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# Training Model for Incorporating Interactive Whiteboards Into the K-12 Classroom

Elizabeth G. Jamerson  
*Old Dominion University*

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**TRAINING MODEL FOR INCORPORATING INTERACTIVE WHITEBOARDS  
INTO THE K-12 CLASSROOM**

by

Elizabeth G. Jamerson

B.A. May 1975, Longwood University

M.A. May 1993, Longwood University

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Requirements for the Degree of

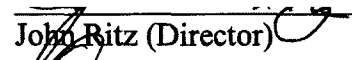
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Approved by:

  
John Ritz (Director)

  
Michael Kosloski (Member)

  
Robert Lucking (Member)

## **ABSTRACT**

# **TRAINING MODEL FOR INCORPORATING INTERACTIVE WHITEBOARDS INTO THE K-12 CLASSROOM**

Elizabeth G. Jamerson  
Old Dominion University, 2015  
Director: Dr. John M. Ritz

School divisions have been implementing interactive whiteboards, as well as other instructional technologies, in ever-increasing numbers with the intent to improve student performance. The benefits of these technologies have been hotly debated, with some researchers claiming that interactive whiteboards improve student achievement, while others claim that the technologies have no effect on student progress. Other researchers concluded that interactive whiteboards are tools which can improve student achievement only if they are used effectively. Research has further suggested that teachers need high quality professional development that incorporates both formal and informal elements to assist teachers incorporate interactive whiteboards into the K-12 classroom. The purpose of this study was to develop a model for providing effective professional development for teachers for incorporating interactive whiteboards, into the K-12 classroom. Three research objectives guided this study: (1) identify best practices for providing teacher professional development that incorporates formal training, (2) identify best practices for providing teacher professional development that incorporates informal training, and (3) integrate best practices for professional development into a model for incorporating interactive whiteboards, into the K-12 classroom.

Data for this study were collected from a review of literature to identify best practices to create a draft model of professional development and from a survey of Virginia Society for Technology in Education members who serve as instructional technology resource teachers to refine the proposed model. Forty instructional technology resource teachers completed the survey. Closed form questions were analyzed using descriptive statistics. Open-form questions were analyzed and coded to identify themes.

The findings of this study suggested that professional development for incorporating interactive whiteboards and other instructional technologies should be carefully planned prior to implementation and should utilize both formal and informal methods. Best practices dictated that professional development should be sustained, ongoing, hands-on, job-embedded, scaffolded, individualized, differentiated by technology skill level of participants, differentiated by subject/grade level, and evaluated routinely using a variety of methods. The study determined that the professional development should conform to theories of adult learning by providing choices and relevancy, include troubleshooting tips, foster awareness of the many features of the interactive whiteboards, go beyond technological fluency but also focus on pedagogy and lesson planning, be validated through portable credentials, have administrative buy-in, provide time for reflection and practice, reflect budget constraints, provide options to overcome barriers to engaging in professional development, and identify ways to motivate learners.



## DEDICATION

This work is dedicated to my brother, Clifford L. Gibson, who lived each day to the fullest and encouraged me to pursue my dreams. He always told me how proud he would be of me when I finished my dissertation. Although he did not live to see it, I know he would have helped me celebrate this accomplishment.

Elizabeth G. Jamerson

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I owe a debt of gratitude to the Virginia Society for Technology in Education (VSTE) Board of Directors, especially Dr. Karen Richardson (Executive Director) and Mrs. Anita Harris, for their help in soliciting participants for my survey. My thanks also go to the VSTE members serving as instructional technology resource teachers who took part in the survey.

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## CHAPTER I

### INTRODUCTION

The information age, brought about by new technologies, has forever changed the nature of public education. In the information age, classrooms have become infused with new instructional technologies, including LCD projectors, iPods, iPads, visual presenters, graphing calculators, and digital microscopes. Teachers utilize online course management systems, create podcasts, stream video, and blog. Ubiquitous computing has become the goal as school divisions strive to provide each student with a laptop computer or tablet. In these high-tech classrooms, one of the more recent of the available instructional technology devices is the interactive whiteboard (IWB). Proponents of these boards have touted their educational benefits, and IWBs have appeared in schools around the world at astonishing rates (Banister, 2010; Beauchamp & Parkinson, 2005; Cuthell, 2007; Futuresource Consulting, 2008; Glover, Miller, Averis, & Door, 2007; Haldane, 2007; Hayes, 2010; Hennessy & London, 2013, Quillen, 2012; Schut, 2007). Their presence is predicted to continue to grow, along with support networks, software to use with the boards, and IWB conferences (Betcher & Lee, 2009; O’Neill, 2012; PRWeb, 2012).

The interactive whiteboard—an electronic tool that connects to a computer and projector thereby turning the large board surface into a touch-sensitive screen—allows teachers and students to write and erase annotations, control the computer monitor, and store information. *Forbes Magazine* referred to the boards as “portals to the outside world” (Corcoran, 2009, p. 40). Various brand names of IWBs are sold including ActivBoard, eBeam, Interwrite, Mimio, Numonica, Polyvision, SMART Board, Star Board, and PolyVision; these versatile and costly boards have become a staple of the

classroom in many localities, with sales predicted to grow (Kopp, 2012). A press release from Futuresource Consulting (2008), after a study of 66 countries, estimated that one in six classrooms would be equipped with an IWB within the next five years, with the United States helping to lead the way. Global Industry Analysts, Inc. released a report projecting that by 2018, the U. S. market would reach \$1.85 billion (PRWeb, 2012). SMART Technologies, manufacturer of more than half of the interactive whiteboards sold in the world market, has seen sales rise from 170,000 boards in 2004 to 700,000 per year in 2009 (Corcoran, 2009). In order to pay for the inclusion of IWBs and other instructional technologies, school budgets have been escalating rapidly. While IWBs have become regular fixtures in many classrooms, school systems have consistently neglected to pay sufficient attention to training for incorporating them into the classroom in a way that is conducive to improving student achievement (Alston & Miller, 2001; Baker, Clay, Scott, Arrington, & Gratama, 2005; Bannister, 2010; Beggs, 2000; Fermanich, 2002; Franklin & Beach, 2002; Jones & Vincent, 2007; Miller & Glover, 2007; Nightingale, 2006; Starr, 2010).

### **Statement of the Problem**

Putting instructional technologies such as interactive whiteboards into the classroom has not always resulted in an improvement in student performance (Deubel, 2010; Lei, 2010; Northcote, Mildenhall, Marshall, & Swan, 2010; Ringstaff & Kelley, 2002; Schuck & Kearney, 2007). Educational systems are suffering from “a technology implementation crisis” (Greaves, Hayes, Wilson, Gielmiak, & Wilson, 2010, p. 12), which has generally been attributed to a lack of effective professional development (Belson & Larkin, 2004; Franklin & Beach, 2002; Grinager, 2006; Martin et al., 2010;



Starr, 2010; Vrasidas & Glass, 2007). Greaves et al. (2010) suggested that school divisions either do not know best practices for technology implementation or choose to ignore them. The purpose of this study is to develop a model for providing effective professional development for teachers for incorporating interactive whiteboards into the K-12 classroom.

In spite of all the money spent on IWBs and other instructional technologies, studies on their benefits, especially on the core courses offered in schools, have been conflicting (Baker et al., 2005; Bethel et al., 2007; Blazer, 2008; British Educational Communications and Technology Agency [BECTA], 2003; Chatterji & Jones, 2012; Lei, 2010; Robertson, 2003; Schuck & Kearney, 2007; Sherry, Jessee, & Billig, 2002; Sweeny, 2006; Townsend, 2011; Willems & Willems, 2011). Some researchers found that the presence of instructional technologies did result in increased student achievement (Boser, 2013; Haystead & Marzano, 2009; Keengwe, Schnellert, & Mills, 2012; Levy, 2002; Schracter, 1999; Sivin-Kachala & Bialo, 2000; Wood & Ashfield, 2008), while others held that they had little or no effect on student performance (Cuban, 2001; Friedman & Heafner, 2007; Mathematica Policy Research, 2013; Nagel, 2011; Parker, Bianchi, & Cheah, 2008; Peck, Cuban, & Kirkpatrick, 2002).

As the debate concerning the correlation between the use of instructional technologies, including IWBs, and the improvement in student achievement as measured by standardized tests continued, other interesting findings came to light. Many studies over time have revealed that neither the amount of instructional technology a school had nor how often the instructional technology was used mattered; the important variable was how instructional technology was being used in the classroom (Carlson & Gadio, 2002;

Cuban, Kirkpatrick, & Peck, 2001; Hennessy & London, 2013; Keengwe, Onchwari, & Wachira, 2008; Lei, 2010; Lei & Zhao, 2007; Martin et al., 2010; Sweeny, 2006; Wenglinsky, 1998). Furthermore, research suggested that professional development was necessary to get teachers to use instructional technology in the classroom in a way that was meaningful, that required higher-order thinking on the part of the students, and that appealed to the various learning styles of students in the classroom—all of which were necessary to impact student achievement positively (Alanis, 2004; Beggs, 2000; Beglau et al., 2011; California Teachers Association, n.d.; Fermanich, 2002; Greaves et al., 2010; Lei, 2010; Martin et al., 2010; Schuck & Kearney, 2007; Wenglinsky, 2000). Numerous researchers have asserted that training for incorporating instructional technology into the classroom was necessary since teachers could not possibly teach using unfamiliar tools (Barnes, 2005; Carlson & Gadio, 2002; Center for Technology in Learning, 2009; Education Alliance, 2005; Higgins & Spitulnik, 2008; Howland & Wedman, 2004; Hughes & Ooms, 2004; Starr, 2010). As Hawkins (1997), director of the Center for Children and Technology, noted at the height of instructional technology invasion,

Teachers need to become expert with a new set of skills and knowledge. The lecture and drill methods many learned in college are no longer adequate to attain these goals. Professional development in new practices and in the technological tools they require need to be merged. (para. 15)

Qualitative studies concerning the use of IWBs in the classroom confirmed this assertion (Gray, Lewis, & Tice, 2009; Grover, 2010; Haldane, 2010; Miller & Glover, 2007). Teachers and administrators alike identified professional development as a key component of successful integration of all instructional technologies, including IWBs

(Gooler, Kautzer, & Knuth, 2000; Higgins & Spitulnik, 2008; Mills & Schmertzing, 2005; Murcia & McKenzie, 2008; O'Hanlon, 2007; SMART Technologies, 2011; White, 2007). If professional development has been consistently identified as the key to successful integration of instructional technology devices such as IWBs into the classroom, then identifying the best training methods becomes more and more important.

### **Research Objectives**

The ultimate goal of this study is to construct a professional development model for incorporating instructional technology, particularly interactive whiteboards, into the K-12 classroom. To guide this study, the following research objectives were established:

RO1: Identify best practices for providing teacher professional development that incorporates formal training.

RO2: Identify best practices for providing teacher professional development that incorporates informal training.

RO3: Integrate best practices for professional development into a model for incorporating instructional technologies, particularly interactive whiteboards, into the K-12 classroom.

### **Background and Significance**

In the attempt to improve student performance, schools have spent large sums of money to purchase instructional technologies such as interactive whiteboards, but they have not provided adequate, systematic, sustained professional development that incorporates both formal and informal components (Bannister, 2010; Beglau et al., 2011; Chatterji & Jones, 2012; Hennessy & London, 2013; Kobelsky, Larosiliere, & Plummer, 2012; Kopp, 2012; Marr, 2011; Nightingale, 2006). While studies have consistently

indicated that teacher professional development is the key to successful instructional technology integration of devices such as IWBs, training for teachers has been deemed inadequate (Benedetto, 2005; Diaz, 2001; Hennessy & London, 2013; Jones & Vincent, 2007; Minor, Losike-Sedimo, Reglin, & Royster, 2013). The training that has been provided has tended to be formal in nature, which ignores a growing body of literature that suggests informal training may be more effective (Brinkerhoff, 2006; Burns, 2008; Carrera, 2006; Chivers, 2006; Davey & Tatnall, 2007; Hennessy & London, 2013; Marsick & Watkins, 2001; Winzenried, Dalgarno, & Tinkler, 2010).

Legislation, such as No Child Left Behind (2002), required that divisions provide teachers with professional development for technology integration. However, research has indicated that professional development for teachers has been deemed both inadequate as well as somewhat ineffective (Corcoran, 1995; Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; DeMonte, 2013; Fishman, Best, Foster, & Marx, 2000; Foltos, 2003b; Minor, Losike-Sedimo, Reglin, & Royster, 2013; Shareski, 2004). Rather than using varying methods, school divisions have continued to rely heavily on traditional formal training; most professional development has been in the form of workshops, seminars, and college courses (Choy, Chen, Bugarin, & Broughman, 2006; Corcoran, 1995; Harwell, 2003; Martin, Khaemba, & Chris, 2011; Teclehaimanot & Lamb, 2005), which fails to take into account studies suggesting that informal learning can be of at least equal benefit (Brinkerhoff, 2006; Hayes, 2010; Koenraad, 2008; Shareski, 2004; Winzenried, Dalgarno, & Tinkler, 2010). Researchers have identified types of informal learning experiences for incorporating IWBs and other instructional technologies into the classroom that could easily be facilitated by schools, including

establishing a mentoring program, providing collaboration opportunities, creating online learning portals (such as wikis, blogs, or discussion boards) to facilitate sharing of knowledge, setting up a professional library with books, journals, and Internet resources for independent study, establishing a community of practice, providing opportunities for peer coaching, and establishing systematic opportunities for teachers to observe other teachers using technology (Brinkerhoff, 2006; Burns, 2008; Cross, 2007; Garet, Porter, Desimone, Yoon, & Birman, 2001). Since both formal and informal learning opportunities have advantages, many researchers have found that a combination of both formal and informal learning opportunities should be provided for optimum benefits (Gibbons et al., 1980; Gill, 2008; Hilton, 2001; McNally, 2006; Scrimshaw, 2004).

Results of this study will be noteworthy because it will provide recommendations for the number of hours and types of professional development needed for teachers to become effective users of interactive whiteboards. Moreover, the study will provide a training model that follows best practices for use of both formal and informal professional development. The study is significant because school divisions are in need of a professional development model for incorporating instructional technologies, including interactive whiteboards, into the classroom (Beglau et al., 2011; Borthwick & Pierson, 2008; Martin et al., 2010; Sweeney, 2006; World Ort, 2010). These technologies have remained underutilized, which researchers have contributed to a lack of sustained, scaffolded, effective, professional development that meets the needs of classroom teachers (Bingimlas, 2009; DeSantis, 2012; Epper & Bates, 2001; Espinosa & Chen, 1996; Fox, Mears, & Pearson, 2010; Hennessy & London, 2012; Lowden, 2005; McLester, 2004; Mertens & Flowers, 2004). Current research on maximizing the

effectiveness of interactive whiteboards has been limited, but preliminary data, including findings by Haystead and Marzano (2009), have indicated that the key to successful integration of IWBs that ensures student achievement was dependent upon the training provided. While the goal of instructional technologies is to transform the teaching/learning experience, a lack of professional development has resulted in teachers who often do not progress from the substitution level of using an expensive IWB for a glorified blackboard, traditional whiteboard, or video projector (Alach, 2011; DeSantis, 2012; Lewin, Somekh, & Steadman, 2008; Sweeny, 2006; World Ort, 2010). A model that addresses the issues of time, cost, individual teacher needs, various learning styles, duration, and scaffolding would establish a framework for school divisions to follow.

### **Delimitation**

The following delimitation will exist within this study:

- 1) This study will use survey data that were delimited geographically to include input from only Virginia Instructional Technology Resource Teachers (ITRTs).

### **Limitations**

The following limitations existed within this study:

- 1) This study utilized data from Instructional Technology Resource Teachers of varying degrees of experience, computer fluency, and skills.
- 2) No attempt was made to develop a training model for any one specific brand of interactive whiteboard.
- 3) Study population was self-selected.

### **Assumptions**

The following assumptions were made:

- 1) It was assumed that all Instructional Technology Resource Teachers responding to the survey had knowledge of interactive whiteboards.
- 2) The model also assumed that professional development needs of teachers for incorporating IWB's into classrooms in all school divisions would be similar regardless of socio-economic status or geographic location.

### **Procedures**

An extensive review of the literature in the field was conducted to identify best practices for providing professional development for incorporating technology, especially interactive whiteboards, into the K-12 classroom. A draft professional development model for teachers for incorporating interactive whiteboards into the K-12 classroom was developed based on the literature review. Data were obtained from Instructional Technology Resource Teachers concerning the perceived effectiveness of the training model in order to refine the model.

To obtain the perceptions concerning the model, a survey was created to accompany the draft model. Both the proposed model and the survey were distributed to a representative sampling of Instructional Technology Resource Teachers across Virginia. In an attempt to achieve state-wide representation, a review of the Virginia Department of Education (2013) website was conducted, which enumerated a total of 132 school divisions. These schools were divided into eight regions (Virginia Department of Education, 2012b). Surveys were distributed to ITRTs in each region.

Survey data will report the perceptions of the professional development model by the ITRTs concerning best practices for providing training for incorporating instructional technologies into the classroom. Survey data will also identify elements that are needed

in a professional development model for the successful integration of instructional technologies into the classroom.

Data were analyzed to determine practitioner satisfaction with the professional development model. Descriptive statistics identified satisfaction levels with various components of the model. The model was refined based on the input from the study participants.

### **Definition of Terms**

Definitions of key terms used in this study are as follows:

Ed Tech was a federal funding source that derives from Title II, Part D of the No Child Left Behind Act of 2001. The money went to states, which in turn distributed it to regions. One purpose of the funding was to aid states and localities implement programs that used instructional technology in the classrooms to improve student performance. A second purpose was to “enhance the ongoing professional development of teachers, principals, and administrators by providing constant access to training and updated research in teaching and learning through electronic means” (Sec. 2402[a][5]).

Incorporating technology into the classroom referred to creating a classroom learning environment rich with instructional technology that was systematically interwoven into the curriculum and used to engage learners (Earle, 2002). It meant more than merely being able to turn on a computer or to use technology as a teacher productivity tool (i.e., using an electronic gradebook, typing a handout).

Formal learning referred to instruction characterized by a set curriculum, generally having specific start and end dates, facilitated by an instructor/expert, and often



resulting in the receipt of a credential or certificate of some type (Carrera, 2006; Mariam, Caffarella, & Baumgartner, 2007; Liu & Batt, 2007).

Informal learning referred to learning opportunities that had few predetermined guidelines, often occurred spontaneously, seldom led to certifications, and were frequently limited in scope (Mariam et al., 2007). For purposes of this paper, informal learning referred to those learning opportunities often categorized as nonformal learning, including utilizing mentors, engaging in peer observation, having collaboration time, joining communities of practice, utilizing school-maintained resource libraries, participating in online learning portals (such as wikis, blogs, and discussion boards), and engaging in individual study and reflection. Incidental learning, which was unintentional and occurred spontaneously as part of everyday life (Hague & Logan, 2009; Marsick & Watkins, 1990, 2001), was excluded from this study.

Instructional technology referred not only to computers, but also to a large assortment of tools and practices for enhancing learning and instruction (Muir, 2007). According to Reynolds (2004), this included large data systems, audio and video capacity, and online learning. Instructional technology was often used synonymously with “education technology” and with “Information and Communication Technology” (ICT).

Instructional technology resource teacher referred to a teacher who assists classroom teachers incorporate instructional technologies into the classroom by providing on-site, on-demand assistance and professional development (Coffman, 2009; Office of Educational Technology, n.d.; Virginia Department of Education, 2008a).

Interactive whiteboard (IWB) referred to a large, interactive, touch-sensitive board which was attached to a computer and projector (Glover & Miller, 2007). The board displayed the image appearing on the computer monitor and was interactive; the user could operate the computer by touching the board, either manually or with a special pen. The term was generic and referred to any of a number of brands, including SMART Boards and ActivBoards, among others. IWBs were classified as a type of instructional technology.

Professional development was “the sum total of formal and informal learning experiences throughout one’s career from preservice to retirement” (Fullan & Stiegelbauer, 1991, p. 4). The term is synonymous with *staff development* and *in-service* (Cooper, 2008; Joyce & Calhoun, 2010). For purposes of this paper, it was used interchangeably with *training* and *learning opportunity*.

Professional development model referred to a design for learning that depicts the accepted principles of effective staff training practices for acquiring or extending knowledge (Ifanti & Fotopoulou, 2011; Sparks & Loucks-Horsley, 1989).

### **Summary and Overview**

Public schools, both in Virginia and all across the nation, have faced similar dilemmas—the need to increase student performance (as indicated by standardized tests) and the necessity to do so within the constraints of an ever-tightening budget. Research has suggested that, used correctly and combined with appropriate learning strategies, instructional technology can be part of the solution for improving student achievement. Research, however, has also suggested that technology is not the answer in and of itself, but merely a means to the end (Alach, 2011; Brown, 2005; Carlson & Gadio, 2002;

Chuang, Thompson, & Smith, 2003; Cuban et al., 2001; Hecht & Roberts, 1996; November, 2010; Peck, Cuban, & Kirkpatrick, 2002; Ringstaff & Kelley, 2002; Rodriguez & Knuth, 2000; Shareski, 2004; Sweeney, 2006). Studies have suggested that teachers, the variable affecting student achievement the most (Harris & Sass, 2007), need adequate professional development for incorporating instructional technology into the classroom in order for it to be effective. Finally, research has indicated that the professional development teachers have been provided has tended to be formal in nature, despite studies indicating that adults learn best through informal learning opportunities (Carrera, 2006; Marsick, 2009).

The purpose of this study was to develop a model for providing professional development for teachers for incorporating instructional technology, particularly interactive whiteboards, into their classroom practice. To develop this model, a review of literature was conducted to identify professional development best practices, to determine provisions for including training that addresses pedagogical changes leading to increased student achievement, and to ascertain elements deemed necessary for the successful incorporation of instructional technologies. The results of the study will be of value in designing future professional development opportunities and investments in new instructional technology.

Chapter II of this study contained a review of literature that examined studies pertaining to the effects of interactive whiteboards and other instructional technologies in the classroom, the importance of professional development—both formal and informal, the effect of professional development for teachers on student achievement, the difficulties in measuring the return on investment of professional development, best

practices regarding professional development for incorporating IWBs, as well as other instructional technology, into the classroom.

Chapter III outlined the methods and procedures used in this study. The proposed model of professional development for incorporating instructional technologies, especially interactive whiteboards, into the classroom was presented as was the survey to gather input from Instructional Technology Resource Teachers concerning the model. The population being studied was described. The procedures for analyzing and using the survey results were provided.

Chapter IV presented the findings of this study regarding the best practices for incorporating IWBs into the classroom. These practices were compiled from the review of literature as well as from participant surveys.

Chapter V offered conclusions derived from the surveys. A final professional development model was presented. In addition, recommendations were given for future professional development opportunities for incorporating instructional technologies, such as interactive whiteboards, into the classroom.

## **CHAPTER II**

### **REVIEW OF LITERATURE**

This review of literature provided an overview of the current and historical literature concerning effectiveness of incorporating instructional technology into the classroom, which included a review of the ongoing controversy regarding the effects of instructional technologies, particularly IWBs, on student achievement, examining both perceived benefits and criticisms. Next, this review explored the importance of providing teachers with high quality professional development that includes both formal and informal learning opportunities for incorporating IWBs, as well as other instructional technologies, into the classroom. In addition, this review examined the correlation between improved student achievement and providing teachers with both formal and informal professional development for incorporating technology into the classroom. It examined both qualitative and quantitative studies concerning the effectiveness of interactive whiteboards in general and the variables that affected their success, focusing on best practices for providing teachers with adequate, quality, individualized professional development, both formal and informal in nature, which would lead to pedagogical changes in teaching.

#### **Research on Instructional Technologies**

The use of instructional technologies, such as interactive whiteboards, in the classroom has been a prominent topic of debate in the educational and political communities. School divisions in the United States have been under increased pressure to improve student performance so that the nation can be competitive in the global learning environment. While research over time has resulted in conflicting results regarding the

impact of instructional technology on student performance (Branigan, 2002; Eschenmann, 2003; Gringer, 2006; International Society for Technology in Education, 2008; Kobelsky, Larosiliere, & Plummer, 2012; Kulik, 2003; Lee & Lind, 2011; Lei, 2010; Pitler, Flynn, & Gady, 2004; State Educational Technology Directors Association, 2010; Wenglinsky, 2006), such studies have influenced educators, and public schools (grades K-12) have been accumulating technology at rapid rates, spending ever-increasing amounts of money (Deluna, 2012; Kobelsky, Larosiliere, & Plummer, 2012; White, Ringstaff, & Kelley, 2002). The marketing research firm Gartner revealed that K-12 spending for technology for 2010 reached \$9.2 billion (Nagel, 2011), up from \$7 billion dollars annually in 2004 (Hofer, Chamberlin, & Scot, 2004), with \$7.5 billion being spent for non-hardware educational technologies (Software & Information Industry Association, 2012). While a substantial portion of school technology budgets has consistently been spent on infrastructure (Culp, Honey, & Mandinach, 2005; Nagel, 2011, National Education Association, 2000), school administrators also spent large amounts on software and a variety of instructional technology devices, such as iPads, visual presenters, LCD projectors, and laptops (Gray, Thomas, Lewis, & Tice, 2010; Greaves Group, 2006; Hall & Higgins, 2005). One of the most prized instructional technology devices was the IWB, and more and more dollars in school budgets have been allocated for these boards (Davis, 2007; DiGregorio & Sobel-Lojeski, 2009; Glover, Miller, Averis, & Door, 2007; Hennessy & London, 2013; Slay, Siebörger, Hodgkinson-Williams, 2008; Türel & Johnson, 2012). However, many school divisions failed to provide sufficient, high-quality professional development to train teachers how to use these new instructional technologies, including IWBs in the classroom, even though lack

of training was consistently identified as one of the leading barriers to incorporating technology into the classroom successfully (Beggs, 2000; Hofer et al., 2004; Ertmer, 1999; Glover, & Averis, 2004; Gulbahar & Guven, 2008; Martin, Khaemba, & Chris, 2011; Martin et al., 2010; Miller, Prakash, n.d.; Rooney, 2011; SMART Technologies, 2011). The professional development that has been provided has primarily been formal in nature, despite developing research suggesting that informal learning opportunities might be more beneficial to teachers for incorporating IWBs into the classroom (Burns, 2008; Jones & Vincent, 2006; Lewin, Scrimshaw, Somekh, & Haldane, 2009; SMART Technologies, 2009; Türel & Johnson, 2012).

Even though interactive whiteboards have been increasingly found in schools around the world, they are still classified as a relatively new instructional technology in education (Armstrong et al., 2005; Cogill, 2003; Türel & Johnson, 2012; Wood & Ashfield, 2008). More than a decade ago the British Educational Communications and Technology Agency (BECTA; 2003) stated that not enough studies had been conducted on the educational benefits of IWBs or the effects of other variables, such as professional development, on their benefits. Research has since continued to provide contradictory results and to ignore the importance of many variables associated with their use (Alach, 2011; DiGregorio & Sobel-Lojeski, 2009; Marzano, 2009; Northcote et al., 2010; Willems & Willems, 2011). As more and more schools acquired IWBs, more studies have appeared, but thus far few existing studies have focused on types of professional development needed to facilitate use of IWBs in the classroom (Schroeder, 2007; Winkler, 2011). This review of literature explored the following issues:

1. The controversy concerning the incorporation of instructional technologies, with a focus on IWBs, into the classroom. Controversies included the benefits, effects on student achievement (focusing on core courses of mathematics, science, language arts, and social studies), return-on-investment, and costs.
2. Professional development as a major factor contributing to the effectiveness of interactive whiteboards as a change agent.
3. Best practices for designing a professional development model utilizing both formal and informal learning for incorporating instructional technologies, especially interactive whiteboards, into the K-12 classrooms.

