I. E., & Seaman, C. A. (2007). Likert scales and data analyses. *Quality Progress*, *40*(7), 64-65.

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development: Six theories of child development* (pp. 1-60). Greenwich, CT: JAI Press.

Barbour, M., Archambault, L., & DiPietro, M. (2013). K–12 online distance education: Issues and frameworks. *American Journal of Distance Education, 27*(1), 1–3.

Barbour, M. K., & Mulcahy, D. (2008). How are they doing? Examining student achievement Virtual Schooling. Retrieved May 12, 2015 from http://digitalcommons.sacredheart.edu.

Basham, J.D., Stahl, S., Ortiz, K., Rice, M.F., & Smith, S. (2015). *Equity matters: Digital & online learning for students with disabilities.* Lawrence, KS: Center on Online Learning and Students with Disabilities.

Basham, J. D., Hall, T. E., Carter Jr, R. A., & Stahl, W. M. (2016). An operationalized understanding of personalized learning. *Journal of Special Education Technology*, *31*(3), 126-136.

Basham, J. D., Smith, S. J., Greer, D. L., & Marino, M. T. (2013). The scaled arrival of K–12 online education: Emerging realities and implications for the future of education. *Journal of Education, 193*(2), 51-59.

*Berger, J. L., & Karabenick, S. A. (2016). Construct validity of self-reported metacognitive learning strategies. *Educational Assessment, 21*(1), 19-33.

Boekaerts, M. (1997). Self-regulated learning: A new concept embraced by researchers, policy makers, educators, teachers, and students. *Learning and Instruction*, *7*(2), 161-186.

Boekaerts, M. (2007). Understanding students' affective processes in the classroom. In P. Schutz

& R. Pekrun, (Eds) *Emotion in education* (pp. 37-56). London: Elsevier Press.

Candy, P. C. (1991). *Self-Direction for Lifelong Learning. A Comprehensive Guide to Theory and Practice.* San Francisco, CA: Jossey-Bass.

Cavanaugh, C. S., Barbour, M. K., & Clark, T. (2009). Research and practice in K-12 online learning: A review of open access literature. *The International Review of Research in Open and Distributed Learning, 10*(1).

Cavanaugh, C., & Blomeyer, R. L. (Eds.). (2007). *What works in K-12 online learning.* Eugene, OR: International Society for Technology in Education.

*Chang, C. C., Tseng, K. H., Liang, C., & Liao, Y. M. (2013). Constructing and evaluating online goal-setting mechanisms in web-based portfolio assessment system for facilitating self-regulated learning. *Computers & Education, 69*, 237-249.

Chen, Y. T. (2014). A study to explore the effects of self-regulated learning environment for hearing-impaired students. *Journal of Computer Assisted Learning, 30*(2), 97-109.

*Chen, C. M., & Huang, S. H. (2014). Web-based reading annotation system with an attention-based self-regulated learning mechanism for promoting reading performance. *British Journal of Educational Technology, 45*(5), 959-980.

*Chen, C. M., Wang, J. Y., & Chen, Y. C. (2014). Facilitating english-language reading performance by a digital reading annotation system with self-regulated learning mechanisms. *Educational Technology & Society, 17*(1), 102-114.

Cho, M. H., & Shen, D. (2013). Self-regulation in online learning. *Distance education, 34*(3), 290-301.

Christensen, C. M., Horn, M. B., & Staker, H. (2013). *Is K-12 blended learning disruptive? An introduction to the theory of hybrids.* Boston, MA: Clayton Christensen Institute for

Disruptive Innovation.

de la Varre, C., Irvin, M. J., Jordan, A. W., Hannum, W. H., & Farmer, T. W. (2014). Reasons for student dropout in an online course in a rural K–12 setting. *Distance Education, 35*(3), 324-344.

Delacre, M., Lakens, D., & Leys, C. (2017). Why Psychologists Should by Default Use Welch's t-test instead of student's t-test. *International Review of Social Psychology*, *30*(1).

Egalite, A. J., Mills, J. N., & Greene, J. P. (2016). The softer side of learning: Measuring students' non-cognitive skills. *Improving Schools, 19*(1), 27-40.

Enders, C. K. (2010). *Applied missing data analysis*. New York, NY: Guilford Press.

Entwistle, N. J. (1991). Approaches to learning and perceptions of the learning environment. *Higher Education, 22*(3), 201-204.

ESSA (2015). Every Student Succeeds Act of 2015, Pub. L. No. 114-95 § 114 Stat. 1177 (2015-2016).

Freidhoff, J., Borup, J., Stimson, R., & DeBruler, K. (2015). Documenting and Sharing the Work of Successful On-site Mentors. *Journal of Online Learning Research, 1*(1), 107-128.

Friend, B., Patrick, S., Schneider, C., & Vander Ark, T. (2017). *What's Possible with Personalized Learning?* Vienna, VA: International Association for K-12 Online Learning.