### **Growing Controversy**

School divisions across the nation, including those in Virginia, have been under constant pressure to meet the needs of all students. Critics of public education have examined school data, holding teachers and administrators responsible for low test scores, high dropout rates, discipline problems, and rising taxes to support schools. The federal government has been no kinder. In 2002, legislators passed the No Child Left Behind Act, perhaps the best known of school reform laws, which stated that the public schools have been doing an “abysmal” (p. 1) job, citing data that indicate 70 percent of inner city students in the 4<sup>th</sup> grade cannot read, even on a basic level, and high school students in grade 12 cannot compete globally in mathematics. The legislation called for schools to institute massive reforms that would result in improvement in student performance. Schools that achieved this goal would be rewarded—schools that did not would be sanctioned, both academically and financially.



Technology was viewed by not only educators but also legislators as one of the tools for reform (Beeland, 2001; Bigum & Rowan, 2005; Blazer, 2008; Fletcher, 2009; Kennewell, 2006; Kennewell, Tanner, Jones, & Beauchamp, 2008; North Central Regional Educational Laboratory, 2005; Oppenheimer, 1997; Partnership for 21<sup>st</sup> century Skills, 2009). The growing legislation calling for more technology in classrooms was the result of many studies conducted through government agencies that identified technology as a vehicle for improving student performance. These included, among others, the High Schools that Work assessments and studies of the West Virginia Technology Education Program (Southern Regional Education Board, 2008).

One law of particular importance was Title II, Part D of NCLB (2002): Enhancing Education Through Technology. This law included several goals that stipulated how schools were to carry out the directive to use instructional technology (International Society for Technology in Education, 2008; North Central Regional Educational Laboratory, 2002). The primary goal was for school systems, both elementary and secondary, to improve the academic performance of students through instructional technology. To accomplish this, schools were to “encourage the effective integration of technology resources and systems with teacher training and curriculum development to establish research-based instructional methods that can be widely implemented as best practices by State educational agencies and local educational agencies” (Title II, Part D, 2b).

In order to comply with NCLB and other legislation mandating the use of technology to improve student performance, school divisions across the nation developed division technology plans (U. S. Department of Education, 2006). These plans focused on

several areas, including obtaining research-based instructional technologies, providing appropriate professional development opportunities for instructional personnel, and evaluating the benefits of acquired instructional technologies (Lowden, 2005; Pass, 2008; Rodriguez & Knuth, 2000). In November 2010, Arne Duncan, the U. S. Secretary of Education, released the final version of the National Educational Technology Plan, which identifies technology as the key component of educational reform (Nagel, 2010).

To achieve the goal of technology plans, school systems accumulated instructional technologies at rapid rates. Specialized instructional technologies such as laptops, digital microscopes, and finally interactive whiteboards quickly joined the arsenal of weapons intended to revolutionize the educational process (Grinager, 2006). For example, many schools instituted laptop initiatives with the aim of increasing student performance. The student-to-computer ratio of five-to-one, once considered the ultimate goal, was dropped to one-to-one, with ubiquitous computing becoming the target (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2010). More and more schools started distributing laptops to their students, at least on the high school level. In 2002, Maine became the first state to institute a statewide laptop initiative through the Maine Learning Technology Initiative, providing laptops for all seventh and eighth grade students (Maine Department of Education, 2009). Missouri followed suit, developing the Enhancing Missouri's Instructional Networked Teaching Strategies (eMINTS) initiative (Pitler, Flynn, & Gaddy, 2004). In Virginia, Henrico County, a large school system, became one of the first in the nation to institute a laptop program, beginning with laptops for high school students and then expanding the program to include both high school and middle school students. Approximately 24,000 laptops were distributed to students, and 3,300

laptops were issued to every teacher and administrator (Henrico County Public Schools, n.d.). Other states and localities followed suit, representing a huge investment in both personnel and hardware (Pitler, Flynn, & Gaddy, 2004).

Laptops were not the only pieces of hardware purchased with the intent of improving student performance. Schools purchased LCD projectors in large numbers as well as DVD players, iPods, and visual presenters. Educators also looked to software applications, such as PowerPoint, WebCT, and Inspiration, to transform classrooms (Eib & Cox, 2003; Parker, Bianchi, & Cheah, 2008). In addition, school divisions purchased subscriptions to digital video clips such as those provided by Discovery Learning, audio files, and packaged curriculum programs such as NovaNet and Gizmo (Watson, Gemin, & Ryan, 2008; Trotter, 2007). Finally school divisions turned their attention to the interactive whiteboard.

Since the first interactive whiteboards hit the market in 1991, they have been eagerly sought by the educational community (Earnest C. Manning Awards Foundation, 2002; Gillen, Staarman, Littleton, Mercer, & Twiner, 2006; Quillan, 2012; Teich, 2009), and school divisions expended large sums to obtain IWBs (Glover, Miller, Averis, & Door, 2007; Quillen, 2012; Slay et al., 2008). SMART Board, one of the largest manufacturers of IWBs, boasted that 250,000 classrooms around the world contained their boards (Calgary Technologies, 2006). By 2013, that number had climbed to 2.6 million boards (SMART Technologies, 2014a). The September 22, 2008, issue of *Newsweek* magazine reported that over 70 percent of secondary and primary schools in the United Kingdom were already equipped with IWBs (Phillips, 2008), and the United Kingdom has a \$27 million plan in place to equip every primary and elementary school

with an IWB by 2015 (Schroeder, 2007). The United States has been identified as the fastest growing IWB market, with approximately 320,000 sold by SMART Technologies alone (Mashni, 2010). A nationwide survey by the Institute of Education Sciences revealed that 23 percent of teachers had access to IWBs on a daily basis (Gray, Thomas, Lewis, & Tice, 2010). A survey by Public Broadcast Service and Grunwald Associates LLC (2011) found that IWBs were ranked as the most desired instructional technology by K-12 public school teachers.

With the growing number of IWBs installed in schools in the United States, divisions needed to address the second component of technology plans—professional development. Federal and state governments, through key pieces of legislation, highlighted the importance of high quality, sustained, professional development for teachers for incorporating technology into the classroom (Denton, Davis, Strader, Durbin, & Wang, 2004; Mizell, 2010). Most states have mandated that teachers accumulate a specified number of professional development hours to maintain their teaching certificates (Miles, Odden, Fermanich, & Archibald, 2004). NCLB (2002) incorporated passages that called for teachers to receive professional development for incorporating technology into the classroom. NCLB further required that professional development meet the definition of high quality professional development as established by the bill (Virginia Department of Education, 2004a, 2004b). However, NCLB regulations were vague in regards to the type of professional development required (Borko, 2004), which gave school divisions much flexibility in establishing their training programs. Unfortunately, school divisions did not always exercise this flexibility and continued to offer primarily traditional formal workshops and seminars (Elmore, 2002; Teclehaimanot

& Lamb, 2005; Winzenried, Dalgarno, & Tinkler, 2010). In spite of the fact that some studies posited that as much as 70 to 80 percent of learning that occurs is informal (CARA Group, Inc., 2011; Hague & Logan, 2009; Harrison, 2006), schools have continued to concentrate on formal learning opportunities, measured in seat time, and they have failed overall to foster an atmosphere conducive to engaging in informal learning (Association for Supervision and Curriculum Development, 2004; Bolt, 2008; Sparks & Hirsh, 2007; Walker, 2013).

A third major component in division technology plans called for schools to evaluate their instructional technology purchases and their professional development programs to determine their effects on student achievement. Often this evaluation has been cursory at best (Boser, 2013; Council of Economic Advisors, 2011; Gaytan & McEwen, 2010; Sweeney, 2006), since the general assumption, which Westera (2004) refers to as “techno-optimism” (p. 505), has been that providing teachers with instructional technology would automatically result in an increase in student performance (Bonk, Ehman, Hixon, & Yamagata-Lynch, 2002; Brown, 2001; Guskey, 2002; Higgins, 2010; Noyce, 2006; Rodriguez & Knuth, 2000; Shaha, Lewis, O’Donnell, & Brown, 2004; Slay et al., 2008). Many teachers and educators viewed instructional technology in general as an agent of change for the educational process; they posited that the use of instructional technology would improve the overall quality of teaching by leading teachers away from instruction by lecture to more inquiry-based classrooms (Culp, Honey, & Mandinach, 2005). School administrators thought that increases in student achievement would justify their expenditures (Tiene & Ingram, 2001). Evaluating the effectiveness of instructional technology has been called “challenging” under the best of

circumstances (Ringstaff & Kelley, 2002, p. 3), and, although recommended, only a few schools conducted return-on-investment studies or total cost analyses to determine the overall effectiveness of the instructional technologies or the training programs being implemented (Alach, 2011; Boser, 2013; Brown, 2005; Chatterji & Jones, 2012; DiGregorio & Sobel-Lojeski, 2009; Lowden, 2005; Miles et al., 2005; Overbaugh & Lu, 2008; Porter, Garet, Desimone, & Birman, 2003; Redhead, 2001; Snow-Renner & Lauer, 2005). Few school divisions tried to correlate instructional technology professional development with student achievement (Gaytan & McEwen, 2010). The primary method of evaluating professional development was the teacher survey (Haslam, 2010; Gaytan & McEwen, 2010; Hezel Associates, 2006), although other methods, such as journaling, video recording for critiquing, formative/summative evaluations through observations have been suggested (Gaytan & McEwen, 2010; Lawless & Pellegrino, 2007; Martin et al., 2010; Schmid, 2011). Little rigorous research has been done to correlate professional development and improved student outcomes (Noeth & Volkov, 2004; O'Connell, 2009; Porter, Garet, Desimone, & Birman, 2003; Regional Educational Laboratory Southwest, 2007; Shaha et al., 2004; Wallace, 2009; Yoon, Duncan, Lee, Scarless, & Shapley, 2007).

After many years of using instructional technology in the classroom, researchers were still debating its merits. In spite of all the media buildup, all the money spent for instructional technology, and the number of studies completed through time on the benefits of these technologies, the literature in the field provided conflicting findings on the benefits to student achievement (Alach, 2011; Alsafran & Brown, 2012; Boser, 2013; Educational Testing Service, 1998; Kobelsky, Larosiliere, & Plummer, 2012; Lei, 2010; Pellegrino, Goldman, Bertenthal, & Lawless, 2007; Protheroe, 2005; Ringstaff & Kelley,

2002; Schacter, 1998; Schuck & Kearney, 2007; Wellburn, 1996; Willems & Willems, 2011). Part of the literature suggested that instructional technology such as IWBs promoted student achievement, part of the literature indicated that instructional technology had little or no effect of student achievement, and a growing body of literature indicated instructional technology led to student achievement when certain conditions, such as providing high quality professional development, were met. Some researchers said there was simply not enough data to draw firm conclusions on the effects of instructional technology on student achievement (Baker et al., 2005; Bethel, Bernard, Abrami, & Wade, 2007; Hayes, 2010; Keengwe, Onchwari, & Wachira, 2008; Kobelsky, Larosiliere, & Plummer, 2012; Parker, Bianchi, & Cheah, 2008).

### **Benefits of Instructional Technology in the Classroom**

With so much at stake, researchers have continued to study the effects of using instructional technology for promoting student achievement. Data have been collected and educators, administrators, legislators, and researchers have debated the merits of the various devices and software programs to determine the effects on student achievement and teacher effectiveness. Studies touting the positive effects of instructional technology became numerous (Blazer, 2008; Cuthell, 2005; Grinager, 2006; Kmitta & Davis, 2004; Moeller & Reitzes, 2011; Ranasinghe & Leisher, 2009; Sparks & Hirsh, 2007; White, Ringstaff, & Kelley, 2002; Whitehead, Jensen, & Boschee, 2003).

Perhaps one of the earliest and best known studies concerning the benefits of exposing students to technology was the Apple Classroom of Tomorrow (ACOT) study (Apple Computer, Inc., 1995). The manufacturers of Apple computers conducted a ten-year study in an attempt to determine what would happen when students were exposed to

a technology-enriched environment. As part of the study, students and teachers were each given a computer to use at school and one for home use. Researchers collected data to determine the effects of this technology on both student performance and teaching methods. What the researchers discovered was not that test scores increased dramatically, but that other benefits, not always measured on standardized tests, were accrued: (a) student writing skills improved; (b) students were able to learn more in less time; (c) behavior, attendance, self-image, and attitude improved; (d) students communicated more effectively and were more likely to collaborate; (e) students became self-motivating and more independent; and (f) students became proficient in using technology appropriately. The researchers advocated that technology itself, by providing more ways for students to be successful learners, was responsible for many of the benefits to students. They also suggested that because students found the technology engaging, they devoted more time and energy to their studies.

Other researchers came to similar conclusions, stating the use of technology had secondary benefits which led to student achievement (Blazer, 2008; Henderson, Eshet, & Klemes, 2000; Keengwe, Jared, & Mills, 2012; Keengwe, Onchwari, & Wachira, 2008; National Education Association, 2004; Sherry & Jesse, 2000; Southern Regional Education Board, 2008; Wenglinsky, 1998; Whitehead, Jensen, & Boschee, 2003). Goldberg, Russell, and Cook (2003) found similar evidence that students with access to technology improved the quality and quantity of their writing. Sivin-Kachala and Bialo (2000) found that students improved in phonological awareness, in spelling, in reading comprehension, and in vocabulary development when exposed to technology-enriched classrooms. Many proponents of instructional technology suggested that its use improved



socialization skills and involvement in communities of practice; leveled the playing field for all students, including those with disabilities; and provided opportunities for anytime learning (November, 2010; Ringstaff & Kelley, 2002). The Office for Standards in Education (OFSTED; 2004) noted that computer applications allowed instructors to accomplish things that could not be otherwise done, such as projecting text, revising and saving documents easily, and collaborate instantly with others. Various researchers also noted that technology made it easier for teachers to individualize instruction and for students to learn at their own rates, and allow students to engage in 21<sup>st</sup> century skills such as problem solving, accessing and analyzing data, and collaborating with others (Greaves et al., 2010; Moeller & Reitzes, 2011; National Education Association, 2004; Osborne & Hennessy, 2003; Ranasinghe & Leisher, 2009; White, Ringstaff, & Kelley, 2002).

Educators and legislators still wanted to know how instructional technology affected standardized test results. Some early studies found correlations between the use of instructional technologies in the classroom and improved test scores. Silverstein, Frechtling, and Miyaoka (2000), in an evaluation of instructional technologies in schools in Illinois, found that instructional technology had a significant impact on student achievement, as measured by the standardized tests administered by the state. Sivin-Kachala and Bialo (2000), in a study of effectiveness of technology in schools, found a correlation between the implementation of instructional technologies and improved standardized test scores for both Idaho and West Virginia. In the West Virginia study, test scores on the Comprehensive Tests of Basic Skills (CTBS) for students in grade three who were provided with technology improved by five percentile points in a single year,

representing an impressive gain (Ringstaff & Kelley, 2002). Early studies in computer-based instruction (CBI) repeatedly indicated that students using CBI attained higher levels of achievement than those who did not (Kulik & Kulik, 1991; Wenglisky, 1998), which has been reinforced by later studies on the benefits of CBI (Chiang & Jacobs, 2009; Hannafin & Forshay, 2008; Serin, 2011). Ringstaff and Kelley (2002), in their review of literature, reported that results on the benefits of instructional technology on student achievement were mixed. However, they pointed to various success stories. For example, they noted that Project CHILD, a longitudinal study starting in 1988 of a computer-integrated program implemented first in Florida, found that students consistently scored better on standardized tests than their peers. Some later studies also found that student achievement improved with the use of instructional technologies (Greaves Group, 2006; Gulek & Demirtas, 2005; MacKinnon, 2003; Office for Standards in Education, 2004; Shapley et al., 2006).

Researchers turned their attention to specific instructional technologies, both hardware and software, to study whether benefits could be attributed to particular applications or technological devices. Studies were conducted on devices and tools, including visual presenters, computerized games, video streaming sites, iPods, the Internet, and assistive technologies such as enlarged keyboards and text-to-speech applications, as well as IWBs.

Laptops received much attention and the laptop initiatives developed by some states and by local school divisions across the nation have been closely monitored to determine what effects they had on student achievement. Results from some studies were very positive (Greaves Group, 2006; Pitler, Flynn, & Gaddy, 2004). A study of Maine's

Learning Technology Initiative (MLTI) reported that there was strong evidence that student laptops led to improved test scores (Pitler et al., 2004). Another study of Missouri's Instructional Networked Teaching Strategies (eMINTS) laptop initiative, which provided computers for every two students, reported improved test scores in both mathematics and social studies as compared to students without laptops (Pitler et al., 2004). Keengwe, Schnellert, and Mills (2012), in a study of a one-to-one laptop initiative in a rural Midwestern high school, reported a positive impact on both student engagement and student learning.

The Anytime Anywhere Learning Project (Subramaniam, 2006), developed by Microsoft Corporation in cooperation in conjunction with Toshiba American Information Systems, targeted 52 schools across the nation in 1996. This project, which provided participants with Toshiba Notebooks, was expanded to include 800 schools in 2000, encompassing 125,000 students and teachers. An independent research company was commissioned to evaluate the project (Gulek & Demirtas, 2005). Findings suggested that students with laptops (a) collaborate more, (b) write more and write on a higher level, (c) become more self-directed learners, (d) spend more time doing homework, (e) were better able to transfer knowledge across the curriculum, and (f) were better able to research and problem solve.

The Henrico, Virginia, laptop initiative showed promise of improving standardized test scores. In 2001, when the initiative began, 78 percent of the schools in the district were accredited, indicating 70 percent or more of students had successfully passed the SOL tests. Tests scores improved dramatically and all schools in Henrico were accredited two years later (Pitler et al., 2004). In addition, administrators of Henrico

County reported improved attendance rates, lower dropout rates, and increased parent involvement, all which they attributed to the laptop initiative (Apple, Inc., 2008; Zucker, 2005).

Harvest Park Middle School, located in Pleasanton, California, instituted a laptop immersion project in 2001. The laptop initiative started with students in grade six. Over a three-year period, the program was expanded to students in grades seven and eight, until it included 259 students out of a total population of 1,085 students. At the conclusion of the three years, school officials examined grade point average, final grades, writing assessment scores, and standardized test scores. Findings indicated that students in the laptop initiative outperformed students in the district who did not have laptops in areas including grade point average, writing assessments, and state mandated norm-referenced tests (Gulek & Demirtas, 2005).

While the primary emphasis of lawmakers and administrators was on improved test scores, proponents of instructional technology identified other benefits not measured on standardized tests that could ultimately lead to higher achievement. These benefits included motivational impact, access to up-to-date information, access to primary documents and sources, ability to collaborate with experts and peers, and the chance to become a global citizen (Gringer, 2006; Moeller & Reitzes, 2011; Project Tomorrow, 2010; Shareski, 2004; Tileston, 2004). Similar secondary benefits were associated with IWBs. Researchers found that the boards appealed to all learning styles (Beeland, 2004; Cuthell, 2005; Slay et al., 2008), increased student engagement (Bakadam & Asiri, 2012; Higgins, 2010; Morgan, 2008; Swan, Schenker, & Kratcoski, 2008), and enhanced student concentration (Bui, 2009).

### **Lack of Impact of Instructional Technology on Student Achievement**

While glowing reports and intense longitudinal studies, such as the Apple Classrooms of Tomorrow (ACOT) study, have recorded the supposed benefits of technology, other researchers have cast doubt on their results, suggesting that instructional technology had little or no effect on student achievement. This was certainly true of some early studies. Cuban (1993), a longtime critic of the effectiveness of instructional technology, noted that the expenditures by schools for technology had not resulted in widespread educational reform. Although he admitted that there were some success stories, he posited that these were atypical and often technology sat unused in the classroom. Other researchers have since agreed (Benedetto, 2005; Mundy, Kupczynski, & Lee, 2012; Townsend, 2011). Even when the technology was being used, Cuban claimed that use was often peripheral to normal classroom activity rather than integrated. He likened the frenzy over computers to the hype that surrounded the purchases of radios and televisions in previous eras.

Oppenheimer (1997), in his now-famous article, “The Computer Delusion,” scoffed at the idea that education would ever be reformed by instructional technology. He noted that the primary delusion of instructional technology supporters was that computers would improve either student performance or instructor practices. He also dismissed other ideas, including the idea that technology literacy should be taught very early, that the business community would support technology initiatives, that technologies such as the Internet would result in students forming beneficial connections with others around the world, and that teaching computer skills should be an educational priority.

Cuban (1993) even highlighted possible detrimental effects of having instructional technologies such as computers in the classroom. He questioned whether computers would degrade the student-teacher relationship, destroy the social atmosphere of the classroom, and isolate students rather than enhance collaboration. Wenglinsky (1998) examined the idea that if computers became the core of the educational environment, then the degeneration of the social aspect of learning and the reduced student/teacher interaction might actually decrease student achievement. Oppenheimer (1997) also alluded to the amount of time wasted in classrooms by teachers who were using inappropriate computer programs, by troubleshooting problems with the equipment, and by teaching basic computer literacy to students.

More than 20 years after Cuban's initial criticism of instructional technology, the same skepticism concerning its benefits was still shared by others (Benedetto, 2005; Boser, 2013; Kobelsky, Larosiliere, & Plummer, 2012; Lei & Zhao, 2007; Peake, Briers, & Murphy, 2005; Peters, 2002). For example, a study of 150 agriscience teachers, which was conducted to determine relationships between instructional technology integration and student achievement, revealed a low positive correlation between teacher technology integration and improved mathematics scores and negligible positive correlations between the use of technology in the classroom and improved writing and reading scores (Peake, Briers, & Murphy, 2005). While Wenglinsky (2006) found that under certain circumstances technology improved student achievement, he also noted that, when computers were used to teach lower-order skills, the correlation between use of instructional technology and improved academic achievement as measured by standardized testing was negative. Kennewell, Tanner, Jones, and Beauchamp (2008)

concluded that 20 years of increasing instructional technology brought about no change in teacher pedagogy. Other literature found little indication that instructional technology affected student performance at all (Bethel et al., 2007; Friedman & Heafner, 2007; Keller & Bichelmeyer, 2004). Foltos (2003a) went so far as to suggest that much of the available data were questionable since the studies seemed to be more anecdotal than quantifiable. Bailey, Henry, McBride, and Pucket (2011) called the data correlating instructional technology and student achievement “disappointing.”

Studies on laptop initiatives provided another case in point. While some reports highlighted the benefits of laptop initiatives for improving student achievement, critics contended that just making computers available did not ensure improved academic performance (Bethel et al., 2007; Peck, Cuban, & Kirkpatrick, 2002). A study of the effects of laptop computers for a Texas laptop immersion project found that although teachers used the laptops frequently, they used them to maintain traditional teaching methods (Shapley et al., 2006). Those who claimed that environments rich in technology led to increased student learning consistently qualified this assertion by noting that the technology must be used in innovative ways that follow best practices (Keengwe et al., 2008; Kumar, Rose, & D’Silva, 2008; Lei & Zhao, 2007; Metiri Group, 2006; Wishart & Blease, 1999).

Studies of software applications revealed similar findings. Parker, Bianchi, and Cheah (2008) argued that, in spite of the perceptions of students and teachers, the literature contained no empirical evidence confirming the effectiveness of applications such as PowerPoint and WebCT. Terms such as “Toolishness,” “Screensaver disease,” and “Power Pointlessness” entered the vocabulary to describe the tendency of schools to

believe that the presence of any of these instructional technologies would ensure academic success (Shareski, 2004). Baker et al. (2005) noted that even use of the Internet in classes has been found to have little impact on overall achievement because teachers often used it for routine tasks rather than harnessing its power to bring about enhanced learning. One study evaluated the results of exposure to the popular reading program Reader Rabbit, and it found students using the software experienced a 50 percent reduction in creativity (Oppenheimer, 1997). Baker et al. (2005) further suggested that traditional classrooms often used instructional technology to prepare students to do well on standardized tests rather than as transformational agents to bring about true educational reform.

Young (2004) suggested that instructional technology, when used improperly, actually resulted in poor teaching. Other researchers agreed (Lei & Zhao, 2007; Peters, 2002), with many positing that teachers used the technology to sustain their old teaching practices rather than using it to integrate new teaching methods (Baker et al., 2005; Cuban, 2001) and no real change in pedagogy took place (Crowley, 2009; Kennewell et al., 2008). Marr (2011) posited that poorly used technology could result in “boredom, apathy, and frustration” (p. 29).

Some of the research suggesting instructional technology increased student achievement has been attacked as seriously flawed and invalid. These studies were criticized for having too many variables (such as the innate ability of the instructor), for not being easily replicated, and for being conducted under artificial circumstances (Bethel et al., 2007; Johnson, 2000; McCabe & Skinner, 2003; Noyce, 2006; Oppenheimer, 1997; Peters, 2002; Ringstaff & Kelley, 2002). Some research has been found lacking, with



results often measuring intangible factors, such as motivation and enthusiasm (Amiel & Reeves, 2008). Furthermore, as Oppenheimer (1997) noted more than a decade ago, some of the research was funded by technology companies, which tended to publicize positive results. This claim was supported with major studies for instructional technologies being funded by Pearson Digital, Renaissance Learning, and Curriculum Advantage. This was also true with research on IWBs, with much of the research touting benefits having been conducted or sponsored by companies such as Promethean and SMART Technologies.

Thus, after decades of research concerning the value of instructional technology as a whole and concerning individual technologies, studies still provide conflicting results about their effectiveness in the classroom (Boser, 2013; Chatterji & Jones, 2012; Parker, Bianchi, & Cheah, 2008). This same controversy concerning the benefits of instructional technologies in general was found in the research concerning interactive whiteboards.

### **Interactive Whiteboards and 21<sup>st</sup> Century Learning**

New instructional technology tools have brought about a shift in teaching and learning paradigms (Bailey et al., 2011; Brent & Johnson, 2011; Council on 21<sup>st</sup> century Learning, 2013; Jenson, Taylor, & Fisher, 2010; Pacific Policy Research Center, 2010). Lorin Anderson made this clear in 2001 when she published Bloom's Revised Taxonomy to reflect the new behaviors and opportunities made possible by digital tools (Churches, 2007). Research has suggested that teachers must utilize the new technologies to ensure that students become 21<sup>st</sup> century learners (Betcher & Lee, 2009; Colorado Education Association, 2009; Grinager, 2006; Saavedra & Opfer, 2012; State Educational Technology Directors Association, 2011). New trends in education have reflected the premise that it is no longer sufficient for students to learn specific skill sets and practice

rote memorization, but must be taught to collaborate, think critically, problem solve, be creative, and communicate (Bailey et al., 2011; Greaves et al., 2010; National Education Association, 2010; Pacific Policy Research Center, 2010; Pearlman, 2010; Saavedra & Opfer, 2012; Westera, 2004). The Partnership for 21<sup>st</sup> century Skills (2009) developed a learning model that blended subject-matter content with 21<sup>st</sup> century skills, with life and career skills, and with appropriate technology skills, all based on curriculum standards and supported by appropriate professional development for teachers. Saavedra and Opfer (2012) called instructional technologies “tools for working” (p. 4).

Professional development was a key piece to this framework because teachers cannot teach skills that they do not know and practice in the classroom (Bailey et al., 2011; Grinager, 2006; Saavedra & Opfer, 2012). As Owston (2007) noted, any instructional technology initiative that does not provide effective teacher development and support will have only “disappointing results” (p. 1). Bahadur and Oogarah (2013), in a study of introducing IWBs in to primary schools in Mauritius, suggested that without proper professional development, teachers often clung to their traditional methods of instruction which they felt had “stood the test of time” (p. 19). The researchers referred to this as the “‘go with what you know’ mentality” (p. 19), which often results in failure to adapt to the digital age. Other researchers, such as Bailey et al. (2011) came to the same conclusion. A survey conducted by the Project Tomorrow team found that students were often frustrated by their teachers’ inability to use technological tools in a way that met their needs (Riedel, 2014).

Studies indicated that this was particularly true with IWBs because the boards are very complex technology tools (Alach, 2011; Bannister, 2010; Betcher & Lee, 2009;

Nightingale, 2006; Orbaugh, 2013; World Ort, 2010). As Alach (2011) noted, the success of the IWB is dependent upon the skill of the teacher. However, because of the complexity and capabilities of the boards, they have been singled out as one of the most potentially powerful of instructional technologies (Betcher & Lee, 2009), with Quillen (2012) calling them a vital part of the classroom digital ecosystem. Educators and researchers alike posit that IWBs allow teachers and students to engage in those 21<sup>st</sup> century learning/teaching skills, especially collaboration, communication, and creativity (Betcher & Lee, 2009; McCrea, 2013; State Educational Technology Directors Association, 2011). Brent and Johnson (2011) applauded IWBs for having the ability to make students creators of knowledge. They also noted that, in a survey of teachers, 59 percent of teachers considered IWBs essential for creating 21<sup>st</sup> century classrooms.

#### **Interactive Whiteboards and Student Achievement**

As Kennewell (2006) noted, it is rare for research to center on one piece of educational equipment. However, the speed with which the boards entered the educational world has made them the focus of much scrutiny (Greaves Group, 2006; Türel & Johnson, 2012). Even though IWBs are a relatively new instructional technology in the classroom (Armstrong et al., 2005; Schuck & Kearney, 2007; Smith, Higgins, Wall, & Miller, 2005; Wood & Ashfield, 2008), researchers have already produced some significant studies on their effectiveness. For example, the Mexia ISO School District in Texas reported test scores improving by 30 percent after installing IWBs (Dolan, 2009). However, much of the research that has been conducted has been qualitative in nature, focusing on perceptions of teachers and students; thus little significant data have been collected to support the hypothesis that IWBs do indeed improve student performance

(Bui, 2009; Higgins et al., 2005; Northcote et al., 2010; Türel & Johnson, 2012). Studies that do exist concerning the use of IWBs in the classroom have produced conflicting results similar to those of other instructional technologies such as laptops.

More than a decade ago Wenglinsky (1998) identified five primary uses for instructional technology: support individual learning, sustain group learning, promote instructional management, communicate, and support administration. Educators, legislators, and researchers alike were inclined to believe that the unique features of the IWBs made them a tool to use to accomplish all of these goals. They felt that the boards would facilitate best teaching practices and support classroom management techniques. An IWB, which functions as a large second monitor that could be controlled either by touch or by using a special pen, made it easy for teachers to do whole class instruction. Moreover, teachers could create digital flipcharts, show videos, write on the board, access the Internet, present student work, and save any work created on the board (Brown, 2003; Brozek & Duckworth, 2011; Türel & Johnson, 2012). Bell (2002) posited that classrooms with only one computer could benefit from having an IWB since it maximized access. The specialized features, which varied from brand to brand, offered a wide array of options for educators (Betcher & Lee, 2009).

Many of the boards had various attachments, such as slates, wands, and response systems; these devices could greatly enhance the functionality of the boards and provide more options for teachers to integrate the technology into the classroom. The capabilities of the boards also freed teachers from the need to be at the computer, thus allowing the teacher to be more focused on students (Ball, 2003; Beauchamp & Parkinson, 2005; Beeland, 2001; Berg-Williams, 2011). Research suggested that use of IWBs fostered

interaction between students and teachers as well as between students (Bell, 2004; Cogill, 2002; Fox, Mears, & Pearson, 2010; Jones & Vincent, 2007; Türel & Johnson, 2012).

Other researchers reported that the IWBs provided access to numerous resources for the entire class (Armstrong et al., 2005; Cogill, 2002; Hennessy & London, 2013). Bell (2004) concurred, adding that the boards could also be used for small groups and for distance learning. A report by OFSTED (2004) suggested that the visual capabilities of IWBs helped students go from abstract to concrete. Researchers noted that IWBs have the potential to teach more in less time, thereby making the teaching process more effective (Cuthell, 2005; Hennessy & London, 2013; OFSTED, 2004).

Many researchers suggested that IWBs improved student performance because the boards addressed various learning styles (Beeland, 2001, 2004; Bell, 2002; Brown, 2003; Cuthell, 2005; Futurelab, 2008; Naylor et al., 2008; Wood & Ashfield, 2008). Teachers reported using the IWBs to deliver instruction which appealed to visual learners, auditory learners, and tactile/kinesthetic learners (Bahadur & Oogarah, 2013; Beeland, 2004; Cuthell, 2005; Fox, Mears, & Pearson, 2010; Slay et al., 2008). Since the IWBs allowed for multi-media presentations, the needs of both auditory and visual learners were addressed. Students could interact with the IWBs through touch, which also appealed to kinesthetic learners (Bahadur & Oogarah, 2013; Naylor et al., 2008). Davison and Pratt (2003) reported that manipulating the board made more of an impact on students, which cut down on boredom and made the learning experience more memorable than merely viewing a presentation or lecture. Researchers also suggested that the boards supported independent thinking and decision making (Minor, Losike-Sedimo, Reglin, & Royster, 2013).

Some researchers posited that the use of interactive whiteboards in the classroom significantly enhanced educational experiences for students with special needs and physical impairments (Basilicato, 2005). Even Oppenheimer (1997), the severe critic of the benefits of instructional technology, noted that computerized instruction resulted in consistent benefits for students with disabilities. Interactive whiteboards incorporated tools such as highlighters that aided in decoding and comprehension, image libraries that promoted visual discrimination, and the ability to use large text to help struggling readers and the visually impaired. Researchers identified the improved visibility from the large screens as one of the most valuable assets of the boards (Davison & Pratt, 2003; Professional Development Service for Teachers, 2013; Wall, Higgins, & Smith, 2005). IWBs were purported to assist students who experienced hearing problems (Mackall, 2004) because the boards could display and print hard copies of teacher notes as well as use graphics that promoted visual memory. Since students could generally operate the boards by tapping rather than typing, researchers suggested that the IWBs were good for students with poor motor skills (Bell, 2002; Professional Development Service for Teachers, 2013). A study by López (2009) also found that the achievement gap between English Language Learners and regular students was diminished when IWBs were used in the classroom. A pilot study on the benefits of digital technologies used in classrooms found that IWBs were very beneficial for teaching students with Autism Spectrum Disorders (Verenikina, Tanner, Dixon, & de Graff, 2005.)

Skeptics have pointed out the lack of quantifiable evidence indicating a positive link between test scores and use of IWBs; however, a substantial body of qualitative data is available. These data, as Schroeder (2008) pointed out in a review of literature

concerning use of IWBs, showed that most of these qualitative studies concerning the boards indicated an improvement in the affective domain, rather than increases in the cognitive realm. These studies suggested changes related to attitudes, interests, and feelings that derive from the learning process, which theoretically should result in increased student performance. One positive affective change in particular was student engagement (Bahadur & Oogarah, 2013; Higgins, 2010; Manny-Ikan, Dagan, Tikochinski, & Zorman, 2011; Morgan, 2008; National Centre for Technology in Education, 2008; Serow & Callingham, 2008; Souhila & Khadidja, 2013), which has often been listed as one of the most critical factors influencing student learning (Akey, 2006; Bell, 2002). According to Beeland (2001, 2004), the many features of the boards provided more opportunities for students to come in active contact with the board and thereby increased student engagement. A study involving 72 pre-teens ranging in age from 10 to 12 conducted by Newcastle University found that students in classes with IWBs were more engaged in the learning process simply because of the entertainment appeal (Hall & Higgins, 2005). A similar study conducted by Wall, Higgins, and Smith (2005) found that the visual, participatory, and interactive features of the boards strengthened both attention and concentration. A larger study, supported by The Learning Federation and the Australian National Schools Network, was conducted to determine the effect of IWBs and digital content on student achievement (Hedberg & Freebody, 2007). Teachers in the study reported observing higher levels of engagement in their students as well as increased levels of achievement. Beeland (2001), in a study involving 197 middle school students and 10 teachers, found that both students and teachers preferred lessons delivered through IWBs; participants said that students were more motivated to learn.

SMART Technologies, Inc. (2004, 2008), in two white papers reviewing the research concerning the effectiveness of IWBs, highlighted the link between student engagement and retention. A study by Souhila and Khadidja (2013) of IWBs in English Foreign Language classes found that the boards improved student engagement significantly. Haldane (2007), reviewing the Primary Schools Whiteboard Expansion project in England, noted that presentation capabilities of the IWBs resulted in increased attention spans by students. Cogill (2003) in a study of IWBs in primary schools also found that the boards attracted and kept the attention of students, while Bui (2009), in a review of literature, identified studies which suggested that the IWBs made classes more interesting, enhanced student concentration, and improved student participation.

Research has indicated that motivated students were more apt to be successful in learning (Beeland, 2001; Eggleton, 2011; Neal, 2005). Numerous researchers reported that the interactive whiteboards increased motivation significantly (Beeland, 2001; Banyard & Underwood, 2008; Cogill, 2002; Cuthell, 2007; Davison & Pratt, 2003; Kennewell & Beauchamp, 2007; Kollie, 2008a; Lee, Pun, Li, Kong, & Ip, 2006; Miller, Glover, & Averis, 2005; National Centre for Technology in Education, 2009; SMART Technologies, 2004). Research suggested that the features of the boards attracted student attention, which led to greater motivation and participation (BECTA, 2004; Brozek & Duckworth, 2011; Glover, Miller, Averis, & Door, 2007; Lee et al., 2006; Nocny, 2009; SMART Technologies, 2008), and students were more likely to engage in critical thinking (Bell, 2002). Ball (2003) suggested that having the shared image at the front of the classroom motivated students to engage in more discussion. Hennessy and London (2013) also noted that IWBs can facilitate dialogue in the classroom. A study conducted



by Knight, Pinnant, and Piggott (2005) indicated that use of IWBs in the classroom positively impacted not only motivation, but also self-esteem, which has been linked to higher student achievement (Beeland, 2004; Lee et al., 2006). Other research suggested that IWBs encouraged student creativity and built self-confidence (Cogill, 2002; Cuthell, 2005).

Researchers also noted that use of IWBs in the classroom led to better behavior from students and more effective class control (Beauchamp, 2004; BECTA, 2004; Bui, 2009; Cogill, 2002; Cuthell, 2007; Glover, 2001; Gray, Hagger-Vaughan, Pilkington, & Tomkins, 2005; Morgan, 2008; Slay et al., 2008; Teich, 2010). This was partly because teachers were able to face the students as they conducted the class and therefore could maintain eye contact with them (Beauchamp, 2004). After installing 1,200 IWBs in Dorchester School District in Summerville, South Carolina, the superintendent credited the boards with making disciplinary referrals a rarity (Philips, 2008). Again, proponents argued that better behavior should lead to higher student achievement.

Research, even from the earliest studies, found that IWBs, with their interactive features, allowed teachers to use the highly effective technique of modeling (Blanton, 2008; Brand, 1997; Ertmer, 1999; Fox, 2010; Lehrer & Schauble, 2000; Northcote et al., 2010; Swan, Schenker, & Kratcoski, 2008; Teclehaimanot & Lamb, 2005). Teachers used the IWBs to demonstrate how processes work, to show examples, and to outline expectations (Cogill, 2003; Fox, 2010; Futurelab, 2008). The boards also allowed students to interact with each other, which studies have shown to be necessary if IWBs were to be truly effective; researchers claimed that without this interaction, students

would become passive learners (Bui, 2009; Dhindsa & Emran, 2006; Huang, Liu, Yan, & Chen, 2009; Jewitt, 2008; Kennewell, 2001).

Glover and Miller (2007), in a study of 46 mathematics classrooms, found that the presence of interactive whiteboards changed the classroom culture so that it became more conducive to learning. They noted the total classroom atmosphere was observed to improve due to the physical appearance, the educational artifacts in use, and the relationship between both students and teachers with the technological surroundings.

Studies also revealed that students themselves perceived the interactive whiteboards as helpful. Barrieau (2009), in a research project concerning the effectiveness of SMART Boards in the classroom, reported that 59 percent of students surveyed felt that they learned better with the IWBs, while 25 percent felt they learned somewhat better. A comparable number reported better comprehension when an IWB was used and similar numbers felt more involved with the learning.

Cuthell (2005) posited that use of IWBs profoundly changed teacher pedagogy, requiring them to be more reflective and more innovative, which was supported by Higgins (2010). Bui (2009), in his review of literature, found that teachers felt that the boards enhanced their inventiveness and creativity. Glover and Miller (2007), in their study of mathematics teachers, observed changes in teaching, finding that lessons become less didactic and more dynamic and interactive. Ozmantar, Akkoç, Bingölbali, Demir, and Ergene (2010), in their study of pre-service mathematics teachers, concluded that pre-service teachers learned mathematics concepts quicker when taught with multiple representations generated by technologies such as IWBs. Juersivich, Garofalo, and Fraser

(2009) found that mathematics students understood ideas better when taught with multiple representations.

Research indicated that IWBs had additional benefits which could lead to increased student performance. These included reducing teacher stress, allowing for the sharing of teacher resources, saving time, and improving teacher creativity and productivity.

The research linking IWBs to reduced stress levels was noteworthy. Teacher stress has been cited as a major cause of concern since it interferes with teacher effectiveness (Olivier & Venter, 2003; Ravichandran & Rajendran, 2007). Stress, caused by fear and anxiety, has been shown to debilitate performance (Al-Fudail & Mellar, 2008; Bowe & Pierson, 2008; Taffe & Knipe, 2005). Stress has been linked to increasing levels of teacher turnover, excessive absenteeism, and teacher illness—all of which can impact student achievement (Detert, Derosia, Caravella, & Duquette, 2006; Kyriacou, 2001). According to a study by Optum Research, approximately 88 percent of teachers reported feeling moderate to high stress levels (Detert et al., 2006).

Studies indicated that IWBs decreased two of the primary causes of stress in teachers, which researchers have identified as difficult workloads and the desire to meet the needs of all students (Klassen & Chiu, 2010; Naylor, 2001; Richards, 2012). By reducing the pressure to complete routine tasks, improving delivery, and making changing lesson plans easier, use of IWBs significantly reduced anxiety felt by teachers (Fraser, Garofalo, & Juersivich, 2008; Kopp, 2012; SMART Technologies, 2009). Proponents of the boards noted that the time saved—up to 2 hours per week—in preparing and delivering lessons not only reduced teacher stress levels but allowed them

more time to differentiate instruction for students (Kitchen, Finch, & Sinclair, 2007; SMART Technologies, 2009).

Research has indicated that the IWBs made it easier for teachers to share their resources, which later translated into benefits for students (Brown, 2003; Cogill, 2002, 2003; Hallinan, 2009; Jewitt, 2008; National Centre for Technology in Education, 2008). The sharing of resources also led to a reduction in teacher workload and a corresponding decrease in stress levels (Kyriacou, 2001; SMART Technologies, 2009). Students benefited because stronger teachers could then create materials and lessons that could be utilized by other teachers (Glover & Miller, 2006). Proponents of IWBs also suggested that use of interactive whiteboards in the classroom gave teachers a sense of creative independence, let them move smoothly from one activity to another, and helped teachers improve sequencing of concepts as well as variety and pacing (Brown, 2003; Cuthell, 2005; Futurelab, 2008; Gray et al., 2005; Knight et al., 2004). The boards also allowed teachers to be very flexible in classroom activities, switching from individual student work to small group and whole group activities, thus making teachers more efficient and increasing teaching time (BECTA, 2004). Surveys of teachers as well as students indicated a strong preference for these boards in the classroom (Beeland, 2004; Jones & Vincent, 2007; Lee et al., 2006).

In 2003, BECTA stated that insufficient studies, either qualitative or quantitative, existed on the benefits of using IWBs in education. Since then, there have been several quantitative studies on the effects of IWBs on student achievement. Once again, results were conflicting. Swan et al. (2008) conducted a controlled study to measure the effects of using IWBs in mathematics and English language arts classrooms as measured by

standardized test scores. Their results revealed only marginally higher scores in the IWB classroom. Haystead and Marzano (2009) released a preliminary report involving 1,622 students and 79 teachers located in 50 schools using IWBs. Their findings indicated that there was a significant improvement in student achievement as measured by standardized test scores under certain conditions; optimum improvement was achieved by teachers who had over 10 years of teaching experience, had a high confidence level, and used the boards frequently. Another study, conducted by the Centre for Learning Innovation in New South Wales, Australia, revealed that teachers using interactive whiteboards saw noticeable improvement in student achievement even during the first year of implementation (White, 2007). In an evaluation report of the Schools Whiteboard Expansion Project, a project designed to add IWBs to all secondary schools in London, researchers found no statistical impact on student performance during the year of implementation (Moss et al., 2007); however, the analysis of student achievement involved only a small sampling of the total schools involved in the overall research project. A study by Higgins (2010), evaluating an IWB pilot in program involving over 200 primary school classrooms in England, found an improvement in standardized test scores, but also noted that the gains were short-lived.

### **Criticism of IWBs**

Critics of the IWBs were quick to negate claims concerning the benefits of the boards, referring to them as fads or expensive versions of the old-fashioned chalkboard (Futurelab, 2008). The acquisition of IWBs and other technologies has been labeled “technolust” (Welsh, 2008), which was defined as the desire to get technology for the sake of technology. However, technolust for IWBs has carried an expensive price tag,

since IWBs tended to be more expensive than conventional whiteboards or a combination of projector and screen (Brown, 2003; Wall, Higgins, & Smith, 2005). Moreover, IWBs required an initial steep learning curve for teachers (Alach, 2011; Bakadam & Asiri, 2012; National Centre of Technology in Education, 2008). The many features and tools of the boards made them incredibly complex, requiring long-term training to be used effectively (Alach, 2011; Bannister, 2010; Orbaugh, 2013; World Ort, 2010).

The first criticism concerning the benefits from the use of IWBs in the classroom was directed at the validity of the studies conducted concerning the boards. Much of the research conducted on the use and effectiveness of IWBs has been qualitative in nature (Bui, 2009; Cogill, 2002; Higgins et al., 2005; Smith et al., 2005; Türel & Johnson, 2012; Willems & Willems, 2011). Critics of IWBs have suggested that evaluations of benefits of IWBs have amounted to nothing more than teacher/student perceptions and preferences. Moreover, many of the reported changes have been in the affective domain (Schroeder, 2008), such as on motivation, and gains in this domain are extremely difficult to measure (Boyd, Dooley, & Felton, 2006). Like research on other instructional technologies, critics have also pointed out that quantitative research studies have had too many variables to be considered valid (Johnson, 2000; Oppenheimer, 1997; Peters, 2002; Ringstaff & Kelley, 2002; Schroeder, 2007).

Another major criticism leveled at the boards was the assertion that putting them into classrooms has not resulted in any changes in major pedagogical practice, which was deemed essential if technology is to become the true agent of educational reform (Glover et al., 2007; Jones & Vincent, 2007; Kennewell, 2006; Kent, 2004; Orbaugh, 2013; Sweeny, 2006). Some researchers claimed that teachers merely used the expensive IWBs

to replicate old teaching methods (Balanskat, Blamire, & Kefala, 2006; Burden, 2002; Lee & Boyle, 2003; Lee & Boyle, 2003; Sweeny, 2006; Word & Ashfield, 2008). Some researchers posited that teachers used the boards as expensive presentation tools rather than interactive tools to transform classrooms (Bakadam & Asiri, 2012; Burden, 2002; Hennick, 2012; Marr, 2011; Serow & Callingham, 2008). Gray et al. (2005), in a study of language teachers using IWBs, stated that all participants in the study felt that their role was altered by use of the boards, but not always in a positive way. One teacher in the study described herself as “being less animated and less involved, becoming more a deliverer of material” (p. 43).

Cognitive overload was also identified as a potential problem when using IWBs (Bui, 2009). When teachers used the boards to present too much audio and visual material, students were overwhelmed due to the need to convert the pictures and sounds into words. In a study by Cogill (2003), some primary school teachers using IWBs suggested the boards were sometimes used to extremes and teachers created lessons that were too didactic and overwhelming.

It has also been suggested that teachers used IWBs because the boards were a novel innovation in the classroom, but teachers would soon tire of the boards and revert to former pedagogy (Bahadur & Oogarah, 2013; Glover & Miller, 2001). However, proponents of the boards countered that the frequent uses of the boards overcame the novelty issue and led to meaningful pedagogic changes (Glover & Miller, 2003; Glover et al., 2007; Marr, 2011).

Proponents of IWBs stressed the belief that the boards would lead to improved student performance because they accommodated various learning styles. Kennewell

(2006) challenged these claims, positing that teachers could address multiple learning styles as well as motivate and engage students just as well with traditional methods. While advocates of the boards touted the value of incorporating visual and audio elements, other researchers felt that use of complex graphics and audio files actually detracted from the learning experience (Cogill, 2003; Marzano, 2009). They held that teachers were more intent on presentation than content. Moreover, according to Alanis (2004), visual media has formed the “expectation of passivity” (p. 18), whereby students merely sit and watch. Bahadur and Oogarah (2013), in a study conducted to determine the effects of incorporating IWBs into classes in Mauritius, suggested that the use of the many visual and auditory effects were distracting for students. They found that students concentrated more on what would appear next on the screen rather than the content being covered. Marr (2011) noted that when used improperly, the boards could “create boredom, apathy, and frustration” (p. 29).

Critics of the boards refuted the claim that the pace of learning was improved with the IWBs, suggesting that discussion and extended dialogue were sacrificed to improve the pace, and higher order thinking was reduced as students responded to low-level questions (Kennewell et al., 2008; Smith et al., 2005). Jewitt (2008), in a study of the design of digital materials by teachers for IWBs, found that pace was not necessarily facilitated by the boards. Moreover, Smith et al. (2005) found that teacher creativity diminished rather than increased. Research by the Metiri Group (2009) suggested that students will remain passive learners unless teachers can use IWBs to engage in higher-order thinking.



Proponents of IWBs have claimed that the boards encouraged teachers to involve students with lessons. However, some studies have suggested that IWBs encouraged teachers to take a position in the front of the room (Alach, 2011; Hall & Higgins, 2005; Smith, 2001), thereby creating more teacher/student interaction rather than fostering student/student collaboration (Armstrong et al., 2005; Zevenbergen & Lerman, 2007). Higgins, Beauchamp, and Miller (2007) pointed out that although proponents of IWBs said that the boards would lead to more interactivity, they could not say how this interactivity was demonstrated.

Researchers have stated that the most often cited barrier to using IWBs in the classroom was a lack of technology skills; as Cogill (2002) noted, effective use of the boards requires a minimum level of computer skills from the teachers. Critics of IWBs have claimed that, quite simply, teachers did not have sufficient skills to operate the boards in a way that led to student achievement (Bahadur & Oogarah, 2013; Cogill, 2003; Slay et al., 2008), but only used them in a very superficial way (Lerman & Zevenbergen, 2007). The many features of the IWBs which made the boards so attractive to educators were also identified as potential drawbacks to use in the classrooms since the learning curve was steep. In a study by Beeland (2004), teachers noted that dealing with the technological aspects of using IWBs in the classroom left them feeling as though they needed backup plans. Hall and Higgins (2005) found that students immediately identified teachers without necessary technological skills to operate the IWBs skillfully. Students reported feelings of frustration when delays in the lesson occurred due to teacher ineptitude, while others became distracted by lack of teacher competence in using the IWBs (Alanis, 2004; Erikson & Grant, 2007; Hall & Higgins, 2005; Hallinan, 2009;

Wall, Higgins, & Smith, 2005). Using ICT incorrectly was posited to disrupt the lesson and detract from the overall educational experience (Slay et al., 2008).

Time, often cited as another barrier for incorporating instructional technology into the classroom (Boran, 2010; Ertmer, 1999; Hunter, 2001; Lamberth, 2012; Martin, Khaemba, & Chris, 2011; McManis & Gunnewig, 2012; Mills & Schmertzling, 2005; Mishra & Koehler, 2006; Schrum, 1999; Windelspecht, 2001; Wong, Goh, & Osman, 2013), became an issue with integration of IWBs. Proponents of IWBs held that the boards saved teachers time by allowing them to share resources, easily change and update previously prepared materials, and facilitated development of lessons; however, critics argued that the opposite was true. In a study by Glover et al. (2007) teachers reported that having the IWBs necessitated more intense planning. Participants in a study by Gray et al. (2005) revealed that teachers experienced positive role changes only when they had spent many hours of preparation time. Other researchers concurred, citing complaints from teachers involving the amount of organization and time needed to prepare lessons (Bui, 2009; Slay et al., 2008). Manny-Ikan et al. (2011) noted that many teachers felt over-burdened when faced with integrating IWBs into the classroom, which sometimes resulted in teacher resistance (Bahadur & Oogarah, 2013). Critics suggested that time spent by teachers becoming technologically literate and in preparing lessons could be better spent on something else (Glover & Miller, 2001; Higgins et al., 2007).

Researchers have noted that using IWBs led teachers to dominate lessons and engage in teacher-centered classrooms, which resulted in decreased learning (Cogill, 2002; Kennewell et al., 2008; Knight, Pennant, & Piggott, 2004; Lerman & Zevenbergen, 2007). This was compounded by the necessity to design a very traditional classroom

setting. Researchers noted that seating arrangements in classrooms must be very rigid, so that every child can face the board. Students also need to be seated so that they do not accidentally bump into the boards (Morgan, 2008). This limited the ability to design seating arrangements that facilitated group work or collaborative dialogues (Banyard & Underwood, 2008; Grant & Cunningham, 2009).

While proponents of IWBs claimed the boards reduced stress, critics argued that integrating technologies such as IWBs into the classroom increased teacher stress (Al-Fudail & Mellar, 2008). According to Bitner and Bitner (2002), adopting new technologies was particularly stressful since it not only required teachers to learn how to operate the new technology but also required changes in classroom procedures. A UCLA survey of faculty revealed that 67 percent of faculty members felt stressed by the pressure to remain current with emerging technologies (Baltaci-Goktalay & Ocak, 2006). The term “technostress” was coined to describe the stress that is particularly associated with using new instructional technologies such as IWBs (Al-Fudail & Mellar, 2008) and this stress was also often accompanied by resistance to using new technologies (Haymes, 2008; O’Hanlon, 2009). The estimated costs associated with teacher stress rivaled the expense of incorporating IWBs into the classroom (Dillon, 2007; Hill, 2008; SMART Technologies, 2009).

### **Interactive Whiteboards and the Four Core Subjects**

While critics and proponents continued to debate the general merits of IWBs, some researchers focused on specific content areas. Studies were conducted to determine the potential benefits of IWBs on the four core areas of mathematics, science, English, and social studies. Outcomes of these studies also provided mixed results, with

conflicting findings across subject areas, grade levels, and countries (Hennessy & London, 2013).

### **Mathematics**

Some noteworthy research has been done concerning the benefits of IWBs when teaching mathematics. Researchers have suggested that IWBs would be of particular benefit to mathematics classes since these classes were usually composed of diverse learners (Bui, 2009; Miller, Glover, & Averis, 2004) who would benefit from lessons delivered in multiple modalities. Much of this research, however, has been qualitative in nature and has focused on student and teacher perceptions. Moreover, much of the research has also focused on the affective domain. Ball (2003), in observing math classrooms in Birmingham, reported being particularly impressed with the quick pace, the professional presentations, and the interactivity of teachers with the boards. She also commented on the ease with which teachers could switch between Excel spreadsheets, programs such as Geometer's Sketchpad, and other online manipulatives. Miller, Glover, and Averis (2003), in an analysis of questionnaires given to teachers as part of their end-of-year evaluation, found that teachers felt that IWBs greatly enhanced the math classroom. They reported that using the interactive features, coupled with software such as Geometer's Sketchpad and Excel, helped teach complicated math concepts.