Gemin, B., Pape, L., Vashaw, L., & Watson, J. (2015). *Keeping pace with K-12 digital learning: An annual review of policy and practice.* Durango, CO: Evergreen Education Group.

Graham, C. (2013). Emerging practice and research in blended learning. In M. G. Moore (Ed.), *Handbook of distance education* (pp. 333–350). New York, NY: Routledge.

Greer, D., Rowland, A. L., & Smith, S. J. (2014). Critical considerations for teaching students with disabilities in online environments. *Teaching Exceptional Children*, *46*(5), 79-91.

Harris, K. R., Graham, S., Mason, L. H., & Friedlander, B. (2008). *Powerful writing strategies for all students.* Baltimore, MD: Brookes.

Herman, J. L. (2008). Accountability and assessment: Is public interest in K-12 education being served. In K. E. Ryan & L. A. Shepard (Eds.), *The future of test-based educational accountability* (pp. 211-231). New York, NY: Routledge.

Horn, M. B., & Staker, H. (2011). *The rise of K-12 blended learning.* Boston, MA: Innosight Institute.

Joreskog, K. G. (1979). A general approach to confirmatory maximum likelihood factor analysis with addendum. In K. G. Joreskog & D. Sorbom (Eds.), *Advances in factor analysis and structural equation models* (pp.21-43). Cambridge, MA: Abt Books.

Kim, P., Kim, F. H., & Karimi, A. (2012). Public Online Charter School Students Choices, Perceptions, and Traits. *American Educational Research Journal, 49*(3), 521-545.

Kleijnen, J. P. (1975). *Statistical techniques in simulation in two parts*. *Statistics*, 9.

*Kramarski, B., & Mizrachi, N. (2006a). Online interactions in a mathematical classroom. *Educational Media International, 43*(1), 43-50.

*Kramarski, B., & Mizrachi, N. (2006b). Online discussion and self-regulated learning: Effects of instructional methods on mathematical literacy. *The Journal of Educational Research, 99(*4), 218-231.

Kritzman, M. (1993). What practitioners need to know about monte carlo simulation. *Financial Analysts Journal*, *49*(6), 17-20.

Lackaye, T. D., & Margalit, M. (2006). Comparisons of achievement, effort, and self-perceptions among students with learning disabilities and their peers from different achievement groups. *Journal of Learning Disabilities*, *39*(5), 432-446.

Lane, K. L., Harris, K. R., Graham, S., Weisenbach, J. L., Brindle, M., & Morphy, P. (2008). The effects of self-regulated strategy development on the writing performance of second-grade students with behavioral and writing difficulties. *The Journal of Special Education, 41*(4), 234-253.

Lichtinger, E., & Kaplan, A. (2015). Employing a case study approach to capture motivation and self-regulation of young students with learning disabilities in authentic educational contexts. *Metacognition and Learning, 10*(1), 119-149.

Lord, F. M. (1965). Item sampling in test theory and in research design. *ETS Research Bulletin Series*, 2, i-39.

Loyens, S. M., Magda, J., & Rikers, R. M. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. *Educational Psychology Review*, *20*(4), 411-427.

Olkin, I. (1960). *Contributions to probability and statistics: essays in honor of Harold Hotelling*. Palo Alto, CA: Stanford University Press.

Patrick, S., Worthen, M., Frost, D., & Gentz, S. (2016). *Meeting the Every Student Succeeds Act's promise: State policy to support personalized learning.* Vienna, VA: International Association for K-12 Online Learning.

Peterson, P. E. (2003). *Our schools and our future: Are we still at risk?* Stanford, CA: Hoover Press.

Picciano, A.G., Seaman, J., Shea, P., & Swan, K. (2012). Examining the extent and nature of online learning in American K-12 education: The research initiatives of the Alfred P.

Sloan Foundation. *The Internet and Higher Education, 15*, 127-135.

Pilegard, C., & Fiorella, L. (2016). Helping students help themselves: Generative learning strategies improve middle school students' self-regulation in a cognitive tutor. *Computers in Human Behavior, 65*, 121-126.

Pintrich, P. R. (1995). Understanding self-regulated learning. *New Directions for Teaching and Learning*, (63), 3-12.

Pintrich, P. R. (2000). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psychology*, *92*(3), 544.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33-40.

Pintrich, P. R., Smith, D., Garcia, T., and McKeachie, W. (1991). A manual for the use of the motivated strategies for learning questionnaire (MSLQ). Ann Arbor, MI: The University of Michigan Press.

Poggio, J. P., & Glasnapp, D. R. (1973). Content-sampling as an evaluation and research technique. *Educational and Psychological Measurement, 33*(4), 903-908.

Powell, A., Watson, J., Staley, P., Patrick, S., Horn, M., Fetzer, L., & Verma, S. (2015). *Blending learning: The evolution of online and face-to-face education from 2008-2015.* Vienna, VA: International Association for K-12 Online Learning. Retrieved from http://files.eric.ed.gov/fulltext/ED560788.pdf.