Various researchers reported that enhanced computational graphics displayed on the large screen helped students to increase in conceptual understanding; this was particularly helpful for courses such as geometry (Davison & Pratt, 2003; Bui, 2009; Miller, Glover, & Averis, 2003). A report by OFSTED (2004) suggested the IWBs' ability to use pictograms to stand for data made them effective math tools. Teachers using

IWBs reported increased student achievement in math, which they credited to the increased visualization and conceptualization (Ball, 2003; Cuthell, 2005). In one study, Miller, Glover, and Averis (2004) observed 50 lessons in mathematics; they found that a combination of verbal explanation, a visual example, and the physical movement of going to the IWB promoted better understanding. A study conducted at the University of Virginia exploring the use of IWBs with pre-service teachers in mathematics indicated that teachers using the boards felt that they were more effective in creating and delivering content when using the IWBs (Fraser, Garofalo, & Juersivich, 2009). The teachers also believed that the boards made them more efficient and productive and allowed them to individualize instruction more.

As IWBs became more prevalent in the classroom, quantitative studies began to appear. Results of these studies were varied. *Newsweek* magazine touted the success of British classrooms, reporting students in classrooms containing IWBs improved their progress by an additional five months in mathematics (Philips, 2008). An evaluation of the Whiteboard Expansion Project (Moss et al., 2007) found that using interactive whiteboards in the classroom led to a significant progress in mathematics as measured by standardized tests.

The Missouri eMINTS (enhancing Missouri's Instructional Networked Teaching Strategies) project monitored progress of students in participating schools. To participate, classrooms had to be equipped with computers, Internet connectivity, a teacher workstation attached to an interactive whiteboard, and shared folders so that teachers could show student work. The eMINTS program was designed to change the way teachers taught as well as how students learned. The final evaluation for 2003 (Bickford,

2005) revealed no significant differences in the MAP (Missouri Assessment Program) overall pass rates of students in eMINTS and non-eMINTS schools. However, test scores did reveal a higher number of students scoring in the Pass Advanced range in eMINTS schools as opposed to the non-eMINTS schools.

Zirkle (2008) conducted a study involving 11 special education mathematics students. The students were taught several units, alternating using and not using IWBs to deliver instruction. Data showed significantly higher scores in those units where the IWB was used.

A report by OFSTED (2004) suggested that lower-performing students taught with IWBs benefited from being able to sort and classify various shapes, which improved test scores. The report also suggested that use of IWBs in math classes intellectually challenged the brightest students.

A study was conducted on teaching three-dimensional cubes to third and fourth grade Navajo elementary school students (Zittle, 2004). Students in one group were taught by a teacher using individual computers. The control group received the same instruction delivered with the teacher using the interactive whiteboard rather than individual computers. Students were given pre- and post-assessments. The results of the post tests suggested that students benefited from instruction delivered through the IWB.

Serow and Callingham (2008) completed three case studies concerning implementation of IWBs into mathematics classrooms. Researchers found that for the IWBs to be effective, teachers had to design lessons that utilized the boards in such a manner that provided student-centered activities. The study suggested that sustained

professional development for integrating IWBs played an important part in the success of implementation.

### **Science**

Existing studies involving the use of IWBs in the science classroom also provided conflicting results. IWBs were found to be particularly helpful in science classes for explaining processes, providing visual reinforcements, and creating interactive lessons, including virtual labs (Bui, 2009; Dolan, 2008; Dyrli, 2008; Murcia, 2008). Lehrer and Schauble (2000) highlighted the benefits of creating models and representations in teaching scientific concepts, which would be facilitated in the classroom by the use of IWBs. The boards were also found to be useful in gaining the attention of students in science classrooms (Christophy & Wattson, 2007; Lee et al., 2006; Schut, 2007). Marcia (2008), reviewing a project to use IWBs to teach scientific literacy, noted that the boards assisted students comprehend major scientific concepts, facilitated learning through use of hands-on scientific investigations, and supported multiple learning styles. Brann, Gray, Piety, and Silver-Pacuilla (2010) recommended IWBs to assist students having physical difficulty conducting routine science assignments.

Quantitative studies have shown that students in classrooms using IWBs have scored higher on standardized tests scores than their counterparts (Manny-Ikan et al., 2011). The evaluation of the Whiteboard Expansion Project revealed that use of IWBs in science classrooms led to a marked improvement in science attainment; moreover, the most striking effect occurred with low-attaining males, who progressed an additional seven and a half months in science (Moss et al., 2007).

Christophy and Wattson (2007), in an experimental study of the effects on student performance of using IWBs in chemistry classes, found interesting results. The teacher used test scores, survey results, and observed behaviors to draw her conclusions. The students in the class taught with traditional lecture format scored an average of 87.9 on the tests, while those taught with the IWBs scored 80.3. However, while the traditional class had an evenly spaced set of scores ranging from highest to lowest, the IWB class had a very high number of *A*'s and a large number of *D*'s or below. She gave the students a Multiple Intelligences survey and found that kinesthetic learners and spatial learners did better when taught with the IWBs.

Dhindsa and Emram (2006) conducted a study involving two science classrooms with a combined population of 115 students of both genders whose ages ranged from 16 to 19. One classroom was taught using an IWB while the other used traditional teaching approaches. The IWB classroom was reported to be more effective and minimized gender differences as measured by pre-test and post-test scores.

The final evaluation for 2003 eMINTS classrooms in Missouri (Bickford, 2005) revealed significant differences in the science MAP scores of eMINTS and non-eMINTS schools. The science test was optional in Missouri, and a lower percentage of students were given the test. Test results revealed that 50.4 percent of students in eMINTS schools scored passing grades as opposed to 46.8 percent in the non-eMINTS classrooms.

### **Social Studies**

Few studies have focused on IWBs and social studies. While researchers and educators alike have called for teachers of social studies to incorporate instructional technology into the classroom, only a few studies have been done on the effects of



general use of ICT in social studies classrooms. For example, a study by Friedman and Heafner (2007) focused on use of the Internet rather than other instructional technology tools. However, Braun and Risinger (1999) outlined the benefits of the Internet for social studies classes, noting teachers can have access to unlimited resources such as library catalogues, museums, magazines, newspapers, audio files, videos, and primary sources, which would be facilitated by IWBs.

Only a few studies have been conducted to determine the benefits of IWBs in the social studies classroom. Smith, Penrose, and Whited (2006), in a study involving 225 sophomores and juniors in Ohio, found that introducing an IWB into social studies classes resulted in not only improved interest and attitudes toward social studies, but also improved achievement on social studies writing essays.

Another study by Amolo and Dees (2007) involving 26 fifth-grade students suggested that both student learning and engagement improved. The research was conducted to determine whether introducing an IWB into a traditional classroom would affect learning and engagement. Students received a total of 11 lessons, with each lesson consisting of 55 minutes, all delivered through the IWB. Increased learning was demonstrated by all students as measured by a pre- and post-test. The researchers compared the final scores on this unit to the scores on the previous unit delivered in a traditional manner and saw mean scores jump from 86.12 to 92.96. In addition, qualitative data obtained from surveys and interviews indicated that student satisfaction and engagement increased as well.

A report by OFSTED (2004) alluded to the benefits attained from activities such as virtual tours when projected on IWBs. The study also pointed to the benefits attained

in geography due to activities such as showing aerial photographs, superimposing lines of maps, and presenting attractive graphics and topographical features. Nocny (2009) agreed, finding that the interactive ability of IWBs engaged geography students and that the active participation with the boards resulted in more effective teaching and learning. The eMINTS evaluation for social studies classrooms found no statistical differences in eMINTS schools and non-eMINTS schools as measured by scores on the MAP (Bickford, 2005).

### **English, Writing, and Language Arts**

Studies on the benefits of using IWBs in the English/language arts classrooms were also lacking. A report by OFSTED (2004) highlighted benefits of using IWBs in English classes. The report suggested that the IWBs made it easy for students to work collaboratively, to sequence events, to focus on tasks, and to write. López (2010), in a quasi-experimental study investigating the effects of using interactive whiteboards with English Language Learners (ELL), found that the boards helped close the achievement gap between the ELL students and the regular students.

Bell (2002), conducting doctoral research on the use of IWBs on students in an 8<sup>th</sup> grade writing class, found a significant improvement in student attitudes concerning use of technology as well as attitudes concerning writing instruction. Her sample students noted that they liked the boards for demonstration and they responded well to color. Rochette (2007) found IWBs helpful in teaching close reading because the IWB enabled the teacher to circle, underline, annotate passages, and include illustrations. Solvie (2004) suggested that IWBs improved student literacy by providing an organizational framework and by scaffolding student learning.

Quantitative studies were few in number. The evaluation of the Whiteboard Expansion Project revealed that use of IWBs in English classrooms produced no conclusive results concerning student achievement, which was attributed to the nature of literacy evaluation and development (Moss et al., 2007). The eMINTS evaluation for 2003 classrooms revealed a significant difference between eMINTS and non-eMINTS schools. Scores on the MAP revealed that students in the eMINTS schools outperformed their counterparts in non-eMINTS schools (Bickford, 2005). Balanskat et al. (2006) found that placing IWBs in classroom resulted in higher performance by students on tests in English (as well as math and science) as compared to their counterparts without IWBs.

Swan, Schenker, and Kratcoski (2008) reviewed English language arts scores on state standardized test for a small urban school district in Ohio involving all students in grades 3 through 8. They compared scores of the students in classes taught with an IWB to those of students in classrooms without the boards. Results revealed a statistically significant higher achievement level across grades in the classrooms where teachers were using the IWBs.

### **Importance of Providing Professional Development for Using IWBs**

While the debate over the benefits of instructional technology, including IWBs, has continued, most educators and researchers have agreed that it is not the presence of instructional technology itself that can enhance student performance—it is the way in which it is used (Alach, 2011; Brown, 2005; Carlson & Gadio, 2002; Chuang, Thompson, & Smith, 2003; Cuban et al., 2001; Hecht & Roberts, 1996; November, 2010; Peck, Cuban, & Kirkpatrick, 2002; Ringstaff & Kelley, 2002; Rodriguez & Knuth, 2000; Shareski, 2004; Sweeney, 2006). Therefore the issue of training has moved to the

forefront (Baker et al., 2005; Bannister, 2010; Hall & Higgins, 2005; Keengwe et al., 2008). Continued research tied the benefits of instructional technologies to the amount and type of professional development provided to teachers (Armstrong et al., 2005; BECTA, 2003, 2005; Beggs, 2000; Essig, 2011; Hall & Higgins, 2005; Jones & Vincent, 2007; Ringstaff & Kelley, 2002; Rodriguez & Knuth, 2000; Schuck & Kearney, 2007; State Educational Technology Directors Association, 2010; Young, 2011). Culp, Honey, and Mandinach (2005) stated that 20 years of research suggested that sustained, high-quality professional development for teachers was the most important component in technology integration in the classroom.

This supposition has remained constant over time. Wenglinsky (1998) posited that teachers who used technology more effectively were found to work in schools that provided more teacher development opportunities, and research since then has supported this claim (American Educational Research Association, 2005; Borko, 2004; Darling-Hammond et al., 2009; Goldberg, 2005; Phillips, 2009). Studies have found that students in classes where teachers had participated in technology professional development did better than their counterparts and were more apt to use technology in a manner that facilitated student achievement (Bowe & Pierson, 2008; Brumfield, 2006; Chuang, Thompson, & Schmidt, 2003; Gooler et al., 2000; Norman, 2000; Regional Educational Laboratory Southwest, 2008; State Educational Technology Directors Association, 2010; Winkler, 2011). The Technology-Based Education Strategies Training project developed in New York provided over 60 hours of professional development for teachers for incorporating interactive tools, including IWBs, iPods, and tablet PCs, in the classroom (State Educational Technology Directors Association, 2010). Final evaluation of the

program found that test scores improved significantly, with some school divisions improving as much as 22 percent.

Conversely, research has suggested that teachers who received inadequate professional development were more likely to be unable to use instructional technology in a meaningful manner to improve student performance (Bingimlas, 2009; Epper & Bates, 2001; Espinosa & Chen, 1996; Lowden, 2005; McLester, 2004; Mertens & Flowers, 2004). Young (2004) noted that many instructors used instructional technology poorly because they had received little or no training, and he further suggested that often they turned to technology merely because students expected them to use it. He also contended that instructors used various instructional technologies without proper consideration of pedagogy. Without training, instructors quite often were focused on teaching students to use the technology rather than using the technology to increase student learning. In order to incorporate instructional technology into the classroom successfully, teachers needed to change their pedagogy and their basic beliefs; this can be brought about only by experience and professional development (Boran, 2010; Benedetto, 2005; Ertmer, 2005; Higgins, 2010; Manny-Ikan et al., 2011; Mishra & Koehler, 2006; Ringstaff & Kelley, 2002).

Research has suggested that for IWBs to be used effectively, teachers must have a high confidence level in their ability to use them, and teachers must be able to demonstrate fluency in their overall technological skills (Bingimlas, 2009; Bui, 2009; Celik, 2012; Cogill, 2003; Cuthell, 2007; Dolan, 2009; Glover et al., 2007; Slay et al., 2008), both of which can only be achieved with high quality professional development

(BECTA, 2005; Hall & Higgins, 2005; O'Hanlon, 2007; Overbaugh & Lu, 2008; Penuel, Boscardin, Masyn, & Crawford, 2007; Teclehaimanot & Lamb, 2005).

Brown and Murray (2005) noted that the rapid infusion of instructional technology, such as IWBs, could be described as problematic, especially when considering the learning curve for teachers. Inability of teachers to use technology fluently, including IWBs, has resulted in technology that merely sits in the classroom as a curiosity or is only used sporadically (Alanis, 2004; Bakadam & Asiri, 2012).

Administrators and policy makers often assume that, since modern-day instructional technology has been around for a while, that teachers—particularly newer teachers—are fluent with technology and do not require training, which Riedel (2014) referred to as one of the popular educational myths. Researchers have noted teachers go through progressive stages when new technologies, including interactive whiteboards, are introduced into the classroom (Dunne, 2002; Hennessy & London, 2013; Sweeney, 2006, 2013; Westera, 2004). In the initial stage, which Puentedura (2010, 2012) identifies as substitution, teachers merely use the new technology as a substitute for an old method. Thus teachers used the IWB as a substitute for a regular whiteboard or as a screen to show videos. To be most effective, however, Puentedura (2012) stressed that teachers had to go from substitution, to augmentation, to modification, and finally to redefinition. Studies have suggested that this movement from enhancement to transformation (Greaves et al., 2010; Puentedura, 2012) when incorporating instructional technology, including IWBs, required a systematic, sustained, scaffolded program of professional development (Bannister, 2010; DeSantis, 2012; Hennessy & London, 2013; Kobelsky, Larosiliere, & Plummer, 2012; Martin et al., 2010). Moreover, in order for IWBs to be used effectively,

research has suggested that professional development must be holistic and linked to curriculum (Crowley, 2009).

By passing several key pieces of legislation, the federal government has also recognized the importance of professional development for teachers for incorporating instructional technology into the classroom. The most important of these laws was the No Child Left Behind Act (2002), particularly Part D: Enhancing Education Through Technology (often referred to as Ed Tech). The primary purpose of Ed Tech was to assist both states and localities to improve instructional technology in schools. A major portion of Ed Tech called for funds to be allocated to schools to provide high quality professional development for teachers to assist them in successfully integrating instructional technology in the classroom.

With the increasing pressure put on teachers to incorporate technology into the classroom, teachers themselves have identified this lack of adequate professional development as a key barrier for successful integration (Alston & Miller, 2001; Baker et al., 2005; Beggs, 2000; Boran, 2010; Ertmer, 1999; Jenson et al., 2002; Miller, Khaemba, & Chris, 2011; Mills & Schmertzling, 2005; Shore, 2009). This has been a persistent problem. The National Center for Education Statistics (2000) found that two-thirds of teachers surveyed reported that lack of training opportunities was a major problem. Since then, CDW-G (2006) commissioned the QED (Quality Education Data) to complete a study surveying over 1,000 teachers to obtain their opinions on technology in the classroom. The study identified technology professional development as a major need, with one-fifth of those surveyed reported receiving no professional development during the previous year. Teachers continue to cite technology professional development in

technology integration as a need (CDW-G, 2012; Lamberth, 2012; Wong, Goh, & Osman, 2013).

Even students have identified a lack of teacher technology fluency as a barrier for effectively using instructional technology, including IWBs, in the classroom (Slay et al., 2008). Beggs (2000), in a study involving 348 full-time faculty members of the State University of West Georgia, noted that 86.6 percent of respondents rated professional development as either important to critically important for successfully incorporating technology into the classroom. Belson and Larkin (2004) claimed insufficient professional development for incorporating technology led to frustration and confusion on the part of teachers, which led teachers to abandon technology and return to their old teaching methods.

As with other instructional technologies, teachers given IWBs have reported needing more professional development opportunities for incorporating the boards into the classroom. A case study involving five schools in South Western Sydney Region which had received IWBs found that teachers consistently recognized the importance of professional development and support (White, 2007). Other qualitative studies, in which teachers who used IWBs were interviewed, indicated that teachers were generally supportive of the IWBs and noted that they had indeed changed their teaching styles; however, they attributed much of the change to quality professional development (Bahadur & Oogarah, 2013; Glover & Miller, 2007).

Many localities have already determined that intensive training programs are necessary to ensure that IWBs are used effectively in the classroom. The Miami-Dade school division installed over 10,000 IWBs into classrooms for the 2014-2015 school



year and contracted with Promethean to provide 18 months of training for teachers (Meyer, 2014). Isreal, through the Schulich Canada Smart Classroom Initiative, spent \$25 million to mass install IWBs into classrooms. To ensure that the boards were used effectively, the Clore Isreal Foundation funded training for the teachers through the Hebrew University of Jerusalem.

### **Benefits of Teacher Professional Development to Incorporate Instructional Technologies**

Lack of professional development for incorporating instructional technology into the classroom has been linked with inadequate skill levels, wasted time, high stress levels, poor methodology, and low self-efficacy in general. Conversely, studies have suggested that providing professional development to teachers could address all of these issues (Owston, 2007; Shaha et al., 2004).

The most obvious benefit derived from professional development was improvement in fluency and skill levels, often cited as a barrier for incorporating instructional technology (Baylor & Richie, 2002; Howland & Wedman, 2004; Minor, Losike-Sedimo, Reglin, & Royster, 2013, Park & Ertmer, 2008). A study sponsored by the UFT Teacher Center (Mazzella, 2011) noted that teachers using IWBs, as well as other instructional technologies, must have knowledge of how to use these electronic tools before they can effectively incorporate them into the classroom. Furthermore, researchers have (2005) suggested that teachers who were provided with training that connected technology applications to particular curricular objectives were more likely to expand technology skills on their own (Center for Applied Research in Educational Technology, 2005; Hennessy & London, 2013; Jang, 2010).

Research also suggested that professional development can improve the confidence and comfort levels of teachers, thereby removing still another barrier to true integration (Beckett et al., 2003; Benedetto, 2005; Brinkerhoff, 2006; Borthwick & Pierson, 2008; Enayati, Modanloo, & Kazemi, 2012; Kleyn-Kennedy, 2006; Meichtry & Smith, 2004; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; Park, Cramer, & Ertmer, 2004; Russell, Bebell, O'Dwyer, & O'Connor, 2003; Watson, 2006). Studies have suggested that teachers who have been trained to use instructional technology in the classroom felt much better prepared than those who had not received training; in addition, they are much more likely to incorporate high tech devices in the classroom (Alanis, 2004; Ertmer, 2005; Hennessy & London, 2013; Jenson et al., 2002; Kleyn-Kennedy, 2006; Martin, Khaemba, & Chris, 2011; Slay et al., 2008; Southern Regional Educational Board, 2008). Baylor and Ritchie (2002) found that professional development for using instructional technology resulted in improved teacher morale, leading to better attitudes regarding these technologies and a greater likelihood that the teachers would use them in the classroom. A study by CDW-G, which involved extensive surveying of teachers, suggested that professional development for incorporating technology into the classroom resulted in more confidence, a greater likelihood of integrating 21<sup>st</sup> century skills, and a greater chance of feeling that technology is important. One respondent to the survey noted, "If something is new, you have to have time to learn it yourself before you can teach it to others" (CDW-G, 2006, p. 15).

Researchers have noted that instructional technology must be coupled with altered teaching practices to bring about true educational reform (Benedetto, 2005; Crowley, 2009; Cuban et al., 2001; Ertmer, 2005; Espinosa & Chen, 1996; Hennessy & London,

2013; Ringstaff & Kelley, 2002). Benedetto (2005) conducted a study of the benefits of the Integrate Technology initiative, the Louisiana state-supported program to provide instructional technology training to teachers in the state. The purpose of the training was to introduce various instructional technologies to teachers and to encourage the shift to more constructivist pedagogy by teachers in the classroom. The results of the study indicated that teachers had to be provided with adequate professional development which included follow-up training and support. Churches (2007) posited that training for incorporating instructional technology into the classroom would lead teachers away from using only first order thinking skills to using higher order 21<sup>st</sup> century learning skills.

Cogill (2002) came to the same conclusion concerning professional development for incorporating IWBs into the classroom. She noted that training for using IWBs made teachers competent users and therefore encouraged them to utilize the boards effectively. Research has indicated that for the boards to be used effectively, teachers must be convinced that the technology can bring about student achievement; this can only be brought about by adequate training for teachers (Glover, Miller, Averis, & Door, 2007; Hennessy & London, 2013). Nocny (2009) concurred, suggesting that providing adequate professional development for teachers would help them avoid needless mistakes in methodology which could decrease the effectiveness of lessons.

Of primary importance to school divisions was the link between teacher training and student performance; much research has revealed a positive correlation between the number of hours of teacher professional development and improved student achievement (Bowe & Pierson, 2008; Brumfield, 2006; Kinder, 2000, Lowden, 2005; McLester, 2004; Mertens & Flowers, 2004; Regional Educational Laboratory southwest, 2008; State

Educational Technology Directors Association, 2010; Wenglinsky, 2000). A report of the three-year Eisenhower Professional Development Program suggested that quality professional development led to changes in classroom practices and to improved student achievement (Porter, Garet, Desimone, Yoon, & Birman, 2000). A landmark study by Sanders and Rivers (1996) revealed that students who had effective math teachers for three consecutive years scored in the 83<sup>rd</sup> percentile on the fifth grade math test, while their counterparts with three consecutive years of ineffective teachers scored in the 29<sup>th</sup> percentile. In addition, studies have revealed a direct link between the time spent in professional development and changes in teaching practice (Gulamhussein, 2013; Holland, 2005; Out-of-School Time Resource Center, 2007).

Professional development was also identified as the vehicle to remove some of the other barriers preventing effective implementation of instructional technologies such as IWBs into the classroom. These other barriers, which were identified from the earliest days of instructional technologies, included the time necessary to incorporate instructional technologies into the classroom, technical difficulties, and lack of technology fluency (Alanis, 2004; Banerjee, 2004; Education Alliance, 2005; Ertmer, 1999; Franklin, Turner, Kariuki, & Duran, 2001; Hunter, 2001; Jenson et al., 2002; Plair, 2008; Schrum, 1999).

Teachers have reported difficulty dealing with increasing demands for their time. In an early study of five metropolitan school districts in Portland, Oregon, school personnel from technology coordinators to teachers and administrators all identified time as the chief barrier for incorporating instructional technology into the classroom (Vojtek & Vojtek, 1997). Later studies had similar findings. A report issued by the National

Center for Education Statistics (2000) stated that teachers listed time as one of the major barriers prohibiting effective technology integration in the classroom. A study by Hunter (2001) of the Piedmont Research Institute involving 100 teachers revealed that time was consistently listed as a major barrier for incorporating technology into the classroom. Ironically, Vojtek and Vojtek (1997) pointed out that technology was the very tool to overcome the time barrier. Furthermore, they indicated that professional development was the instrument to save time by showing teachers how to use the technology effectively.

Teachers also consistently reported technical difficulties as a barrier (Alonge, 2005; Brinkerhoff, 2006; Earle, 2002; Ertmer, 1999; Gaiter, 2005; Hew & Brush, 2007; Jenson et al., 2002; Martin, Khaemba, & Chris, 2011; National Center for Education Statistics, 2000; Thorburn, 2004; Todorova & Osburg, 2010). The members of an Arkansas educational task force concurred, identifying computer maintenance and troubleshooting training as major technology needs (Technology in Education Task Force, 2004), since teachers with poor experiences using instructional technologies would hesitate to incorporate it into their lessons. Rodriguez and Knuth (2000) suggested that providing teachers with training for dealing with technical difficulties would remove this barrier and motivate teachers to use technology more frequently. Training was provided for teachers in troubleshooting even in the early APCOT study, which may have contributed to its success (Ringstaff & Kelley, 2002).

### **Amount and Type of Professional Development Provided Teachers**

Even though studies over time revealed the importance of professional development (American Federation of Teachers, 2008; Beggs, 2000; Colorado Statewide

Systemic Initiative, 1997; Culp et al., 2005; Pierson, 2005; Shaha & Ellsworth, 2013; Sheeky, 2003; Sparks & Loucks-Horsley, 1989; Wallace, 2009; Zemsky & Massy, 2004), schools have continued to provide additional funds for software and hardware while spending for professional development has lagged behind (Alanis, 2004; American Federation of Teachers, 2003; Bonk et al., 2002; Carlson & Gadio, 2002; Franklin & Beach, 2002; Hennessy & London, 2013; Hofer et al., 2004; Miles, Odden, Fermanich, & Archibald, 2004; Peters, 2002; Shareski, 2004; Vrasidas & Glass, 2007). According to a survey by the National Education Association, even when professional development was provided for integrating technology into the curriculum, teachers rated only 43% of it as useful (National Education Association, 2008a).

The same trend held true with the acquisition of IWBs. School divisions spent exorbitant amounts purchasing the boards, but they did not provide the training which studies identified as the primary component of successful implementation (Bannister, 2010; Cogill, 2002; DeSantis, 2012; Hennessy & London, 2013; Kennewell, 2006).

Views about the adequacy of professional development for instructional technology varied. The *PBS TeacherLine National Survey of Teacher Professional Development* showed that approximately 67 percent of both superintendents and principals felt that support was always or frequently provided for teachers when new technologies were purchased for their divisions (Hezel Associates, 2006). A report by Gray, Lewis, and Tice (2009) stated that 95% of school divisions offered professional development for teachers for incorporating technology into the classroom. The Virginia Division Level Technology Report for 2009-2010 found that technology professional development for teachers varied greatly by school divisions. Of the 122 divisions

reporting, 120 offered traditional workshops lasting three hours or less, 104 offered workshops lasting three hours or more, 90 offered workshops lasting more than one day, 106 offered computer-based instruction, 107 offered one-on-one mentoring, and 22 offered other types of professional development. The other types of professional development for incorporating instructional technologies include webcasts/webinars, podcasts, coursework, and hands-on support. The Virginia Building Level Technology Report for 2009-2010 found that of the 1,536 schools reporting, 509 strongly agreed that their teachers were adequately trained to integrate technology into the classroom, 814 agreed, 175 disagreed, and 38 strongly disagreed. A nationwide survey by the Institute of Education Sciences found that 13 percent of teachers reported having no training for incorporating technology into the classroom, while 7 percent reported receiving more than 33 hours per year (Gray et al., 2010).

Cuban (1993, 1997), who has time and again stated that technology often goes unused or under utilized in the classroom, posited that lack of professional development was not the predominant reason why teachers failed to incorporate instructional technology into the classroom. He pointed to college professors who had received much professional development and had extensive experience with computers who still used them in unimaginative and limited ways. He held that cultural beliefs of teachers and administrators, combined with the way schools have been organized, has been responsible for the limited use of true instructional technology integration in the classroom. Other researchers, however, have suggested that professional development could be the vehicle to change those cultural beliefs and classroom pedagogy (Benedetto, 2005; Ertmer, 2005; Mishra & Koehler, 2006; Wong, Goh, & Osman, 2013). Armstrong

et al. (2005), in a video case study of teaching incorporating interactive whiteboards into the classroom, found that failure to provide adequate training resulted in teachers who were unaware of the potential of the IWBs and who were unable to harness the capabilities of the boards to bring about increased student achievement. A report by OFSTED (2004) concurred, noting that without proper professional development, teachers were not able to use the boards effectively. Many studies reflected that teachers utilized only a small number of the features of the IWBs, with boards often used only as projection devices when the same visual display capabilities could have been achieved with the much less expensive LCD projectors (Alach, 2011; Bakadam & Asiri, 2012; Davison & Pratt, 2003; DeSantis, 2012; Fox, Mears, & Pearson, 2010; Serow & Callingham, 2008; World Ort, 2010), and some teachers, administrators, and researchers viewed the IWBs as luxury or superfluous items (Alach, 2011; Miller, Glover, & Averis, 2004; Orbaugh, 2013). One teacher was discovered who merely used the surface of the IWB to demonstrate practice for handwriting. Moreover, IWBs were often used by teachers as simple technological instructional aides or as supplements to instruction, much like a VCR, instead of fully integrated learning tools (DiGregorio & Sobel-Lojeski, 2010; Glover et al., 2007; Miller, Glover, & Averis, 2004; Westera, 2004).

### **Effective Professional Development**

Researchers have suggested that the reason instructional technology has not lived up to expectations was due not only to a lack of funds for professional development in general but also due to poorly designed training programs (Cassandra Drennon & Associates, 2005; Espinosa & Chen, 1996; Gulamhussein, 2013; Literacy and Numeracy Secretariat, 2009; McKenzie, 2001b; Rodriguez & Knuth, 2000; November, 2010;



Prakash, n.d.; Shareski, 2004). While legislators, researchers, and educators all recognized the importance of professional development for teachers, many school systems have failed to include sufficient time and funds in providing adequate training for teachers (Bannister, 2010; Hennessy & London, 2013; Vrasidas & Glass, 2007). Insufficient data exist on the amount of time and money spent on professional development for teachers, partially due to methods of reporting and categorizing information and of drawing money from multiple funding streams (Fermanich, 2003; Gulamhussein, 2013; Noyce, 2006; Literacy and Numeracy Secretariat, 2009). Research revealed that school systems spent only three percent of their general budgets on professional development, which was far less than their business counterparts (American Federation of Teachers, 2003; Killeen, Monk, & Plecki, 2007; Smith & Kritsonis, 2006). For example, Konrad (2007) noted that General Motor's Saturn plan established the organizational goal to provide each employee with 92 hours of training yearly. The amount of professional development provided to teachers did not match that provided to their counterparts in the military either. The military, which has long recognized the importance of training, as early as the 1970s reported having one-sixth of its military personnel involved in training at any particular time (Bushnell, 1976). Researchers have recommended following the 70/30 rule, which calls for 70 percent of funds to be spent on supporting the human infrastructure and 30 percent to be allocated for equipment (Ringstaff & Kelley, 2002).

To be effective, research has suggested that training must be both ongoing and significant (Gulamhussein, 2013). According to Yoon et al. (2007), teachers who received 49 hours on average of professional development spread out over 6 to 12 months

saw student achievement increase up to 21 percentile points. However, the research also indicated that training that lasted less than 15 hours had no significant effect (Darling-Hammond, 2009; Gulamhussein, 2013). Research on professional development for IWBs has consistently indicated the need for long-term training (Bannister, 2010; Betcher & Lee, 2009; Hennessy & London, 2013).

Moreover, the overall training that has been provided for teachers has often failed to meet the needs in quality, quantity, and variety (Chen & Chang, 2006; Corcoran, 1995; Darling-Hammond et al., 2009; DeMonte, 2013; Elmore, 2002; Feiman-Nemser, 2001; Fishman et al., 2000; Gulamhussein, 2013; Mizell, 2010; Neville, Sherman, & Cohen, 2005; Shareski, 2004; Walker, 2013; Zuker, 2001). Decades ago, Agne and Ducharme (1978) criticized teacher professional development, describing it as ineffectual. Since then, the censure of the professional development provided for teachers has continued to grow. Many have described teacher professional development as inadequate, unsuitable, and generally failing to meet the expectations of the participants (Anagnou & Fragoulis, 2014; Bransford, Brown, & Cocking, 2000; California Teachers Association, n.d.; Elmore, 2002; Feiman-Nemser, 2001; Goldberg, 2005; Kopcha, 2012; Little, 1994; Minor, Losike-Sedimo, Reglin, & Royster, 2013; Moeini, 2009; Smith & Kritsonis, 2006; Sparks & Loucks-Horsley, 1989). Schools divisions have relied heavily on formal learning opportunities such as workshops, seminars, and graduate courses (Choy, Chen, Bugarin, & Broughman, 2006; Corcoran, 1995; Martin, Khaemba, & Chris, 2011; Prakash, n.d.; Raack, 2000; State Educational Technology Directors Association, 2008a; Teclehaimanot & Lamb, 2005; Thompson, 2006), which led Korte (2006) to describe the typical teacher training as one-dimensional, with a subject matter expert providing

information to potential learners; he characterized it as lacking in both creativity and flexibility. Elmore (2002) noted that workshops were sometimes “hit-and-run” (p. 6) affairs which had little effect on teacher practice or student improvement. Other phrases used to describe these sessions include “sit and get,” (U.S. Department of Education, 2005, p. 1; Walker, 2013, n.p.) “spray and pray,” (Barnett, 2003, p. 6; Schrum, 1999, p. 84; Vaga, 2013, n.p.; Walker, 2013, n.p.), “chalk and talk,” (p. 84), and “drive by” (DeMonte, 2013, p. 7; Rebor, 2009, 25; Vega, 2013, n.p.; Walker, 2013). Too often school systems planned professional development around events such as monthly workshops and periodic seminars rather than considering the desired result from the training (Darling-Hammond et al., 2009; Feiman-Nemser, 2001; Guskey, 2001; Ottenbreit-Leftwich, 2010; Raack, 2000). Frequently teachers were not involved in the planning of the trainings, workshops were not conducted by those with recent classroom experience, and professional development opportunities were passive events with few teachers being actively involved (Feiman-Nemser, 2001; Gulamhussein, 2013; Lowden, 2006; National Foundation for the Improvement of Education, 1996; NEA Foundation for the Improvement of Education, 2000; Raack, 2000; Smith & Kritsonis, 2006). In fact, according to Smith and Kritsonis (2006), teachers often viewed professional development as a waste of time since it was so disconnected from real classroom needs, while school board members and parents perceived it as time away from students.

Prolific research over time has suggested that teacher professional development in general has been lacking in quality (Bailey et al., 2011; Chen & Chang, 2006; Darling-Hammond et al., 2009; DeMonte, 2013; Elmore, 2002; Feiman-Nemser, 2001; Foltos, 2003b; Guskey, 2001; Neville et al., 2005; Zuker, 2001). Professional development for

teachers for incorporating technology into the curriculum has also historically been called deficient (Blazer, 2008; Daly, Pachler, & Pelletier, 2010; Fishman et al., 2000; Lawless & Pellegrino, 2007; National Foundation for the Improvement of Education, 1996; Phelps, Graham, & Kerr, 2004; Prakash, n.d.), and critics have described it as “fragmented” (Chen & Chang, 2006, n.p.; Jones, 2001, p. 37; Vega, 2013, n.p.) and “faddish,” (Harwell, 2003, p. 6; Pelochino, 2014, n.p.; Sparks, 2002, p. 90; U. S. Department of Education, 2005; p. 9) taking place in isolation (Brand, 1997; Bredeson, 2003; Ottenbreit-Leftwich, 2010). Recent research has confirmed this view of training for incorporating instructional technology into the classroom (Bill and Melinda Gates Foundation, 2012; Hooker, 2008; Mizell, 2010). While educators and researchers continued to highlight the need for professional development for integrating instructional technology into the classroom (Overbaugh & Lu, 2008; Zuker, 2001), programs that attempted to do this, such as the national Preparing Tomorrow’s Teachers to Use Technology and other NCLB initiatives, have been labeled as having “no demonstrated results” (Lawless & Pellegrino, 2007).

Despite the conflicting data linking professional development with effective instructional technology incorporation and student achievement, numerous studies still cite the lack of sufficient training as a primary barrier to using technology effectively in the classroom (Bailey et al., 2011; Baker et al., 2005; Bingimlas, 2009; Brinkerhoff, 2006; Hughes & Ooms, 2004; Owston, 2007; Rodriguez & Knuth, 2000; Vincent & Jones, 2007). Research has attempted to identify best practices for delivering teacher training that translates into higher student achievement.

Much of the instructional technology training has focused on “how-to” sessions rather than concentrating on true integration (Bonk et al., 2002; Brand, 1997; Dunne, 2002, Hooker, 2008; McKenzie, 2001a; New York State Department of Education, 2009a; Plair, 2008; Todorova & Osburg, 2010). Moreover, technology professional development, like most other teacher training, has generally occurred in isolated, formalized settings with the focus on technical competence (Carlson & Gardio, 2002; Elmore, 2002; Hardy, 2012; Lawless & Pellegrina, 2007; Lee, 2002; McKenzie, 2001a; Prakash, n.d.; Rodriguez & Knuth, 2000; Teclehaimanot & Lamb, 2005). Diaz (2001) noted that the focus of instructional technology training has been on the technology rather than the implementation, referred to as “technocratic determination” (LeBaron & McDonough, 2009, p. 11). It has often been assumed that providing teachers with the latest high-tech gadgets and software, and training them how to use the equipment or programs, would result in better teaching (Gaffney, 2010). While those teachers may become proficient end users of the technology, without adequate professional development for integrating technology into the classroom there may not have been a corresponding change in teaching pedagogy (Crowley, 2009; Ertmer & Lehman, 2003; Fishman et al., 2000; Gaffney, 2010; Mishra & Koehler, 2006; Ottenbreit-Leftwich, 2010).

Diaz (2001) also noted that, due to the rapid changes going on in the world of technology, training for teachers to incorporate it into the classroom had to be fast and cost-efficient, which did not always equate to effective and systemic. A report by OFSTED (2004) suggested that much professional development resulted in limited awareness of the possibilities in individual disciplines and made little impact on teachers’

reflection of using instructional technology in the classroom. Research has indicated that adults need to reflect and then respond to new ideas and technologies, such as IWBs in the classroom, if they are to incorporate them into practice (Campbell, 2010; Ertmer, 1999; King, 2002; Learn First Alliance, 2000; Murcia, 2008).

Formal professional development has often failed to take into account individual teacher needs (Birman, Desimone, Porter & Garet, 2000; Gulamhussein, 2013; Ottenbreit-Leftwich, 2010; Mizell, 2010; Phelps et al., 2004). Since formal trainings have a specific beginning and ending date, all participants have been expected to learn in the same time frame. However, research has found that the time required for training and development, especially for technology fluency, varies greatly from teacher to teacher, and a one-size-fits-all training does not take into account individual learning curves and often results in added stress and anxiety and technology avoidance (Brand, 1997; Bubb & Earley, 2007; Carlson, 2002; Hughes & Ooms, 2004; Kedzior & Fifield, 2004; New York State Education Department, 2009a; Phelps et al., 2004; Smith, Hofer, Gillespie, Solomon, & Rowe, 2003; Zhao & Cziko, 2001). Researchers seemed to agree that no single workshop or seminar would enable a teacher to use an IWB or any other instructional technology effectively in the classroom (Center for Technology in Learning, 2009; Foltos, n.d.; Prakash, n.d.; Rodriguez & Knuth, 2000; Slay et al., 2008).

Why have schools concentrated on these formal training sessions? Schools were familiar with this type of professional development, since these sessions met the basic requirements of NCLB, and schools continued to rely on formal training for teachers (Wei, Darling-Hammond, & Adamson, 2010). While stressing the importance of professional development for teachers, NCLB legislation provided only a rudimentary

definition of professional development and an ambiguous description of what it must include. According to NCLB (2002), professional development must be tied to school curriculum, student achievement, and state standards. Moreover, it must be rigorous, sustained, and evaluated. These NCLB guidelines mirrored the recommendations for teacher professional development created by the National Staff Development Council (NSDC) (2009). However, NCLB legislation did not specifically state what comprised high-quality professional development or outline methods for making professional development available to teachers (Borko, 2004).

Although lawmakers responsible for NCLB did not delve into types of learning, researchers around the world had been defining and weighing the benefits of both formal and informal learning experiences. The results have serious implications for school professional development plans, particularly for instructional technology training, which would ensure that teacher training went beyond mere operational skills which has historically been the thrust of formal teacher training (Cowan, 2013; Hew & Brush, 2007; Gulamhussein, 2013; Teclehaimanot & Lamb, 2005; Todorova & Osburg, 2010; Virginia Department of Education, 2010; Zhao & Bryant, 2006).

It is very true that teachers should become skilled users of the instructional technology that they must employ in the classroom. Researchers have noted that proficiency was critical (Alonge, 2005; Benedetto, 2006; Betcher & Lee, 2009; Goktas, Yildirim, & Yildirim, 2009; Minor, Losike-Sedimo, Reglin, & Royster, 2013, National Foundation for the Improvement of Education, 1996; November, 2010; Shareski, 2004; SMART Technologies, 2009), but by itself has not been shown to be sufficient. For example, Diaz (2001) noted that training a teacher to use a flat-bed scanner did not result

in improved teaching practices. Moreover, teachers have reported that they feel relatively competent to use technology, at least on the minimal level, but survey results indicated that 80 percent of teachers desired to have more training on how to incorporate instructional technology into the classroom (Ertmer, 2005).

Best practices have suggested that administrators must first decide what high-quality professional development for incorporating instructional technology into the classroom should constitute, taking care to incorporate basic principles of adult education. One of the basic tenants of andragogy called for learners to have a wide variety of choices for learning experiences and for the learner to be able to take responsibility for developing a personal learning plan to meet individual needs (Bubb & Earley, 2007; Enns, 2007; Feiman-Nemser, 2001; Lepänjuuri & Pylkkä, 2006; Knowles, 1984; McKenzie, 2001a; Shareski, 2004). Historically, very little teacher professional development has incorporated these principles since training has been mandated from the top down and has been predominately composed of one-time workshops offering little variety in the presentation format (Curwood, 2011; Elmore, 2002; Feiman-Nemser, 2001; Gulamhussein, 2013; King, 2002; Literacy and Numeracy Secretariat, 2009; Shareski, 2004; Thompson, 2006). Current research has suggested that teachers must have time for exploration, collaboration, reflection, and engagement in hands-on activities (Alanis, 2004; Blazer, 2008; Center for Technology in Learning, 2009; Ertmer, 1999; Foltos, 2003b; Gorder, 2008; Hunter, 2001; Rodriguez & Knuth, 2000; Teclehaimanot & Lamb, 2005). Research also suggested that professional development should be job-embedded and on-going (American Federation of Teachers, 2008; Blazer, 2008; Center for Technology in Learning, 2009; Croft, Cogshull, Dolan, Powers, & Killion, 2010;



Greaves et al., 2010; Literacy and Numeracy Secretariat, 2007; National Institute for Excellence in Teaching, 2012; NEA Foundation for the Improvement of Education, 2000; Ohio Department of Education, 2008; Tafel, 2008; Vega, 2013; Walker, 2013).

The development of new instructional technologies has created a need for new training strategies (Beglau et al., 2011; Goral, 2001; Hennessy & London, 2013; Hewlett-Packard Development Company, 2014; Westera, 2004), with Crowley (2009) going so far as to call for a total restructuring of the professional development process for incorporating IWBs into the classroom. However, the standard face-to-face formal training, usually in the form of workshops and conferences, has remained the norm for providing professional development for teachers for incorporating instructional technology into the classroom (Choy et al., 2006; Gulamhussein, 2013; Shareski, 2004; Tienken & Achilles, 2005). While formal training will always be a vital part of professional development, researchers have agreed that it can no longer be considered the only venue (Barnes, 2005; Gooler, Kautzer, & Knuth, 2000; Hennessy & London, 2013; Prakash, n.d.). Studies have shown that informal learning opportunities can be more effective than formal ones (Beith, 2006; Ertmer & Lehman, 2003; Grover, 2010; Haldane, 2010; Morgan, Gilman, & Cruzeiro, 2005; Phelps et al., 2004).

### **Formal Learning**

Formal instruction, long the staple of the academic world, has been identified as learning with a standardized curriculum delivered by an instructor/expert (Kennedy, 2005; Liu & Batt, 2007), having an identifiable starting and ending date (Colley, Hodkinson, & Malcolm, 2002; Loewenstein & Spletzer, 1994), often resulting in some type of credential (Carrera, 2006; Mazza, 2007; Merriam, Caffarella, & Baumgartner,

2007), and usually providing some kind of evaluation process (McNamara, 2008).

According to the *PBS TeacherLine National Survey of Teacher Professional Development*, during the 2005-2006 school year teachers received most of their professional development time engaged in formal workshops or conferences (Hezel Associates, 2006). Typically, formal learning has been designed by management/administrators to meet perceived deficiencies, which may not meet the needs of participants (Bolt, 2008; Elmore, 2002; Kennedy, 2005; Merriam et al., 2007). Bredeson (2003) concurred and described current professional development as designed more for “convenience and organization expediency” (p. 7), when it should be designed to be “enriching” and “energizing” (p. 11). Formal learning has also been described as hierarchical, standardized, stagnant, delivered through organized learning modules, and seldom resulting in teacher buy-in or change in teacher practice (Bolt, 2008; Ferriter, 2009; Gulamhussein, 2013; Hines, 2008).

Other studies have highlighted the value of formal learning. Research has indicated that teachers who are provided with formal training for integrating instructional technology into the classroom used technology more often (Mills & Schmertzing, 2005). Researchers have noted that formal instruction, such as that provided by college courses, covers a standardized curriculum and provides quality assurance (Kennedy, 2005). Chivers stated that formal learning “may play an important role in the achievement of the powerful meta-competences necessary to perform at the highest professional levels” (2006, p. 9). Research has also indicated that for some subjects, informal learning was less effective than formal instruction, particularly when prerequisites were necessary (Al-Mutka, 2010; Kennedy 2005; Woodall, 2012). Moreover, the *PBS TeacherLine National*

*Survey of Teacher Professional Development* revealed that teachers rated workshops, college courses, and conferences quite highly for improving content knowledge and for impacting instructional methods (Hezel Associates, 2006). As McNamara (1997) pointed out, numerous benefits of formal learning have been identified, including the following:

1. Formal learning has a planned curriculum, which lessens the chance of having gaps in the overall education.
2. Formal learning is generally facilitated by experts in the field.
3. Formal learning allows for the systematic accumulation of desirable knowledge and skills.
4. Formal learning provides the learner with a portable credential recognized by the educational and corporate world.
5. Formal learning ensures that learners achieve specified training/knowledge in a timely manner.

However, as other researchers noted, after initial training, most professionals continued to learn through informal learning (Anagnou & Fragoulis, 2014; Cheetham & Chivers, 2001; Lewin et al., 2009). Indeed, many researchers have criticized the conventional forms of professional development, such as workshops and lectures, referring to them as too controlled by management and excessively isolated from daily practice (Bolt, 2008; Carlson & Gardio, 2002; Corcoran, 1995; Feiman-Nemser, 2001; Keller, 2002; Kennedy, 2005; Literacy & Numeracy Secretariat, 2007; McKenzie, 2001a; Phelps et al., 2004; Thompson, 2006). Workshops and seminars for instructional technology training were also criticized for not allowing sufficient time for review and practice of skills or for achieving confidence (Beith, 2006). Unfortunately, teachers

reported that much of the professional development available to them fell in this category (Curwood, 2011; Darling-Hammond et al., 2009; Jones, 2001; Thompson, 2005), often being composed of short-term conferences and workshops.

The identified benefits of formal learning were legion, and studies have shown that teachers gained in confidence when provided with formal training (Benedetto, 2005; Espinosa & Chen, 1996; Smith & Kritsonis, 2006). However, the idea has been that if teachers were provided with knowledge in formal training sessions, they would rush back to the classroom and implement the knowledge into the classroom, which has not happened (Gulamhussein, 2013; Hines, 2008; Shareski, 2004). There is little research available that directly links participation in a college course with changes in teacher practice (Parise & Spillane, 2010). However, as Shareski (2004) noted, traditional workshops can serve to inspire teachers by making them aware of new knowledge, skills, and techniques to use in the classroom.

Conversely, formal professional development activities such as college courses have often been disconnected from their daily work, which teachers found to be less effective than training delivered in context (Elmore, 2002; Kennedy, 2005; National Foundation for the Improvement of Education, 1996; Opfer & Pedder, 2010; Thompson, 2006). Moreover, delivering instruction to large groups in formal settings presented difficulties for meeting the needs of diverse learners with different interests and varied aptitude levels, which is common in workshops teaching skills for incorporating instructional technology into the classroom (Benson, 1997; Jones, 2007; Literacy and Numeracy Secretariat, 2009). In these formal training sessions, many students needed to move faster while others needed more time. Teachers also reported wanting content

focused professional development rather than generalized instruction (Curwood, 2011; Gulamhussein, 2013; Scott & Mouza, 2007).

### **Informal Learning**

Informal learning has been characterized as having few pre-determined guidelines, seldom leading to a certification or credential, often occurring spontaneously, and frequently being limited in scope (American Society for Training and Development, 2008; Anagnou & Fragoulis, 2014; Bull et al., 2008; Burns, 2008; Carrera, 2006; Chen, Millard, & Wills, 2008; Gill, 2008; Harrison, 2006). Although much research has been done on informal learning, currently no absolute distinction exists between formal and informal learning (Chen, Millard, & Wills, 2008; Colley et al., 2002; Hague & Logan, 2009). This lack of standard definition complicates the issue of determining the importance and relevance of informal learning. Informal learning has been defined broadly by some researchers as any type of learning that is not formal (Eraut, 2002; Livingstone, 2000) and very narrowly by others to only that learning which takes place during the process of daily living (Merriam et al., 2007). Furthermore, various researchers have classified what is commonly referred to as informal learning into sub-categories, such as non-formal, incidental, and implicit learning. Non-formal learning has been defined as learning that generally does not lead to certifications, lasts only a short time, is primarily voluntary, may or may not take place in the workplace, has minimal prerequisites, but is intentional and organized in nature and quite often the learner sets aside time for the learning activity (Anagnou & Fragoulis, 2014; Colardyn & Bjornavold, 2004; Hague & Logan, 2009; Merriam et al., 2007). Implicit or incidental learning refers to the method of obtaining knowledge that takes place merely through exposure with no

conscious effort required (Eysenck & Keane, 2005; Smaller, 2005). Other researchers categorized informal and non-formal learning as separate and distinct types of learning (Merriam et al., 2007), rather than one being a subset of the other. To further complicate matters, researchers have noted that non-formal and formal learning activities have several characteristics in common, since non-formal learning has definite goals and objectives and may also employ a facilitator (Colley et al., 2002; Hague & Logan, 2009; Merriam et al., 2007).

Informal learning has received high marks for its effectiveness. Studies by Joyce and Showers (2002) suggested that fewer than 10 percent of participants incorporated new techniques and ideas learned during traditional learning opportunities such as workshops. Carrera (2006) stated that learning throughout life was much more a product of informal than formal learning. Hooker (2008) specifically noted that informal communication among teachers was the most widespread method for transferring instructional technology skills and knowledge. More and more research has suggested that informal learning methods are underutilized avenues for improving teacher practice (Davidson, 2009; Gulamhussein, 2013; Literacy and Numeracy Secretariat, 2007).

Elmore (2002) emphatically stated that effective professional development for teachers should exemplify the model of adult learning, which is much more in tune with informal learning. Elmore further noted that to be effective, professional development should be conducted as close as possible to the place where teaching takes place, which is typically more descriptive of informal learning rather than formal. Research has suggested that training be brought to teachers rather than bringing the teachers to the training because professional development that is embedded into the work day becomes

an integral part of teaching rather than a separate entity (Center for Technology in Learning, 2009; Diaz, 2001; Guskey, 2001; Jurasaitė-Harbison, 2009; Literacy and Numeracy Secretariat, 2007; Opfer & Pedder, 2010). Diaz (2001) noted that personalized training in familiar surroundings would be more effective than taking teachers from their own environment.

According to Hoekstra, Brekelmans, Beijaard, and Korthagen (2009), informal learning was the preferred method of learning for experienced teachers since professional development for teachers needed to be differentiated. Moreover, informal learning was considered more likely to lead to life-long learning habits (Anagnou & Fragoulis, 2014). This was particularly true of technological skills, with approximately 90 percent of teachers reporting that they learned to use instructional technologies by themselves (Ringstaff & Kelley, 2002). Often this learning occurred through trial-and-error methods (Martin, Khaemba, & Chris, 2011).

Since much of the research has suggested that most learning in the workplace takes place informally, informal learning has been an accepted practice in the business world (Burns, 2008; Carrera, 2006; CARA Group, 2011; Cheetham & Chivers, 2001). Researchers such as Henschel have estimated that as much as three-fourths of corporate learning took place in an informal setting (Chivers, 2006). The American Society for Training and Development (2008) conducted a study to analyze trends in workplace learning and performance. In the study, 1,104 human resource professionals were surveyed. Results of the survey revealed that informal learning was widespread in the workplace, with approximately half of those participating in the study noting that informal learning took place to a “high” or “extremely high” degree (2008, p. 25).

Considering the benefits of informal learning, de Vries and Brall (2008) went so far as to say that even corporations overinvest in formal learning when informal learning would be more effective.

Research has indicated that teachers, like other professionals, could benefit from informal learning opportunities (Anagnou & Fragoulis, 2014; Brinkerhoff, 2006; Bull et al., 2008; Cross, 2007; de Vries & Brall, 2008; Woodall, 2012). More than a decade ago, the National Foundation for the Improvement of Education (1996) stressed the importance for teachers to be engaged in mentoring, peer observation, independent study, collaborating, and using new methods to attain professional growth. NCLB recommended the use of mentors and professional development coaches, and it called for the establishment of educational collaboration teams, all of which suggest informal learning. In addition to these methods, researchers have identified other types of informal learning available to teachers, such as listening to podcasts, searching the Web, participating in discussion boards and wikis, visiting museums, networking, observing, analyzing feedback, reflecting, calling the help desk, or simply joining a conversation (Bull et al., 2008; Burns, 2008; Chivers, 2006; Chuang et al., 2003; Cross, 2007; Hines, 2008).

Research has suggested that use of informal learning removed the often-cited barriers to using instructional technology in the classroom, even when these learning opportunities were not supported systematically (Hoekstra, Korthagen, Brekelmans, Beijaard, & Imants, 2009). These barriers included lack of time, lack of skill, lack of confidence, and lack of support (Bill and Melinda Gates Foundation, 2012; Center for Technology in Learning, 2009; Curwood, 2011; Fox, 2007; Marr, 2011; National



Foundation for the Improvement of Education, 1996; Ottenbreit-Leftwich, 2010; Rodriguez & Knuth, 2000; Thompson, 2006).

Studies have suggested that professional development opportunities that were long-lasting provided many opportunities for educators to take part in active learning, generally placed greater weight on content, and resulted in more coherence (Gulamhussein, 2013; Learning First Alliance, 2000; Snow-Renner & Lauer, 2005). In fact, NCLB, in its outline of quality professional development, expressly eliminated one-day or other short term formal workshops. Informal professional development opportunities could be structured so that they covered longer periods of time.