Reis, S. M., McCoach, D. B., Little, C. A., Muller, L. M., & Kaniskan, R. B. (2011). The effects of differentiated instruction and enrichment pedagogy on reading achievement in five elementary schools. *American Educational Research Journal*, *48*(2), 462-501.

Rice, K. L. (2006). A comprehensive look at distance education in the K–12 context. *Journal of*

Research on Technology in Education, 38(4), 425-448.

Roeser, R. W., Skinner, E., Beers, J., & Jennings, P. A. (2012). Mindfulness training and teachers' professional development: An emerging area of research and practice. *Child Development Perspectives, 6(*2), 167-173.

Rose, R. (2014). *Access and equity for all learners in blended and online education.* Vienna, VA: International Association for K-12 Online Learning. Retrieved from http://files.eric.ed.gov/fulltext/ED561307.pdf.

Sansone, C., Fraughton, T., Zachary, J. L., Butner, J., & Heiner, C. (2011). Self-regulation of motivation when learning online: the importance of who, why and how. *Educational Technology Research and Development*, *59*(2), 199-212.

Scheiter, K., & Gerjets, P. (2007). Learner control in hypermedia environments. *Educational Psychology Review*, *19*(3), 285-307.

Schunk, D. H. (1990). Goal setting and self-efficacy during self-regulated learning. *Educational Psychologist*, *25*(1), 71-86.

Schunk, D. H. (2005). Self-regulated learning: The educational legacy of Paul R. Pintrich. *Educational Psychologist*, *40*(2), 85-94.

Schunk, D. H., & Zimmerman, B. J. (2003). Self-regulation and learning. In I. B. Weiner (Ed.). *Handbook of psychology (Vol. 7)*. New York, NY: Routledge.

*Sha, L., Looi, C. K., Chen, W., Seow, P., & Wong, L. H. (2012). Recognizing and measuring self-regulated learning in a mobile learning environment. *Computers in Human Behavior, 28*(2), 718-728.

Shoemaker, D. M. (1971). An application of item-examinee sampling to scaling attitudes. *Journal of Educational Measurement*, *8*(4), 279-282.

Staker, H. (2011). *The rise of K-12 blended learning: Profiles of emerging models.* Boston, MA: *Innosight Institute*. Retrieved from http://files.eric.ed.gov/fulltext/ED535181.pdf.

Staker, H., & Horn, M. B. (2012). Classifying K-12 blended learning. Boston, MA: *Innosight Institute*. Retrieved from http://files.eric.ed.gov/fulltext/ED535180.pdf.

Stout, J., Kachur, D., & Edwards, C. (2013). *Classroom walkthroughs to improve teaching and learning*. New York, NY: Routledge.

Swanson, H. L. (1999). *Interventions for students with learning disabilities: A meta-analysis of treatment outcomes*. New York, NY: Guilford Press.

Taft, R. J., & Mason, L. H. (2011). Examining effects of writing interventions highlighting results for students with primary disabilities other than learning disabilities. *Remedial and Special Education, 32*(5), 359-370.

Watson, J., Pape, L., Murin, A., Gemin, B., & Vashaw, L. (2014). *Keeping pace with K-12 digital learning: An annual review of policy and practice.* Evergreen, CO: Evergreen Education Group.

Wilks, S. S. (1963). *Mathematical statistics*. New York, NY: John Wiley & Sons.

Winne, P. H. (1997). Experimenting to bootstrap self-regulated learning. *Journal of Educational Psychology, 89*(3), 397.

Winne, P. H., & Hadwin, A. F. (1998). Studying as self-regulated learning. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 27-30). New York, NY: Routledge.

Winne, P. H., & Hadwin, A. F. (2008). The weave of motivation and self-regulated learning. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 297-314). New York, NY: Lawrence

Erlbaum Associates.

Yuen, K. K. (1974). The two-sample trimmed t for unequal population variances. *Biometrika*, *61*(1), 165-170.

Zeidner, M., Boekaerts, M. & Pintrich, P. (2000). Self-regulation: Directions and challenges for future research. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.). *Handbook of self-regulation* (pp. 749–768). New York, NY: Academic Press.

Zhao, Y. (2014). *Who's Afraid of the Big Bad Dragon?: Why China Has the Best (and Worst) Education System in the World*. New York, NY: John Wiley & Sons.

Zimmerman, B. J. (1998a). Developing self-fulfilling cycles of academic regulation: An analysis of exemplary instructional models. In D. H. Schunk & B. J. Zimmerman (Eds.), *Self-regulated learning: From teaching to self-reflective practice* (pp. 1-19). New York, NY: Guilford Publications.

Zimmerman, B. J. (1998b). Academic studying and the development of personal skill: A self-regulatory perspective. *Educational Psychologist, 33*(2), 73-86.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, *45*(1), 166-183.

Zimmerman, B. J. (2013). From cognitive modeling to self-regulation: A social cognitive career path. *Educational Psychologist*, *48*(3), 135-147.