Proponents of informal learning have touted its flexibility, which allows for the rapid diffusion of knowledge and skills (Bull et al., 2008; Cross, 2007; de Vries & Brall, 2008). Moreover reform type professional development opportunities, including education networks and study groups, have been labeled more effective than conferences and workshops since they generally extend over a longer time (Jurasaitė-Harbison, 2009; Snow-Renner & Lauer, 2005). Research has repeatedly suggested that sustained, long-term, systemic professional development results in changes in teacher practice (Bill and Melinda Gates Foundation, 2012; Center for Technology in Learning, 2009; Curwood, 2011).

Since informal learning has been found to be more aligned with theories of adult learning as expressed by Knowles (1984), experts have posited that learners would be autonomous and have more control and ownership over their own learning (Ala-Mutka, 2010; Jurasaitė-Harbison, 2009; Marsick & Watkins, 1990; The NEA Foundation for the Improvement of Education, 2000). Teachers using IWBs could base their participation in

professional development opportunities on relevance to their own lives and classroom needs.

In light of the many benefits of informal learning and the fact that informal learning opportunities can take many forms easily adapted to use in education, researchers have suggested that schools should facilitate informal professional development (European Center for the Development of Vocational Training, 2007; Florida Regional Workforce Boards, 2005; Keller, 2002; Morgan et al., 2005; Phelps et al., 2004). These opportunities could include mentoring, collaboration, maintaining online resource sites (such as wikis, blogs, and discussion boards), observation, peer coaching, personal study using a school-maintained professional library (real and virtual), and joining a community of practice, among others. Research has indicated that each of these methods provides opportunities for teachers to create, explore, and discuss (Feiman-Nemser, 2001; Hennessy & London, 2013; Morgan et al., 2005; National Foundation for the Improvement of Education, 1996; Shareski, 2004; Teclehaimanot & Lamb, 2005) the use of IWBs in the classroom. Foltos (n.d.), the Director of Educational Innovation at Peer-Ed, and an advocate of a more innovative model of professional development, said that teachers needed collaborative time during the actual school day for instruction, practice, feedback, and continued support. This more collaborative culture must include multiple avenues, such as peer coaching and communities of practice. Other supporters agreed, arguing that the technology age demanded new approaches to professional development rather than the traditional structure still being used by schools (Beglau et al., 2011; Bredeson, 2003; Center for Technology in Learning, 2009; Feiman-Nemser, 2001; Florida Regional Workforce Boards, 2005; Jones, 2007; Jurasaitė-

Harbison, 2009; Koenraad, 2008; Plair, 2008; Renyi, 1996; Rodriquez & Knuth, 2000; Teclehaimanot & Lamb, 2005). In order for training for incorporating instructional technology into the classroom to be effective, the training must adopt the following components: be hands-on, incorporate a variety of learning opportunities, provide sufficient time, and include active involvement by participants (Hennessy & London, 2013; Keller, 2002; Rodriquez & Knuth, 2000; Teclehaimanot & Lamb, 2005).

Furthermore, professional development must be tailored for individual needs (Florida Regional Workforce Boards, 2005; Mazzella, 2011; Shaha et al., 2004; Todorova & Osburg, 2010), so that it is “just in time” (Ehman, Bonk, & Yamagata-Lynch, 2005, p. 260; Grover, 2010, p. 52; Hew & Brush, 2007, p. 239; Phelps et al., 2004, p. 6; Shaha & Ellsworth, 2013) rather than “just in case” (Grover, 2010, p. 54; Hugh & Brush, 2007; p. 239).

Research has indicated that these characteristics of professional development can be informal learning opportunities, including mentoring, peer coaching, participation in communities of practice, use of collaboration time, professional resource libraries, observation, and use of online learning portals such as discussion boards. Each of these methods has its own advantages and disadvantages.

### **Mentoring**

Mentoring is one method of informal learning that facilitates the transfer of many critical workplace skills (CARA Group, 2011). Mentoring has been defined as an individualized training approach that connects a more experienced employee with a less experienced one for the purpose of providing not only support but also regular occasions for sharing knowledge and advice (Center for Inspired Teaching, 2008; Cheetham &

Chivers, 2001; Fischer & Andel, 2002; Hooker, 2008; Kedzior & Fifield, 2004; Literacy and Numeracy Secretariat, 2007; Parker, 2010; Peter, 2007; Shinnars & Sweetland, 2008). Mentoring has long been recognized as an effective training method (Vega, 2013) and has received much attention from researchers. Although teacher mentorship programs historically have not been as well developed as those in the workplace, the last two decades have seen a continuous rise in the use of mentors in the educational setting (Anagnou & Fragoulis, 2014; Daloz, 1999; Feiman-Nemser, 2001; Ganser, 2002; Hobson, Ashby, Malderez, & Tomlinson, 2009; National Foundation for the Improvement of Education, 1999). Many school divisions have provided technology mentors, although economically disadvantaged school divisions were less likely to do so (Greaves et al., 2010; Shapley, Benner, Heikes, & Pieper, 2002). Within the last decade, researchers have advocated for cybermentoring (Ganser, 2002; Greaves et al., 2010; Hooker, 2008; Johnson et al., 2006; New Teacher Center, 2008), which would expand the availability of appropriate mentors.

School systems have routinely provided general mentoring programs for teachers since mentoring has been shown to reduce teacher turnover, improve classroom climates, reduce stress, increase retention, and improve teacher effectiveness (Choy et al., 2006; Feiman-Nemser, 2001; Hooker, 2008; Kedzior & Fifield, 2004; Lau, 2004; National Foundation for Improvement in Education, 1999; Parker, 2010; Rudnesky, 2006; Shinnars & Sweetland, 2008), as well as reducing the feeling of teacher isolation (Hooker, 2008; Stanulis & Burrill, 2004). Booth and Runge (2005), in a survey of new teachers (three years of experience or less), noted that teachers found mentoring and other casual learning experiences highly effective in promoting teacher confidence and

competence. Studies suggested that mentoring was beneficial for new teachers because it was situated in the workplace and took place in a social atmosphere (American Federation of Teachers, 2008; Center for Technology in Learning, 2009; Kedzior & Fifield, 2004; Swan et al., 2002).

More specifically, research has shown mentoring to be an effective professional development method for integrating technology, including IWBs (Betcher & Lee, 2009; Chuang et al., 2003; Essig, 2011, Franklin et al., 2001; LeBaron & McDonough, 2009; Mizell, 2010; Oigara & Wallace, 2012; State Educational Technology Directors Association, 2011; Teclehaimanot & Lamb, 2005). Shore (2009) noted that the use of instructional technology specialists, who served partly as mentors, has been very successful in training teachers for technology integration. State governments also realized the importance of professional development and have implemented plans for technology professional development (Fox, 2007). Virginia established a program whereby funds were given to school divisions to have at least one instructional technology resource person/mentor to provide training and assistance for teachers to incorporate technology into the classroom (Fox, 2007; State Educational Technology Directors Association, 2008b). A survey of teachers revealed that 66 percent of those who had been provided with an instructional technology mentor said that the experience resulted in greatly improved teaching (State Educational Technology Directors Association, 2008a). Research through time has suggested that mentoring is particularly effective for new teachers (Brand, 1997; Feiman-Nemser, 2001; Mizell, 2010; Southwest Educational Development Lab, 2000; Teclehaimanot & Lamb, 2005) and new computer users tend to integrate instructional technology more effectively when they have someone to turn to for

assistance and support (Brand, 1997; Rudnesky, 2004, 2006; Thompson, 2006).

Mentoring has been touted as particularly effective when dealing with teacher fear, which many teachers report occurring when incorporating new instructional technologies such as IWBs into the classroom (Daloz, 1999; Rudnesky, 2006; Vincent, 2007).

Linwood Public Schools District in New Jersey developed a mentoring program to assist teachers with integrating instructional technology into the classroom. In this program, novice users were paired with proficient teachers who integrated instructional technology regularly. Data were kept to determine if the mentoring resulted in accelerated training. The study found that technology mentoring promoted collegiality, eliminated many of the barriers to incorporating instructional technology into the classroom, changed teachers' perceptions concerning instructional technology, motivated teachers to use the technologies, and decreased the time needed for teachers to become proficient users (Rudnesky, 2004).

Rensselaer Polytechnic Institute developed the Capital Area Technology and Inquiry in Education (CATIE) program to address the issue of instructional technology professional development (Swan et al., 2002). Through this program, mentors skilled in using and integrating instructional technology into the classroom were available on site to assist other teachers. The mentors worked jointly with their mentees to develop technology-rich lesson plans. Mentees reported increased technology skills, more confidence incorporating instructional technologies into the classroom, and more creativity with lesson plans. Moreover, the teachers noted that their improved skills resulted in lessons that allowed students to be more independent, motivated, and engaged.

Franklin et al. (2001), in a study of instructional technology mentoring in a rural elementary school, revealed that the mentoring relationship overcame many of the barriers for incorporating technology into the classroom. The reported benefits included support for redesigning curriculum, opportunities for modeling, and help in connecting theory and practice.

Zhao and Bryant (2006) conducted a study which provided elementary teachers and social studies teachers with mentoring after they had received mandated formal training for incorporating technology into the classroom. Their study found that the formal training alone resulted in basic skills attainment in both test groups. However, when provided with mentoring experiences, the teachers had higher levels of integration, suggesting that mentoring supported traditional professional development.

Winkler (2011) conducted a study to determine the effect of professional development for incorporating interactive whiteboards on student achievement in math classes. This study involved 18 teachers randomly selected, who had a total of 311 students. He found that use of collaborative mentoring was particularly effective. Students taught by the teachers who received mentoring in using the features of the boards significantly achieved more than students taught by other teachers.

Another study, conducted by Vincent and Jones (2007), examined the effect of providing mentors for teachers in a rural Victoria, Australia, school for incorporating IWBs into the classroom. The researchers found the mentoring model to be highly successful, reporting that teachers who participated in the project were more likely to engage in complex classroom activities that promoted learning.

However, studies have identified problems relating to teacher mentoring.

Researchers noted that the main constraint associated with mentoring was lack of time (Anagnou & Fragoulis, 2014; Feiman-Nemser, 2001; Hooker, 2010), which was also identified as a barrier for incorporating technology into classrooms in the first place. Lack of time resulted in failure to work with mentees adequately, inability to define mentor roles, and frustration on the part of both mentors and mentees. Koki (1997) noted more than a decade ago that mentoring can be even more demanding than teaching. He also held that even veteran teachers could not always assess new teachers effectively, indicating that mentors must be suitably trained. Hooker (2008) agreed, calling mentoring “labor intensive” (p. 16). Like other training methods, research has suggested that best practices must be followed to achieve maximum results. According to Orchwari (2006) and Hooker (2008), mentoring is successful only when the experience is based on reciprocal commitment and trust and when it is both structured and focused. Moreover, Snow-Renner and Lauer (2005) asserted that professional development utilizing mentors should provide sufficient time for the mentoring to take place in order for it to be effective. Costs have also been identified as an issue, including stipends for mentors, training costs for both mentors and mentees, and technology costs for cybermentoring (Hooker, 2008).

### **Peer Coaching**

Another training venue touted as beneficial for teachers seeking to incorporate technology into the classroom is peer coaching (Syh-Jong, 2010). Peer coaching has been defined as the process of two or more teachers working together to improve skills, problem solve, reflect on any current practices, and learn from each other (Beglau et al.,



2011; Jang, 2010; Koki, 1997; Robbins, 1991; Youghans, 2010). According to Showers and Joyce (1996), the use of peer coaching to implement new teaching approaches began in the 1980s. While peer coaching has been used more in urban schools than rural (Hezel Associates, 2006), it has been expanding to all schools rapidly where it has been replacing some of the more traditional professional development opportunities (Center for Technology in Learning, 2009; Foltos, 2003b). It has been distinguished from mentoring in two distinct ways: Peer coaching is confidential and it is done between equals (Literacy and Numeracy Secretariat, 2007). While it includes observation, it involves much more than providing feedback; it also encompasses teachers giving each other suggestions, possibilities, and participating in mutual learning (Cheetham & Chivers, 2001; Cooper, 2008; Jennings & Gottesman, 1994; Joyce & Showers, 2002; Kennedy, 2005; Literacy and Numeracy Secretariat, 2007). As Erenben (2007) noted, teachers engaged in peer coaching helped to identify behavior patterns without being judgmental, which is crucial when trying to get teachers to use new technologies such as IWBs. Although it is often informal in nature, it has been structured to help teachers reach their maximum potential (Florida Regional Workforce Boards, 2005). Peer coaching has been shown to reduce teacher isolation, provide teachers with a support system, improve teacher job satisfaction, increase energy levels, facilitate the implementation of advanced tools and practices, and encourage positive personal relationships (Beglau et al., 2011; Center for Technology in Learning, 2009; Goktas et al., 2009; Guiney, 2001; Jang, 2010; Jennings & Gottesman, 1994; National Foundation for the Improvement of Education, 1996; State Educational Technology Directors Association, 2008a; Sugar, 2005). The collaborative relationship between teachers and

mentors has resulted in the application of workshop information into practice in the classroom (Bellanca, 2009; Gulamhussein, 2013), and teachers were more likely to reflect critically and change pedagogical practices (Brand, 1997; Cooper, 2008; Ertmer, 1999; Hoekstra, Korthagen, Brekelmans, Beijjaard, & Imants, 2009; Jang, 2010; Sugar, 2005). Showers and Joyce (1996, 2002) touted the benefits of peer coaching, noting that teachers who were engaged in it retained information longer, were more apt to adopt new teaching methods, and were more likely to pool their resources. They recommended that teachers division wide form small peer coaching groups which would bring about higher student achievement. Sugar (2005) noted that a study initiated through the Technology Literacy Challenge Fund to investigate the benefits of instituting a coaching program for incorporating instructional technology found that the benefits of the program were significant. Teachers in the program generally rated having coaches as either very effective or effective, and they applauded the hands-on approach aspect of the program as well as the ability to work one-on-one with a coach rather than getting lost in a large group setting. Another study, which compared standardized test scores of students in classrooms where teachers were coached to those of students in classrooms where teachers had not been coached, found that the students in the teacher-coached classrooms had higher scores than students in the non-coached rooms (Gulamhussein, 2013).

Although many school divisions claimed to use peer coaching, a discrepancy has been found between the division level and the school level data on just how often it has been incorporated into the professional development program, with 46 percent of superintendents saying it was used as opposed to 65 percent of principals (Hezel

Associates, 2006). Only 38 percent of teachers, however, reported engaging in instructional coaching.

Foltos (n.d.) highlighted the benefits of peer coaching for incorporating instructional technology into the classroom, noting its importance for getting teachers to adopt new learning practices. Other research supported this claim (Greaves et al., 2010). A study of Georgia teachers conducted by Barnes (2005) revealed that peer coaching resulted in an increase of technology use in classrooms. Guiney (2001) noted that the success of the Massachusetts Comprehensive Assessment System could be directly traced to the use of a peer coaching program, and Branigan (2002) made a similar claim concerning the success of the eMINTS computer immersion program. In a study of Boston schools, Guiney (2001) found a direct positive correlation between the use of peer coaching and improvement in student academic achievement as measured by standardized test scores. Other studies involving peer coaching have reported increases in student test scores as a result of implementing peer coaching (Foltos, 2003b). In a study to examine the effect of peer coaching and technology integration, Jang (2010) found that providing peer coaches helped to transform pedagogy as well as improve subject-matter knowledge.

According to the *PBS TeacherLine National Survey of Teacher Professional Development*, very few teachers felt that coaching either improved their content knowledge or impacted their methods of instruction (Hezel Associates, 2006). According to Guiney (2001), use of coaches resulted in higher standardized test scores in schools that had coaches the longest. Peer coaching has been shown to meet the needs of schools by providing a vehicle for the transfer of skills from teachers directly to the classroom

where it can “maximize all the money and time which has been spent in training, retraining, staff development, or skills enrichment” (Jennings & Gottesman, 1994, p. 7). Microsoft felt strongly enough about the benefits of peer coaching to invest \$35 million dollars to begin a peer coaching program (Ishizuka, 2004). In an evaluation of this program, Barron, Dawson, and Yendol-Hoppey (2009) noted that the participants all felt that peer coaching for incorporating technology into the classroom provided positive results, although the recurring issues of sufficient time and resources remained barriers. Prakash (n.d.), CEO of Learning Links Foundation, highlighted the importance of teachers drawing upon the experiences of other teachers. Gulbahar and Guven (2008) concurred, suggesting that peer coaching is a necessary piece for successful instructional technology integration.

Peer coaching allowed for meeting individual teacher needs and assisting in all facets of training including development of instructional technology skills, integration, and management of resources for teachers of varying skill levels (Ottenbreit-Leftwich, 2010; Young, Marotta, & Dardenne, 2010). This method has been praised for providing just-in-time learning, and Murcia and McKenzie (2008) suggested professional development for incorporating IWBs required “expert input at point of need” (p. 11). In addition, peer coaching took place onsite, which eliminated travel and situated the training in the workplace. Because of these benefits, many states have developed initiatives to provide instructional technology resource teachers to assist other teachers to incorporate instructional technology into the classroom. A study by CDW-G (2012) found that more teachers were requesting the services of IT professionals. Virginia

recommended that school divisions have one instructional technology resource teacher for every 1,000 students.

A report by the Bill and Melinda Gates Foundation (2012) found that teachers, when trying to incorporate any new technologies into educational practice, turned to a peer as the first choice for knowledge and guidance. Glover et al. (2007) touted the benefits of peer coaching for teachers for incorporating IWBs into the classroom, noting that teachers became much more confident users. They noted that the benefits were enhanced when peer coaching was combined with reflective practice and more traditional professional development opportunities. SMART Technologies (2009) also stressed the importance of peer education as part of an effective training program.

Many benefits of peer coaching have been identified, including ease of structure, job-embedded nature, and cost effectiveness. Major barriers were time requirements for coaches, scheduling classes so that peers can coach each other, and having teachers adopt protocols for peer coaching (Literacy and Numeracy Secretariat, 2007).

### **Communities of Practice**

A third method of informal learning that facilitates the use of technology in the classroom is the formation of social learning groups, often referred to as communities of practice (Marsick, 2009). The use of communities of practice has become a focus in the educational world since the work done by Jean Lave and Etienne Wenger in the 1990s. Wenger, a computer scientist, defined a community of practice as a group of individuals with similar concerns and interests who wanted to learn more by interacting with each other on a regular basis (Wenger & Snyder, 1999). Professions such as architecture, accounting, and law have long recognized the value of both networking and joining

professional associations (National Foundation for the Improvement of Education, 1996; Neville et al., 2005; Rodriguez & Knuth, 2000). Elmore (2002) applauded the use of communities of practice in education, saying that professional development should take this form since teachers could work collectively on common problems. He stated that the learning would be much more powerful when it involved many individuals who were wrestling with the same problems and the result would be improvement in the school systems rather than in just the individual. Joining a community of practice in which participants were separated by space provided opportunities for teachers to obtain fresh perspectives and expand their horizons (Hooker, 2008; Salazar, Aguirre-Muñoz, Fox, & Nuñez-Lucas, 2010).

The National Staff Development Council (2010), in its standards for staff development, stated in order for staff development to promote student learning, teachers needed to be organized into learning communities. Establishing effective communities of practice was seen as critical for fostering successful integration of instructional technology into the classroom (Center for Implementing Technology in Education, 2009; Todorova & Osburg, 2010). Prakash noted that a community of practice derived “strength from its informal, non-prescriptive nature which supports spontaneous and friendly interaction through collaborative activities undertaken” (n.d., p. 8). Communities of practice have capitalized upon the social aspect of learning, which many educators and researchers have declared beneficial (Borthwick & Risberg, 2008; Center for Implementing Technology in Education, 2009; Fox, Deanery, & Wilson, 2010; Hines, 2008; Harwell, 2003; Jamieson, 2009; Jurasaitė-Harbison, 2009; Lau, 2004; Lisewski, 2005; Merriam et al., 2007; Straub, 2009). Research by Vygotsky (1978) and others

concerning the value of cultural context learning supported this claim, highlighting the benefits of social interaction, particularly for adults (Bonk et al., 2002; Dickey, 2008; Ferriter, 2009; Klopfer, Osterweil, Groff, & Haas, 2009; Merriam et al., 2007, Serow & Callingham, 2008; State Educational Technology Directors Association, 2008a; Thompson, 2006). Businesses, such as Ford, have utilized learning communities for their professional development (Ford Partnership for Advancement Studies, 2010).

Researchers have suggested that participation in informal learning communities could create a wider base of understanding for all school personnel (Bellanca, 2009; Blankstein, 2013; Cassandra Drennon & Associates, 2005; Harwell, 2003; Liu, Carr, & Strobel, 2009; Snow-Renner & Lauer, 2005), provide emotional support, reduce the feelings of isolation experienced by many teachers as they attempt to incorporate technology into the classroom (Rodriquez & Knuth, 2000; Vega, 2013), and help build capacity (Serrat, 2008). Ala-Mutka (2010) stated that both novice users and experts could benefit from participation, all could learn at their own pace, and all could learn according to their individual learning styles. Moreover, participants could receive the latest, most up-to-date information. Finally, educators have noted that the development of communities of practice would be a solution for long-term professional development (Ala-Mutka, 2010; Bonk et al., 2002; Center for Comprehensive School Reform and Improvement, 2007; LeBaron & McDonough., 2009; Prakash, n.d.), since it is a situated work-based method that can extend beyond the school day if desired (Lisewski, 2005; Slowinski, 2000). Researchers have noted that communities of practice are generally built on existing networks (Jones, 2007; Schlager & Fusco, 2003), so they require little effort to put in place and have the added benefit of both empowering teachers and bringing an

element of excitement to professional development. Halverson (2007) documented the results of starting a community of practice in one of the worst performing schools in Chicago. Teachers met once a month for breakfast, provided by the principal, to discuss school reform and to share experiences and best practices of instruction. Although poorly attended a first, membership grew as did student achievement.

Research also suggested that communities of practice bolster teacher confidence and promote the acceptance of new practices (Bailey et al., 2011; Blanchard, Grable, & Sharp, 2009). Gulamhussein (2013) asserted that there is a strong relationship between collegiality established in the communities of practice and collective action. Moreover, the other suggested benefits from participating in communities of practice include boosting engagement and enhancing transition (Donnison, Edwards, Itter, Martin, & Yager, 2009).

More and more school systems have recognized the benefits of establishing communities of practice and the number of online communities of practice is growing (PBS & Grunwald Associates, 2011). The Vermont Agency for Education, to help facilitate the implementation of Common Core Standards, created a state-wide learning community called the Vermont Professional Learning Network (Meyer, 2014). The community provides both virtual and in-person learning opportunities for teachers throughout Vermont.

The evaluation report for the Primary Schools Whiteboard Expansion Project, sponsored by the United Kingdom Department for Education and Skills, found that the establishment of a community of practice was particularly important for teacher professional development for incorporating IWBs into the classroom (Lewin, Scrimshaw,



& Somekh, 2004). Slowinski (2000) and Thomas and Schmid (2010) urged administrators to incorporate communities of practice as part of teachers' professional development plans. This was deemed particularly important since passive learning has seldom resulted in pedagogical change; research has indicated that teachers grow capacity only through active discourse and interaction with peers (Byrne, Brown, & Challen, 2010; Hines, 2008). A small study involving two school divisions integrating IWBs into the classroom found that teachers reported receiving more benefits from informal sharing of practices than they did from formal training on hardware and software (Winzenried, Dalgarno, & Tinker, 2010). Teachers reported that they particularly appreciated conversing with teachers whose experiences and backgrounds with IWBs were different from their own, which allowed them to broaden their content knowledge as well as their professional skills (Haldane, 2010). Grover (2010), after conducting a study of primary teachers in New Zealand who were incorporating IWBs into their classroom, recommended that school divisions establish communities of practice with other school divisions for the systematic exchange of ideas and learning strategies for using the IWBs to enhance student learning. Furthermore, Web-based learning communities devoted to interactive whiteboards have been growing rapidly, including such groups as Promethean Planet and the Hitachi StarBoard Community.

Researchers have pointed out that communities of practice are a practical method of professional development because they are convenient, can change over time to meet evolving problems, and they can be organized through friends' groups, team meetings, grade level meetings, and other types of study groups (Center for Comprehensive School Reform and Improvement, 2007). In addition, supporters of the communities have noted

that participants can meet face-to-face, on the Web, or by video conferences, and the members can meet during the school day or at any other time (Harwell, 2003). Web-based communities have been praised for being accessible, inexpensive, and ongoing (Beglau et al., 2011; Global Education, 2008; Liu et al., 2009).

Naylor et al. (2008) and Essig (2011) identified communities of practice as a very effective method of providing training for using IWBs. Their study of the IWB initiative in a Vancouver elementary school found that establishing a personal learning community composed of teachers using the boards resulted in opportunities to broaden thinking, reflect upon practices, and engage in inquiry learning. Cogill (2008), in a study of changing pedagogical practices of teachers in primary grades, found that the most significant influence of effective IWB implementation was participation in a community of practice as long as the group had a passionate leader, participants were paired informally with a mentor, and the participants were inclined to learn.

While use of communities of practice has provided numerous benefits to educational organizations, several drawbacks have been identified (Ala-Mutka, 2010; Hooker, 2008). The benefits derived from their use were found to be entirely dependent upon intrinsic motivation; therefore, unmotivated teachers derived few benefits. For the community to be effective, Coughlin and Kajder (2009) stated that all members must accept responsibility for the growth of all the members. Hooker (2008) noted that communities of practice are both labor intensive and time consuming. Researchers also pointed out that communities of practice depend upon working together while many teachers thrive on competition and individualism (Donnison et al., 2009). Kennedy (2005) posited that learning in the community could range from proactive to passive,

based on the drive of the participant. Moreover, learning through communities of practice has been described as limited in scope, covering only topics of interest to participants. Research has suggested that certain conditions must exist for learning communities to be successful, including leadership, organizational practices, discipline to maintain focus, and the character of the discussions taking place (Blankstein, 2013; Byrne et al., 2010; Cogill, 2008; Center for Comprehensive School Reform and Improvement, 2007; Graham, 2007; Hooker, 2008). Booth (2012) and Gulamhussein (2013) cautioned that sustaining an effective online community of practice was also dependent upon having a strong facilitator and a sense of trust among members.

### **Collaboration Time**

A fourth method of informal professional development that helps teachers incorporate instructional technology into the classroom is providing teachers with collaboration time (Kaplan, Chan, Farbman, & Novoryta, 2014). Collaboration, or working together on a project or intellectual endeavor, has historically been seen as important for educators. However, teachers have traditionally been isolated in their classrooms, seldom engaging in discourse with other teachers (Ertesvåg, 2011; Keller, 2002; Literacy and Numeracy Secretariat, 2007; Phelps et al., 2004). Over a decade ago Jennings and Gottesman (1994) posited that the failure of much educational reform can be attributed to this lack of collaboration. Current practice has evolved and collaboration has been gaining ground and is now viewed as a critical 21<sup>st</sup> century skill (Bailey et al., 2014; Blankstein, 2013). A report by the National Center for Education Statistics found that 75 percent of teachers reported collaborating regularly with colleagues (Choy et al., 2006). However, rigorous research on the link between collaborative professional

development and student achievement has now emerged, and early results have indicated that teacher collaboration between peers has a positive impact on student outcomes (Byrne et al., 2010; Coughlin & Kajder, 2009; DeMonte, 2013; Goddard, Goddard, & Tschannen-Moran, 2007).

For example, a longitudinal study of the impact on collaborative professional development done with middle school science teachers showed a dramatic increase in student science scores when compared to the teachers who were not in the collaborative professional development initiative (Coughlin & Kajder, 2009). Another study of Utah teachers who were involved in a cognitive apprenticeship collaborative project had students who had gain scores greatly exceeding the student gain scores of teachers not in the project (Coughlin & Kajder, 2009). A study by Sturko and Gregson (2009) found that CTE teachers who engaged in professional development incorporating collaboration and team building became more capable practitioners.

A number of benefits have been associated with teachers collaborating in teams rather than independently, including higher levels of general satisfaction, more professional commitment, motivation, reflection, better attitudes, and efficacy (Byrne et al., 2010; Coughlin & Kajder, 2009; Ifanti & Fotopoulou, 2011; Sturko & Gregson, 2009). Researchers have concluded that collaboration can lead to skill augmentation, allow for development of curriculum, and foster analysis of student achievement (Ertmer, 1999; Fox, 2007; Learning First Alliance, 2000; Sturko & Gregson, 2009). Teachers involved in collaboration also demonstrated a greater knowledge of their students, including their personal backgrounds and educational histories (Coughlin & Kajder, 2009). Teacher collaboration was found to encourage teachers to become risk takers and

to be more likely to learn from mistakes (Kedzior & Fifield, 2004). Moreover, teachers reported valuing the support they received from colleagues, ranking informal discussion as particularly helpful (Curwood, 2011; McNally, Blake, & Reid, 2009). Collaboration was credited with fostering collegiality and providing opportunities for reflection (Ehman, Bonk, & Yamagata-Lynch, 2005; Fox, 2007; Keller, 2002; Phelps et al., 2004).

Researchers identified other practical advantages of collaboration as a method of professional development. Providing collaborative time had the advantage of being easy to organize and facilitate, allowed for the collaboration to take place during the school day, and was relatively inexpensive. In addition, the social setting enhanced the transfer of information from colleague to colleague and allowed teachers to jointly plan and facilitate learning experiences (Curwood, 2011; Melber & Cox-Petersen, 2005; Morgan et al., 2005; Tafel, 2008). Collaboration time facilitated action research, which Cuthell (2007) stressed was a key element for successful professional development. Harwell (2003) recommended that 25 percent of each school day be devoted to teacher collaborative planning and sharing of information.

Collaboration was also cited as a valuable method of sharing knowledge concerning instructional technology integration (Klopfer et al., 2009), since research has suggested that teachers in need of technology training were more likely to turn to their peers first (Jones, 2001). A study by Grover (2010) on the impact of professional development on incorporating IWBs into the classroom found that teachers listed collaboration as the principal form of staff training. Goktas et al. (2009) referred to this support by colleagues as an “extrinsic enabler” (p. 194). Collaboration was cited as

particularly valuable for incorporating IWBs into classroom instruction (Bahadur & Oogarah, 2013; Hallinan, 2009; Marr, 2011; Murcia & McKenzie, 2008).

Collaboration time for instructional technology integration also allowed teachers to plan jointly and facilitate learning experiences (Morgan et al., 2005), thereby encouraging them to share ideas for using IWBs in the classroom. Haldane (2010) particularly stressed the importance of teacher collaboration for maximizing the benefits of IWBs in the classroom, further noting that teachers valued the chances to work together to broaden knowledge bases and acquire new skills.

However, despite all the benefits cited for collaboration, not all school divisions made concerted efforts to foster collaboration. Hoekstra, Brekelmans, Beijs, and Korthagen (2009A) conducted a study involving the informal learning habits of 32 teachers. The teachers in the study reported participating in only a small number of collaborative activities. Hoekstra et al. suggested that this was due to school organizational structures, which Kaplan et al. (2014) note could be corrected by optimizing teacher schedules through such strategies as extended school days.

Goddard et al. (2007) held that insufficient evidence existed to link collaborative school efforts to student learning. However, some research has noted that collaboration among teachers did not always prove to be successful. Participants in collaborative projects or groups reported feelings of frustration when team meetings or planning sessions did not achieve desired results or meet the perceived goals of participants (Center for Comprehensive School Reform and Improvement, 2007). Research has also indicated that teachers frequently avoided sharing concerns or problems with colleagues for fear of imposing and many teachers preferred to be autonomous (Center for

Comprehensive School Reform and Improvement, 2007; Ertesvåg, 2011). Other research has said that collaborative efforts can easily lose focus, often due to the appearance of new problems or by the intrusion of personal conversations (Blankstein, 2013; Center for Comprehensive School Reform and Improvement, 2007). Romero (2010), in an action research project concerning the effectiveness of teacher collaboration, found that in collaborative activities such as grade-level team meetings, all teachers were not given input into the discussion topics. In addition, while collaboration among teachers can result in plans of action, there may be no resulting follow-through. Miles (2009), in an audit of conference notes for collaborative sessions of teachers in Title I classrooms, found that 28 teachers recorded implementation strategies, but only 8 teachers recorded actual implementation. Since incorporating any instructional technology device, particularly IWBs, requires focus, shared vision, clear group norms, and a concise implementation plan, any of these problems may disrupt the goals of the collaborative effort.

### **Professional Resource Library**

A fifth type of informal professional development found effective in supporting teacher practice was utilization of professional resource libraries (Expert Panel on Literacy, 2004; Jenkins & Yoshimura, 2010; National Foundation for the Improvement of Education, 1996; Oakleaf, 2010; Samaras, Beck, Freese, & Kosnik, 2005). Maintaining a professional resource library would allow teachers to be more self-directed and Hooker (2008) has suggested that this would lead to teachers becoming lifelong learners. Learning on one's own has been deemed the method most often employed by adults, but

as Merriam et al. (2007) noted, it is often overlooked and has typically been considered less important than formal learning sessions.

A nationwide survey conducted by the Institute of Education Sciences noted that 78 percent of teachers reported using independent learning either moderately or to a great extent (Gray et al., 2010) for incorporating technology into the classroom. A study of Florida agriscience teachers likewise found that 60 percent of respondents reported being self-taught to use instructional technologies (Alonge, 2005).

Bredeson (2003), who stated that professional development concerned people rather than credentials, alluded to the benefits of providing teachers with resources such as Internet sites, libraries of research concerning exemplary practices, and assessment tools. Various researchers had stated that one of the best ways to acquire skills for incorporating instructional technology into the classroom was to empower teachers to engage in continuous, life-long, self-directed learning (Phelps et al., 2004; Morgan et al., 2005). Self study has been touted as one method of transforming the learning process (Byrne et al., 2010; Samaras, Beck, Freese, & Losnik, 2005) and providing a resource library would assist with this objective.

Phelps et al. (2004) also noted that good professional development for using instructional technology should inspire enthusiasm and a positive attitude, rather than stimulating anxiety. Resource libraries would be non-threatening, would allow the learner to go at his/her own pace, and could be custom made to pursue the skills and knowledge the learner did not possess (Jenkins & Yoshimura, 2013). With this goal in mind, the Community College of Rhode Island developed a hybrid method of professional development that combined many formal methods such as workshops and courses, but it



also used posted print-based instructions, audio tutorials, and technology tips sent out through e-mail (Beith, 2006).

According to the *PBS TeacherLine National Survey of Teacher Professional Development*, during the 2005-2006 school year not all teachers rated the use of teacher resource centers very highly, with only 18 percent saying it greatly increased their knowledge, 51 percent saying that it increased their knowledge slightly, and 31 percent indicating that it neither increased nor decreased their knowledge (Hezel Associates, 2006). Responses were basically the same for positively changing their teaching practices.

According to Fox (2007), school divisions across the nation have been trying to make resources available for individual professional development. The State of Massachusetts created the Massachusetts Online Network for Education, which is an online portal containing applications and teacher resources for improving instruction (Fox, 2007). In a similar project, Nebraska created the Learning Web, a repository of learning resources available to teachers (Fox, 2007), which has been credited with transforming teachers' instructional technology usage. The Florida Department of Education called for school divisions to encourage teachers to read scholarly journals as part of their professional development plans, since journals contained the latest research concerning teaching strategies and methodologies (Florida Regional Workforce Boards, 2005). Betcher and Lee (2009) noted that Australia, through The Learning Federation, provides a large educational resources library with free access to educators. Currently a number of vendors, including makers of IWBs such as SMART Technologies (2014b) have appeared which offer subscription services for online professional resource libraries.

Vega (2013) highlighted the benefits of creating videos of teachers engaged in best practices, which could be viewed by other teachers at their leisure.

Researchers have suggested that providing teachers with time for personal study would offer teachers opportunities to gather information from journals, electronic databases, museums, videos, and a wide range of other sources (Birman, Desimone, Porter, & Garet, 2000; BECTA, 2005; Hooker, 2008; National Foundation for the Improvement of Education, 1996; Research Centre for Museums & Galleries, 2007). Individual studies would allow the professional development to be driven by the learners' own needs and preferred study methods (Jenkins & Yoshimura, 2010; Prakash, n.d.), as Sandholtz and Reilly (2004) noted it was the preferred method for teachers to learn to integrate instructional technology. Having the school division assist the process by maintaining the professional library would encourage teachers to participate in individual professional development. Henrico Public Schools, after implementing a one-to-one laptop initiative for high school students, found that developing an on-line reference library containing exemplary lesson plans aided teachers in their individual quests for ways to use laptops (Jones, 2007). Taking this a step further, a Hammond, Indiana, school facilitated individual study by having teachers share their professional readings at regularly scheduled staff meetings (Kinder, 2000). This provided opportunities for other teachers to benefit from each teacher's individual study and provided a means for the school division to track the professional development.

Research by Bonk and Yamagata-Lynch (2005) suggested that teachers needed to see specific integration ideas in order to incorporate IWBs into the classroom successfully. Providing a library of lesson plans showing how to incorporate IWBs into

classroom instruction and giving activities that engaged students in higher-order thinking would provide these examples. More and more resources, such as books and journal articles, have been published and could be made available to teachers at a relatively low cost.

While researchers have identified the benefits of providing teachers professional resource libraries for professional development for incorporating IWBs and other instructional technologies into the classroom, several problems were identified. As Phelps et al. (2004) noted, many teachers engaged in this type of self-directed approach for professional development often expected a “quick fix” (p. 7). The effectiveness of the library would be dependent upon the motivation of the individual teacher, a method would have to be found to validate the learning, and school divisions would have to recognize independent study as a viable option. School divisions would have to find time and personnel to maintain and update the resource library or provide funding for a subscription professional resource library.

### **Observation**

Observation has been identified as another method of providing teachers with informal professional development (Davidson, 2009). Peer observation, as outlined by Byrne et al. (2010), called for teachers to observe other teachers with the intent of improving the quality of teaching, thereby increasing student achievement. Merriam et al. (2007) noted that the basic tenet of social learning theory states that people learn in a social context by observing others. Peer observation allows for the assessing of teaching practices and results in structured criticism; moreover, it is useful to both the observer and the observed (Hooker, 2008; Kaplan et al., 2014; Literacy and Numeracy Secretariat,

2007; Sparks & Loucks-Horsley, 1989). The cost would be minimal and the observations would be job-embedded, taking place during the school day.

Observation has been identified as a fundamental method of professional development for incorporating instructional technology, including IWBs, into the classroom (Betcher & Lee, 2009; Cowan, 2013; Grover, 2010; Oigara & Wallace, 2012; White, Ringstaff, & Kelley, 2002). Foltos (n.d.) stated that teachers require opportunities to see new technology usage put in practice before they can use them effectively. Other researchers concurred, finding that one of the barriers for incorporating any type of instructional technology was the lack of modeling (Dickey, 2008; Goktas et al., 2009; Matzen & Edmunds, 2007; Oigara & Wallace, 2012); thus, observation of exemplary practitioners of IWBs would better prepare teachers to develop lessons of their own. Modeling has been regarded as particularly effective method of introducing new concepts or practices (Gulamhussein, 2013).

In a study to determine the impact of professional development on teachers using IWBs, Grover (2010) found that teachers viewed observation as an extremely helpful training method. Observation included viewing both external experts as well as colleagues use the boards. Teachers engaged in observation obtained assistance with diverse issues such as classroom management, giving homework, and delivering content.

Observation has also involved principals, lead teachers, or peers observing teachers using IWBs and giving feedback. This has been recommended as an effective method of improving teacher practice (Trombley, 2012). The Lubbock, Texas, school division implemented a whiteboard initiative. Teachers were encouraged to create lessons using their IWBs, which were then presented to a group of administrators and teachers

for review. The best lessons were shared with others as models. This resulted in teachers expanding the ways they used the boards (SMART Technologies, 2012).

In addition to being one of the simplest methods of providing training, it also has the advantage of being the least expensive (Out-of-School Time Resource Center, 2007). LeBaron and McDonough (2009) pointed to research suggesting that in addition to being perhaps the simplest, it may be the most important. Teachers who observed strong role models using technology effectively were more likely to imitate. Murcia and McKenzie (2008) reported that observing teachers using IWBs effectively led to a “ripple effect” (p. 11), thereby encouraging others to incorporate IWBs in their classrooms. Betcher and Lee (2009) added that observation of IWBs being used in other classrooms was an excellent way of inspiring acceptance if not enthusiasm.

Bryne et al. (2010) highlighted several concerns about observation as a method of professional development. They noted that observations were only effective if done frequently and observations should never be the only professional development method deployed. They also noted that peer observations have often been dictated by administration in such a manner that resulted in compliance but did not result in true learning.

### **Online Educational Portals**

One final informal professional development method identified as successful for educators was the use of online education portals. The advent of the Internet has added an entirely new dimension to professional development (Greaves et al., 2010; Wihak & Hall, 2011), making online educational portals a valuable resource for teachers. Online educational portals, such as wikis, blogs, and discussion boards, have provided

opportunities for learners, including teachers, to locate information and communicate with others who have like interests (Forte, Humphreys, & Park, 2012; PBS & Grunwald Associates LLC, 2011; Woodall, 2012). With the increased number of these educational portals available, teachers have been availing themselves of lesson plans, activities, and reflections on teaching practices posted by skillful educators (Ferriter, 2009; Foley & Chang, 2006; Jones, 2001; Light & Polin, 2010; PBS & Grunwald Associates LLC, 2011; Yang, 2009). Coughlin and Kajder (2009) noted that the online environment supported dialogue, inquiry, and data-sharing. Various social media such as blogs also enhance human connections (Beglau et al., 2011; Greaves et al., 2010). A report by the Bill and Melinda Gates Foundation (2012) stated that most teachers utilized online resources for gathering materials and ideas for their practice and recommended providing continuing education credits for their efforts.

These portals have often been utilized by communities of practice rather than or in place of having face-to-face meetings; however, members of a community of practice are all expected to participate in not only information sharing and problem solving, but also in establishing a distinct identity (Yang, 2009). Teachers can benefit from these online forums with minimum investments in time and without becoming full-fledged members of a community (Foley & Chang, 2006).

Another benefit cited was ease of use (Hines, 2008; Roumen, 2007). With online discussion boards, teachers were able to investigate their current interests, locate information directly related to their field of practice, and create ownership (Salazar et al., 2010). Roumen (2007) held that the traditional school setting was no longer the most attractive option for teachers to obtain knowledge or information. He suggested that the

use of these powerful Web 2.0 tools would revolutionize staff development. Researchers suggested that the traditional after-school workshop, often dreaded by teachers (Hines, 2008; Hunter, 2001), could be traded for online learning opportunities which were good for any-time and just-in-time learning, and which allowed for the lifelong learning researchers have said is necessary for teacher professional development (Center for Technology in Learning, 2009; Little, 1993; November, 2010; Routmen, 2007; Salazar et al., 2010; Schrum, 1999). Glassett and Schrum (2009) noted that technology professional development often tended to be “just in case,” (p. 139) with all teachers learning particular technologies and software regardless of whether they could use it in the classroom. These online portals allowed teachers to be in control of their learning; they also provided teachers with access to rich, hard-to-obtain data streams as well as provided them with a pleasant social environment for education that encouraged life-long learning (Beglau et al., 2011; Herrington, Herrington, Kervin, & Ferry, 2006; Roumen, 2007).

For example, a study by Yang (2009) involving 43 student teachers investigated the value of using blogs to enhance their learning experience. The results revealed that all participants were actively engaged in discussions of educational theory, posted comments demonstrating critical thinking was taking place, and provided feedback about the benefits of electronic communication. Yang posited collaborative reflection was a key ingredient in fostering professional growth and online sites motivated readers, provided links to many additional resources, and encouraged interaction between practitioners. A survey by PBS and Grunwold Associates LLC (2011) found that 38 percent of teachers valued the ability to interact with authorities in the field online and 15 percent appreciated the ability to participate in social media communities.

## **New Trends**

While traditional methods of providing professional development for teachers still have a place in preparing teachers for the classroom, these informal methods have advantages as well. New trends in professional development appeal to learning styles as well as life styles of participants. Research has suggested that traditional formal training alone will not ensure that teachers make the most advantageous use of instructional technology (Coughlin & Kajder, 2009; Greaves et al., 2010; Haldane, 2010; Swan et al., 2002), nor will teaching only isolated skills (Center for Digital Education, 2011; Ertmer & Leman, 2003; Haldane, 2010; Jang, 2010; LaBaron & McDough, 2009; Mishra & Koehler, 2006; Serow & Callingham, 2008). Therefore, a shift toward more informal professional development for incorporating technology into the classroom has already begun (Anagnou & Fragoulis, 2014; LaBaron & McDough, 2009; Gulamhussein, 2013; Literacy and Numeracy Secretariat, 2007; Nagel, 2008; Plair, 2008; Shapley et al., 2002; State Educational Technology Directors Association, 2008a; Walker, 2013), with more and more school divisions deviating from the one-shot workshop and going to more sustainable and individual formats. The State Educational Technology Directors Association (2008a) and the Pennsylvania State Education Association (2008) have recommended teachers be provided with resources for individual study, they be encouraged to participate in learning communities, and teachers be continually exposed to modeling and best practices for incorporating technology into the classroom. When deciding to equip classrooms with interactive whiteboards, Wayne-Westland Community Schools in Michigan implemented an eight-chapter, self-guided course that teachers completed independently (Minor, Losike-Sedimo, Reglin, & Royster, 2013). By the end



of the course, teachers' proficiency scores had improved as measured by a pre- and post-test. Moreover, students in the classes of these teachers showed larger gains in mathematics scores, also measured by pre- and post-tests, than students in other classes.

A report by SETDA (2010) revealed many states had already incorporated informal learning principles in the instructional technology professional development. Illinois, in Project IM-PACT, had teachers become part of a global community of practice. The ultimate goal of the project was to provide professional development for teachers that would translate into increased student achievement. An evaluation of Project IM-PACT found that students improved not only in technology literacy, but also in ISAT reading scores and math scores (State Educational Technology Directors Association, 2010). Washington adapted the Enhanced Peer Coaching for teachers to incorporate technology into the classroom. Peer coaches assisted other teachers find ways to incorporate technology into their classrooms in ways that would support instruction and lead to increased student achievement. Teachers involved with the program reported increased student motivation and engagement, improved teacher and student technology skills, and enhancement of content learning (State Educational Technology Directors Association, 2010). Montana, in the Bridging the Gap initiative, created a network to encourage teacher/mentor partnerships. The program helped provide professional development for teachers, especially in isolated, rural areas. Teachers were able to share not only resources but also expenses (State Educational Technology Directors Association, 2010).

The Florida Department of Education (FDOE) implemented a new model for providing professional development for Florida teachers. The model called for

continuous, just-in-time, learner-driven, collaborative learning, as opposed to sporadic, workshop-based trainings led by outside agents and which called for teachers to implement in isolation (Florida Regional Workforce Boards, 2005). In addition, the FDOE called for more use of informal methods of professional development, including peer coaching, mentoring, and individual scholarly research and study. To determine the effectiveness of professional development and technology integration, Florida implemented a protocol system for gathering data. Since its implementation, Florida has seen improvement in the quality and amount of teacher professional development, but also found a positive relationship between professional development and student achievement (Florida House of Representatives Schools and Learning Council, 2008).

One Georgia middle school set aside one hour on two Thursday's a month for teachers to collaborate on using instructional technology in the classroom (Erenben, 2007). Although voluntary, attendance was 80 to 85 percent. During the sessions, teachers learned new skills, reflected on teaching practices, and discussed proposed strategies. Teachers were awarded one point for every 10 hours spent in these "professional learning sessions" (p. 15) and another for implementing changes discussed in the sessions; teachers earned another point if they showed the sessions positively impacted student learning. In addition to collaboration, teachers engaged in peer coaching and peer observations. The division noted many positive results were achieved, including eliminating teacher isolation, developing shared resources, more analysis of student data, and higher levels of student engagement.

A growing movement has called for teachers to develop personal professional growth plans that allow them to identify personal areas needing assistance, that relate to

their content need, and that impact both student learning and teacher practice (Berry, Daughtrey, Darling-Hammond, & Cook, 2012; Eib & Cox, 2003; Governor's Commission on Training America's Teachers, 2006; Keller, 2002; Louisiana Department of Education, 2013). Byrne et al. (2010) touted the benefits of teachers engaging in "peer development" (p. 216), whereby teachers plan their own development through various means, including observation and mentoring, but could also work with others on specific problems or areas of desired growth. Dickey (2008) touted "cognitive apprenticeship practices" (p. 507) whereby teachers received "modeling, scaffolding and coaching" (p. 507) as well as time to explore, collaborate, and reflect on their practice. These apprenticeships could be conducted in face-to-face training or delivered in an online environment. Other research has highlighted the benefits of using the online environment to promote not pedagogy or andragogy, but "heutagogy," defined as "the principle of teaching and learning created on a foundation of authentic self-determination" (LeBaron & McDonough, 2009, p. 21). This method called for learners to establish their own educational track, often using electronic tools, without relying on credentialing organizations.

### **Criticism of Informal Learning**

Informal staff training has been criticized by some researchers and has not been valued as much as formal professional development (Ala-Mutka, 2010). One particular drawback was that informal learning consumed much of staff members' time (Harrison, 2006), including the time of the learner as well as the mentor, coach, or colleague(s). Moreover, critics suggested that information learned informally may be inaccurate,

inconsistent, or outdated (Harrison, 2006). However, several of these criticisms can be directed at formal learning opportunities as well.

Due to the complex nature of informal learning and the difficulty measuring it, school divisions have retained the highly formalized training patterns consisting of workshops and conferences (Choy et al., 2006; Colley et al., 2002; Ferriter, 2009; Harrelson, 2002; Liu & Batt, 2007; Lohman, 2000; Mazza, 2007; Shareski, 2004) even though numerous studies have suggested informal learning may sometimes be more effective (Coffield, 2002; Gooler et al., 2000; Korte, 2006; Li, Brake, Champion, Fuller, Gabel, & Hatcher-Busch, 2009). A report published by the National Center for Educational Statistics (Choy et al., 2006) revealed that less than 50 percent of teachers had engaged in other forms of professional development, with 46 percent participating in collaborative research, 42 percent in peer mentoring, coaching, or observation, and 25 percent joining networks such as communities of practice.

It has been suggested that schools may be ignoring informal learning because the benefits are hard to identify and to validate (Halliday-Wynes & Beddie, 2009; Liu & Batt, 2007). Schools have often lacked the funds and the time to conduct return-on-investment (ROI) studies for their formal professional development (Boser, 2013; Chatterji & Jones, 2012; Council of Economic Advisers, 2011; Gaytan & McEwen, 2010; McKenzie, 2001a); therefore, it was not surprising that ROI studies on informal professional development were even rarer. With a lack of concrete evidence that informal learning approaches to teacher professional development yield higher test scores, schools have been hesitant to facilitate informal training programs.

In addition, school systems have found it easier to schedule and track formal rather than informal learning (Chivers, 2006; Lohman, 2000). Divisions have merely had to select a day each week or each month, mandate that teachers attend, and find an instructor/facilitator to conduct the training sessions; training was then verified by sign-in sheets and validated with satisfaction surveys (Lowden, 2005; Goodall et al., 2005; Souhila & Khadidja, 2013; Steensma & Groeneveld, 2009), often referred to as feel-good statistics (Noyce, 2006).

### **Informal Professional Development and IWBs**

Research concerning the use of informal training for incorporating IWBs in the classroom revealed the same benefits as informal training for other instructional technologies and, indeed, for professional development as a whole. These benefits included flexibility of scheduling, reduction of time barrier for teachers, formats more in line with adult education theory, the ease of providing continuous learning, and a reduction in training costs. In addition, studies have shown that informal professional development was in many instances more effective for teachers trying to integrate IWBs into the classroom (Emron & Dhindsa, 2010; Hennessy & London, 2013; Lai, 2010; Winzenried et al., 2010). Research indicated that teachers trying to integrate IWBs into the classroom typically chose informal professional development as a first resort and often felt more comfortable with this type of learning. For example, Winzenried et al. (2010) noted that effective professional development for incorporating IWBs into the classroom was more apt to be in the form of informal sharing of practices.

Studies suggested that informal training more effectively allowed for individualized instruction and the training could be tailored specifically to the needs of

the individual learner (Banyard & Underwood, 2008; Betcher & Lee, 2009; Brand, 1997; Brinkerhoff, 2006; Essig, 2011; Koenraad, 2008; Phelps et al., 2004). Teachers were able to select the specific features of the IWBs which they wanted assistance for using, find their own preferred learning style, and relate learning to their specific content area, as opposed to learning every feature of the boards. Informal training could also take into account their interests and prior experiences (Brinkerhoff, 2006; Bull et al., 2008; Koenraad, 2008).

Beeland (2004), in a study of middle school teachers using IWBs, reported teachers experienced high levels of anxiety initially when incorporating interactive whiteboards into classroom instruction, which could be alleviated by informal training such as mentoring or peer observation. Since informal training has no specific start or stop date, professional development can be ongoing, giving IWB users access to long-term support. This served to reduce the anxiety level that new instructional technologies inspire in teachers (Brinkerhoff, 2006).

Haystead and Marzano (2009), in their preliminary report on the effectiveness of ActivBoards in the classroom, found a significant improvement in student achievement in classrooms where teachers used the boards under certain conditions: a) the teacher possessed 10 or more years of teaching experience, b) the teacher had used the interactive whiteboard for two or more years, c) the teacher had used the IWB at least 75 percent of the time spent in the classroom, and d) the teacher had high self-efficacy (Haystead & Marzano, 2009). While this study did not directly address professional development, a direct relationship between self-efficacy and the effective use of technology in the classroom was discovered. Other studies have shown that a direct correlation existed

between a teacher's confidence level and the amount and type of professional development provided (Glover et al., 2007). The study conducted by the Centre for Learning Innovation, which revealed improvement in student learning outcomes without consideration for teacher experience, did suggest that teacher lesson plans became more creative and effective as confidence levels rose (White, 2007). Teachers in this study emphatically stressed "the need for comprehensive training, ongoing support, and a reliable 'help desk' service for difficulties" (White, 2007, p. 17), but they also noted that the support they received from each other was also a factor in improving student performance. Furthermore, researchers have recommended that additional quantitative studies be completed on the effects of professional development for incorporating instructional technologies such as IWBs on student achievement (Schuck & Kearney, 2007; Smith et al., 2005).

Cogill (2003) stressed the importance of adequate professional development for incorporating IWBs into the classroom, but she suggested that training which occurred in small steps spread out over the year was more effective. Tafel (2008) noted that such scaffolding would reduce teacher anxiety and facilitate technology use in the classroom. Formal training alone, with specific beginning and ending dates, would not be sufficient for a long duration since it tends to cover large chunks of learning over a shorter time period. Miller, Glover, and Averis (2008) and other researchers noted that lack of continuing training has led to teachers using the IWBs as mere presentation devices or in other superficial ways, since the lack of professional development left them unaware of the many features of the boards (Bahadur & Oogarah, 2013; Bakadam & Asiri, 2012; World Ort, 2010).

The need for follow-up training as well as initial training has been cited as a requirement for successful integration (Alach, 2011; Koenraad, 2008; Zevenbergen & Lerman, 2007). This could easily be facilitated by the ongoing nature of informal professional development. Time for training, often cited as a barrier for successful IWB integration, would cease to be such a problem because training could take place during the school day or at a time convenient to the learners. This would allow teachers needing assistance using IWBs to utilize planning periods, time before or after school, and other free time.

Finally, informal learning has been found to be more effective than formal in some instances. Jones and Vincent (2006) and Celik (2012) noted that the formal training provided for incorporating IWBs into the classroom, which was often provided by vendors, did not address key pedagogical issues such as how to involve students in hands-on activities, ways to boost student participation, methods for using the boards to encourage independent thinking, or even ways to apply specific features of the boards to individual subjects. These formal trainings emphasizing only the mechanics of the IWBs became an issue when teachers tried to use the boards in their content areas. All of these barriers could be addressed by various forms of informal learning, such as engaging in peer observation, joining a community of practice, or working with a mentor or coach (Burns, 2008; Cheetham & Chivers, 2001). Moreover, teachers could engage in informal learning at a time of need, rather than waiting for a formalized training session to be arranged. This flexibility was identified as very important for encouraging daily use of IWBs in the classroom because studies have shown that when support was not available for technology, it was not used (McKenzie, 2001a). Informal learning has the added



benefit of providing just-in-time learning so critical for integrating IWBs into the classroom.

Although informal learning was found to be advantageous for teachers (Hoekstra, Korthagen, Brekelmans, Beijaard, & Imants, 2009; McKenzie, 2001a; Parise & Spillane, 2010; Scrimshaw, 2004), several major drawbacks to using informal learning have been identified. One of the greatest drawbacks of informal learning was the fact that participation in informal learning was not valued as much as formal learning situations (Ala-Mutka, 2010). In spite of all the research showing that informal training provides equal or better results, even teachers themselves reported feeling that formal training resulted in higher learning (Levenberg & Caspi, 2010).

### **Professional Development Combining Formal and Informal Learning Opportunities**

Since formal and informal learning opportunities each have advantages, researchers have suggested the best professional development would combine the benefits of both (Celik, 2012; Fox et al., 2010; Greaves et al., 2010; Hooker, 2008; Learning First Alliance, 2000; National Foundation for the Improvement of Education, 1996; Woodall, 2012), and new trends have already headed in this direction. After a study to determine the underlying professional development elements that allowed some teachers to sustain instructional technology while others did not, Owston (2007) concluded that training must be permanent, consistent with tenants of adult education, job-embedded, relevant to teacher needs, and collaborative. Martin, Khaemba, and Chris (2011) found that teachers felt they learned to use instructional technology through a variety of methods, including trial and error, college/university courses, and support from others. Foltos (n.d.) pointed to growing research that calls for a fresh professional

development model that incorporates multiple methods of informal learning in addition to the standard formal training. Bennett and Cole (2005) held that a wide variety of learning opportunities, both structured and unstructured, should be offered to teachers since every teacher has his/her individual knowledge pathway. Holland (2005) also touted the benefits of collaboration and informal learning practices, stating that collective involvement by teachers in the same grade, department, or school, would generally result in more active learning; this included observations, planning, critiquing student work, and making presentations.

The use of both formal and informal methods of training was deemed particularly apt for incorporating IWBs into the classroom. A survey of beginning teachers from 18 workplaces revealed that both formal and informal professional development opportunities were important (Fox, Deaney, & Wilson, 2010) because teachers learned the basics about the boards in formal trainings, and then reinforced their skills and knowledge by participating in informal professional development activities. Madden, Prupis, Sangiovanni, and Stanek (2009), in a small action research project conducted in a school in New Jersey, arrived at the same conclusion. SMART Technologies (2009) called for a combination of formal and informal professional development. The company noted, “To be truly successful with interactive whiteboards, teachers require technical training and support, peer mentoring, educational resources and professional development opportunities—in other words, they benefit most from a solution-based approach to interactive whiteboard integration” (p. 7).

Hines (2008) noted that during formal training sessions, teachers were introduced to new tools but generally failed to incorporate them into effective practice unless they

had time to reflect, discuss, or identify how to use the tool in the classroom. Thus teachers could be introduced to IWBs in formal learning settings, and they could then collaborate, reflect, engage in self-study, and observe other uses the boards effectively (Betcher & Lee, 2009; Hennessy & London, 2013; Madden et al., 2009).

Researchers have said effective teacher professional development should involve multiple venues, including study groups, research projects, mentoring, coaching, and collaboration (Bill & Melinda Gates Foundation, 2012; Carlson & Gardio, 2002; Center for Technology in Learning, 2009; Ertmer, 1999; North Central Regional Educational Laboratory, 2004; Opfer & Pedder, 2010; Porter, Garet, Desimone, Yoon, & Birman, 2000; Prakash, n.d.) and not be restricted to the traditional “drive-by” (NEA Foundation for the Improvement of Education, 2000, p. 4), “make and take” (Hooker, 2008, p. 4), “one-size-fits-all” (Mizell, 2010, p. 20; Moeller & Reitzes, 2011, p. 9) workshop or in-service program. More variety and flexibility would ensure that individual teacher needs as well as individual learning styles would be addressed (Brand, 1997; Hooker, 2008; Jurasaitė-Harbison, 2009; Smith & Kritsonis, 2006). Some states have been moving in this direction. The *Missouri Professional Development Guidelines for Student Success* (Missouri School Boards Association, 2009) called for teachers to develop individual professional development plans which included opportunities for teachers to record both formal and informal trainings, including workshop certificates, conferences, teaching videotapes with review forms, and books read with reflective journals.

Teacher preparatory programs have been redesigning their curricula to include informal learning opportunities. In previous programs, preparatory colleges and universities generally provided some formal training in instructional technology for

teachers who planned to enter the classroom, but sometimes this training consisted of a single class (National Education Association, 2008). However, studies have shown that one class is totally insufficient and would be best paired with other types of informal learning such as modeling (Ertmer, 1999; Franklin & Beach, 2002; Teclehaimanot & Lamb, 2005). A report of the results of Preparing Tomorrow's Teachers to Use Technology grant revealed that preservice teachers who observed experienced teachers using instructional technology in a way that enhanced student performance were strongly influenced to follow similar practices themselves. This observation also increased their own comfort level with introducing instructional technology into the classroom, with preservice teachers reporting that they had learned much about discipline and classroom management when using instructional technology (Franklin & Beach, 2002). What was also significant, however, was that the preservice teachers discovered many of them had the same worries and concerns about using instructional technology in the classrooms that veteran teachers did.

The Open University began a program entitled "Teaching and Learning in an Information Technology Environment," which combined the best of formal and informal training for incorporating technology into the classroom. The program, using a peer-supported format, allowed teachers to meet with their mentors online as well as face-to-face in order to develop technology skills, establish learning goals, collaborate, and provide support for each other (Jenson et al., 2002). In addition to the mentoring, coaching, and self-study, teachers participated in workshops, demonstrations, and hands-on activities. Teachers in the program reported benefiting from both the formal and the informal aspects of the program. They appreciated learning the skills and basic

information in the formal setting, but they valued the chance to collaborate and learn from others in the informal learning opportunities. One teacher noted that the follow-up which is often absent in formal trainings was extremely helpful.

Three Indiana school divisions piloted the Professional Development Portfolio (PDP) method for providing professional development for incorporating instructional technology into the classroom that combined formal and informal training (Eib & Cox, 2003). To initiate the program, a formal two-week training session was held for team leaders who then returned to the home site to initiate the program. Teachers researched new ideas and practices for incorporating technology into the classroom. Each teacher was required to maintain a portfolio which documented both teacher and student learning. The PDP method was job-embedded, relied on reflective dialogue, encouraged collaboration among peers, was ongoing, and analyzed student data. A review of the program revealed improved student achievement as well as improved computer skills for both students and teachers.

Davison and Pratt (2003) noted that professional development was needed to ensure that teachers could use all the many features of the IWBs, which has been supported by later research (Alach, 2011; Bannister, 2010; Orbaugh, 2013; World Ort, 2010). Since IWBs have so many features, formal professional development would take an incredible amount of time, but not every teacher would use every feature. For example, not every teacher would need to use the electronic compass, protractor, or ruler. The report issued by the Board of Teacher Registration Queensland suggested that continuing professional learning should include formal learning opportunities such as conferences and seminars, plus informal learning opportunities such as mentoring,

participating in action learning projects, belonging to a learning community, and conducting independent studies (Bennett & Cole, 2004). Thus the formal training could cover features, pedagogy, and learning strategies that would be of benefit to all IWB users, and informal training could hone skills and teach specialized features. Showers and Joyce (1996) found that initial formal training, followed by peer coaching, produced greater learning transfer than formal training by itself. Numerous researchers have concurred with this strategy for incorporating technology into the classroom (Harwell, 2003; Hooker, 2008; Mizell, 2010; Vescio, Ross, & Adams, 2006).

Ashton, Sung, and Raddon (2005) proposed that both the transfer of knowledge and the acquisition of skills were facilitated by a combination of formal and informal training. For example, Burns (2008), in a study of trade and industrial teachers, noted that student teachers reported learning competencies mostly through formal learning, but felt they used the competencies learned informally most often. Colley, Hodkinson, and Malcolm (2002) posited that formal and informal learning should not be in competition with each other, but it should be used in conjunction, and that institutions should do more to facilitate informal learning (Marsick & Watkins, 2001). Research on incorporating interactive whiteboards into the classroom has suggested that teachers be provided with high quality professional development using training methods that combine features of both formal and informal learning as well (Bannister, 2010; Desantis, 2012; Hennessy & London, 2013; Lewin et al., 2009).

Adopting formal and informal professional development opportunities would also address another problem—teacher isolation. As Elmore (2002) noted, teachers are “solo practitioners” (p. 4), who work in isolation in a setting that keeps them separate from

other adults practicing in nearby rooms. Formal training, which provides necessary skills and some degree of interaction between participants, while beneficial, has not always brought about solidarity or a feeling of esprit de corps. Informal learning opportunities such as mentoring, coaching, and participating in a community of practice would allow practitioners to learn from each other in a way that encourages camaraderie and cohesion. Moreover, Elmore insisted that professional development should take place as close to the place where teachers teach as possible. He recommended that training engage small groups of teachers revolving around observation of classroom experiences, which would encourage team building.

Jenson et al. (2002) noted training for incorporating technology into the classroom should include the elements of play and discovery, which were often missing from formal professional development opportunities. They listed other important components of successful training, which included the following: flexibility that allows learners of all skill levels to progress; ongoing support, both online and face-to-face, for incorporating technology into the classroom; ability to learn onsite where teachers will be instructing their students; and an emphasis on activity-based instruction. These cannot be implemented by either formal or informal learning alone. Many researchers have stressed the importance of a holistic approach to professional development, which does not isolate the development of technology skills (Bailey et al., 2011; Brand, 1997; Bryan, 2008; Chai, Koh, & Tsai, 2010; Lawless & Peligrino, 2007; Prakash, n.d.). Jones (2007), the high school education director for Henrico County Public Schools, concurred, noting that merely teaching skills does not result in improved student performance. He called for training which was imbedded in instruction. A study of IWB integration in a Vancouver

elementary school reported great success when combining formal training with communities of practice, wikis, three-way collaboration combining the school and two universities, and peer observation (Naylor et al., 2008).

Research has suggested that professional development must be varied, since teachers change in diverse ways and require differing amounts and types of training (Blazer, 2008; Borko, 2004; Gulamhussein, 2013; Hooker, 2008; Jurasaitė-Harbison, 2009; Rock, 2002; Smith et al., 2003). Providing teachers with both formal and informal professional development opportunities would result in teachers having more control over their professional growth, resulting in more effective staff development (Ala-Mutka, 2010; Colbert, Brown, Choi, & Thomas, 2008; National Foundation for the Improvement of Education, 1996).

#### **Using Formal and Informal Professional Development to Overcome Barriers**

Research has identified numerous barriers to participating in professional development. These barriers included the following:

1. Lack of time. This is perhaps the most often cited barrier for engaging in professional development (Bill & Melinda Gates Foundation, 2014; Bingimlas, 2009; Drage, 2010; Feist, 2003; Johnson, 2014; Nugent, 2007). Research has revealed that while what teachers are expected to know and do has been increasing, school schedules are often inflexible and that time has not necessarily been provided during the school day for professional development (Lucilio, 2013). Research has also shown that often teachers do not want to participate in professional development that extends beyond the regular school hours (Kedzior & Fifield, 2004) and those who do engage in after-school professional development often suffer from burnout and stress (Lucilio, 2013).



2. Conflict with work schedule. Teachers spend much of their day delivering instruction in the classroom, which leave little time during the day for engaging in professional development (Davidson, 2009). Often college courses and workshops are offered during the day when teachers are unable to attend or training sessions just do not fit into busy teacher schedules (Feist, 2003).
3. Geographic location. Teachers also cited geographic barriers as a deterrent for participation in many professional development opportunities. Teachers in geographically isolated areas have often been unable to travel to off-site college courses, workshops, and seminars (CAELA Network, 2010).
4. Lack of personal relevance. Teachers have continually requested professional development that reflects their own goals and needs (Bill & Melinda Gates Foundation, 2014; Bingimlas, 2009; Drage, 2010). Research findings reported by the Organisation in Economic Co-Operation and Development identified “no suitable professional development” available as a major deterrent to participation in training (Davidson, 2010, p. 72).
5. Lack of attention to individual learning styles. Failure of available professional development opportunities to appeal to individual learning styles or follow principles of adult education has been cited as a major deterrent to participation in professional development (Bill & Melinda Gates Foundation, 2014; Feist, 2003; Overbay, Patterson, & Grable, 2009; Plair, 2008; Smith et al., 2003). As Mueller and Wood (2012) noted, professional development must address specific personal characteristics of teachers before they will be able to integrate technology successfully into the

classroom. One-size-fits-all training seldom meets the specific needs of individual teachers and discourages teachers from participating (Abadiano & Turner, 2004).

6. Cost. Cost has always been a barrier for engaging in professional development (Betcher & Lee, 2009; Bill & Linda Gates Foundation, 2014; Brent & Johnson, 2011; Drage, 2010; Nagel, 2013), both on the school level and on the teacher level. Often teachers have had to pay for their own professional development, and college courses, workshops, and seminars can be expensive (Johnson, 2014; Mizell, 2010).

However, to overcome these barriers, institutional change has been deemed necessary (Kedzior & Fifield, 2004), which requires that school divisions be flexible, innovative, and encouraging (Abadiano & Turner, 2004), and offer division-supported self-directed programs (Moore, 2003). Implementing a model of professional development that provides a combination of formal and informal training has been recommended as a way for school divisions to eliminate or minimize the barriers to participation in professional development (Bannister, 2010; Beglau et al., 2011; Curwood, 2011; DeSantis, 2012). Research has indicated that administrative support for professional development increases the participation and effectiveness of training (CAELA Network, 2010; Davidson, 2009). Providing a multi-pronged approach to professional development has been deemed particularly important for training teachers to incorporate complex instructional technologies such as IWBs into the classroom (Burns, 2010; Borthwick & Pierson, 2008; Tweed, 2013).

### **Pioneering Research on IWB Professional Development**

While researchers have debated the benefits of IWBs and their effects on student achievement, most agreed that professional development for incorporating the boards into

the classroom has been lacking. As Bannister (2010) pointed out, school divisions often plan professional development after purchasing the IWBs rather than having a plan in place before. Moreover, the plan should be a long-range plan for sustained, high quality training that meets the needs of teachers (Bannister, 2010, Erikson & Grant, 2007; Wong, Goh, & Osman, 2013). Studies have indicated that true implementation of any technology, including IWBs, follows a progression over time (Overbaugh & Lu, 2008). Teachers routinely begin using the IWBs as productivity tools (for displaying handouts or showing visuals), then move on to creating materials for classroom instruction (such as flipcharts or slideshows), and progress to using the boards to enhance learning and bring about school-wide reform (Bowe & Pierson, 2008; Overbaugh & Lu, 2008). Much of past training stopped at the introductory level (Bannister, 2010; Manny-Ikan et al., 2011) and provided little follow-up training (Bowe & Pierson, 2008).

Pioneering work has begun to identify elements that should be included in IWB training for teachers before true classroom transformation can take place. According to current research, any effective model of professional development for IWBs should address the following elements:

1. A long-range plan should be put into place that provides adequate funding and time for sustained, on-going, high-quality professional development (Bannister, 2010; Brent & Johnson, 2011; Bryan, 2008; Cowan, 2013; Greaves et al., 2010; Hennessy & London, 2013; Mizell, 2010; Ohio Department of Education, 2008).
2. Training should conform to theories of adult education by allowing a certain amount of autonomy, providing just-in-time learning, and taking advantage of social learning opportunities (Beach, 2012; Borthwick & Pierson, 2008; Hague & Logan, 2009; Lai,

- 2010; Madden et al., 2009; Ohio Department of Education, 2008; Rudnesky, 2006; Shaha & Ellsworth, 2013; Sweeney, 2006).
3. Professional development should include foundational skills training so that teachers are fluent and feel both comfortable and confident in their use of the boards, but professional development should also address pedagogy (Campbell & Kent, 2010; Hayes, 2010; Higgins, 2010; Hooker, 2008; Lai, 2010; Minor, Losike-Sedimo, Reglin, & Royster, 2013, Özdemir & Kiliç, 2007; Plair, 2008; Schuck & Kearney, 2007; Trombley, 2012; Wong, Goh, & Osman, 2013). As Boran (2010) pointed out, too much emphasis has been placed on teaching the technology and not enough on teaching effective practices.
  4. Professional development for any technology, especially IWBs, should respond to teacher needs and be individualized (Batchelor, 2011; Blazer, 2008; Bryan, 2008; Essig, 2011; Limperis, 2011; Ohio Department of Education, 2008; Oigara & Wallace, 2012). Training for IWBs has often been intent upon teaching all the various features of the boards to all participants, whether they will use the features or not (Bowe & Pierson, 2008). Research has suggested that an initial overview be given to show participants the varied features of the board, but additional training that allows teachers to explore those features that they will use in their content areas and grow in practice must follow (Betcher & Lee, 2009; Kopcha, 2012; Trombley, 2012).
  5. Training should be embedded in the workplace as much as possible, which acknowledges the demands made on time and keeps the training close to practice (Bannister, 2010; Betcher & Lee, 2009; Cogbill, 2008; Croft et al., 2010; DeMonte,

- 2013; Harwell, 2003; Hennessy & London, 2013; Kopcha, 2012; McLester, 2012; National Institute for Excellence in Teaching, 2012; Rhoton & Stiles, 2002).
6. Professional development events should incorporate evaluation (Blazer, 2008; Gaytan & McEwen, 2010; Greaves et al., 2010) and allow teachers time for self-reflection (Betcher & Lee, 2009; Brent & Johnson, 2011; Greaves et al., 2010; Ohio Department of Education, 2008; Schmid, 2011). In addition, school divisions should get continuous feedback from teachers regarding their training and conduct classroom audits to ensure that the training is being transferred into the classroom (Bailey, 2011; Hooker, 2008; Mizell, 2010; SMART Technologies, 2012; Winkler, 2011). Studies have indicated that quality of professional development is more important than quantity (Gulamhussein, 2013); therefore determining the effectiveness of the training is of vital importance. Teachers should utilize self-assessment to monitor their own progress with implementation of IWBs (Madden et al., 2010; Rudnesky, 2006).
  7. Training should provide opportunities for teachers to have hands-on activities that will build confidence and give teachers a positive attitude about using the boards (Betcher & Lee, 2009; Ertmer et al., 2012; Guzman & Nussbaum, 2009; Lai, 2010; Oigara & Wallace, 2012; Rudnesky, 2006; SMART Technologies, 2010).
  8. Effective professional development for true integration of new technologies such as IWBs into the classroom follows a progression that is best facilitated by using both formal and informal training (Beglau et al., 2011; Curwood, 2011; DeSantis, 2012; Ertmer et al., 2012; Guzman & Nussbaum, 2009; Hayes, 2010; Hennessy & London, 2013; Kennedy, 2009; Lai, 2010; Murcia & McKenzie, 2008; Trombley, 2012; Sweeney, 2006). Initial formal training provides skills to allow teachers to operate the

board on a basic level. Further training should be composed of formal and informal learning opportunities allowing teachers to expand skills and to overcome common barriers of time and fear (Curwood, 2011; Ertmer et al., 2012; Hayes, 2010; Hennessy & London, 2013; Kennedy, 2009; Trombley, 2012). To overcome these barriers, training should include basic troubleshooting and locating resources (Boran, 2010).

9. Any professional development plan for school divisions must take into account the practical consideration of cost and resources (Betcher & Lee, 2009; Brent & Johnson, 2011; Cuthell, 2006; Dunne, 2002; Global Education, 2008; Greaves et al., 2010; Ohio Department of Education, 2008), since an unrealistic budget would be impossible for school divisions to implement and maintain. While researchers have suggested that educators and administrators consider professional development when making technology purchases, many schools fail to take into account the cost of anything other than the hardware and software costs (Bannister, 2010; SMART Technologies, 2006), thereby leaving little money for professional development. Moreover, monetary constraints sometimes prohibit expensive training.

### **Summary**

School divisions have spent billions of dollars on instructional technology—including infrastructure, hardware, and software, in hopes of improving student performance (Chatterji & Jones, 2012; Nagel, 2014). A large proportion of this money was allocated for installation of IWBs in classrooms all around the nation. While numerous studies across time have been conducted debating the ability of these instructional technologies to improve student achievement, results have been conflicting (Pellegrino et al., 2007; Ringstaff & Kelley, 2002; Schacter, 1999). This has led

researchers to conclude that providing teachers with IWBs, or indeed any instructional technology by itself, was not sufficient to bring about student achievement (Brown, 2005; Carlson & Gadio, 2002; Cuban et al., 2001; Marr, 2011; November, 2010; Peck, Cuban, & Kirkpatrick, 2002; Reynard, 2009; Ringstaff & Kelley, 2002; Rodriguez & Knuth, 2000; Rudnesky, 2004; Shareski, 2004). Research has suggested that how the instructional technology was used in the classroom determined whether it resulted in student achievement (Hennessy & London, 2013; Keengwe, Onchwari, & Wachira, 2008; Lei, 2010; Lei & Zhao, 2007; Martin et al., 2010; Sweeny, 2006). Studies, both qualitative and quantitative, have identified professional development as the missing ingredient that will ensure teachers will integrate IWBs and other instructional technology in an appropriate manner (Benedetto, 2005; Ertmer, 2005; Hawkins, 1997; Ringstaff & Kelley, 2002) that will lead to the development of 21<sup>st</sup> century skills in both teachers and students (Keane, Keane, & Blicblau, 2013; Project Tomorrow, 2010). These studies underscored the importance of high quality professional development for teachers for incorporating IWBs into the classroom.

In spite of this overwhelming evidence highlighting the importance of teacher professional development, many school divisions have failed to provide sufficient, high-quality professional development to train teachers how to use instructional technologies such as IWBs in schools (Beggs, 2000; Hofer et al., 2004; Goktas et al., 2009; Haldane, 2010; Keller, 2002; Phelps et al., 2004; Sandholtz & Reilly, 2004). Moreover, research has suggested greater variety in professional development would result in better implementation of IWBs (Crowley, 2009). Traditional professional development for teachers has been centered around workshops, college courses, or conferences (Curwood,

2009; Harwell, 2003; Martin, Khaemba, & Chris, 2011). School divisions have typically ignored the more informal professional development opportunities, including self study, collaborative projects, communities of practice, peer observation, mentoring, and use of online social networking sites such as wikis and blogs (Center for Technology in Learning, 2009; Curwood, 2011; Fox et al., 2010; Governor's Commission on Training America's Teachers, 2006; Learning First Alliance, 2000; Louisiana Department of Education, 2013; National Foundation for the Improvement of Education, 1996; Smith & Kritsonis, 2006). Research has suggested that a blending of both informal and formal learning methods be adopted by school divisions.

Therefore the primary purpose of this research was to develop a professional development model for incorporating IWBs into the K-12 classroom. The model, incorporating both formal and informal professional development, was designed to meet the following criteria: a) be based on best practices, b) meet needs of teachers and administrators, both independently and collectively, c) reflect principles of adult learning, and d) be easily implemented and replicated in multiple school divisions.

Chapter III will outline the methods and procedures used in this study. The survey populations and instruments will be described. The rationale for collecting and analyzing descriptive statistics will be provided.



## CHAPTER III

### METHODS AND PROCEDURES

The purpose of this research study was to develop a model for providing effective professional development for teachers for incorporating IWBs into the K-12 classroom. The study was an outgrowth of the controversy surrounding the benefits of interactive whiteboards and best practices for training teachers to incorporate them into daily instruction. Standard training for incorporating IWBs and other instructional technologies into the classroom has revolved around formal training, primarily workshops, which many teachers have not found to be sufficient (Armstrong et al., 2005; Choy et al., 2006; Cogill, 2002; Hennessy & London, 2013; Kennewell, 2006; OFSTED, 2004; Shareski, 2004). Many researchers have suggested that new training strategies must be developed for incorporating instructional technology into the classroom so professional development becomes more flexible, individual, and social (Barnes, 2005; Carter-Ward, 2006; Crowley, 2009; Madden et al., 2009), and incorporates principles of adult learning (Brinkerhoff, 2006; Elmore, 2002; Trotter, 2006). Researchers have further concluded that a combination of both formal and informal learning provides teachers with opportunities to craft personal professional development plans that meet both their individual needs as well as those of the school divisions (Center for Technology in Learning, 2009; Curwood, 2011; Fox et al., 2010; Governor's Commission on Training America's Teachers, 2006; Learning First Alliance, 2000; Louisiana Department of Education, 2013; National Foundation for the Improvement of Education, 1996; Smith & Kritsonis, 2006).

A growing body of research about the benefits of IWBs has been conducted. Much of the research has been qualitative in nature, relying on perceptions of teachers and students. The quantitative studies that have been conducted have provided conflicting data as to the effects of IWBs on student achievement. Recent studies have suggested that this variation in results may be due to the quantity and type of professional development provided for incorporating the boards into the classroom. Even though studies consistently highlighted the importance of professional development, little research has been conducted to design a professional development model for incorporating IWBs into the classroom (Hennessy & London, 2013). The goal of this study was to develop such a model that incorporates best practices for providing formal and informal professional development for teachers for true IWB classroom integration.

The methods and procedures utilized in this research study were outlined in this chapter. This chapter also included a description of the population, the study design, the methods of data collection, the proposed model, and the survey used to obtain information concerning teacher professional development for incorporating IWBs into the classroom. Data collection procedures and methods of statistical analysis were also described.

### **Development of Model**

The researcher developed a proposed model for professional development for incorporating interactive whiteboards into the K-12 classroom. Elements to be included in the model were identified through an extensive review of literature concerning best practices for delivering professional development. The model was then validated through a panel of experts. The model utilizes a constructivist approach which allows teachers to

process information on both basic operational skills as well as pedagogy in such a manner that teachers can construct meaning in their individual settings (Flynn & Shuman, 2006; Harwell, 2006). The model is designed so that, after it is validated, it can be disseminated and evaluated, which is considered necessary in a workable professional development model (Joyce & Calhoun, 2010). The model addresses the elements of professional development (see Table 1), including type of professional development (formal and informal), duration (time involved), stages of development (induction to full and effective integration), content (subject specific), and evaluation (program and self-evaluation).

Table 1

*Elements Included in Professional Development Model for IWB Incorporation*

Professional development elements	Formal	Informal
Training Venues	Workshops, College Courses, Seminars (can be vendor provided)	Mentoring, Peer Coaching, Communities of Practice, Collaboration Time, Professional Resource Library, Observation, and Online Educational Portals
Duration	Following guidelines provided by NCLB, which mandates a minimum of 3 hours per session with multiple sessions, measured in seat time or continuing education credits; also following guidelines recommended by research which calls for on-going training	Continuous sessions throughout the year, self monitored and recorded through journaling or professional development log

Table 1 (continued)

Professional development elements	Formal	Informal
Stages of Training	Induction (basic operational skills necessary for all users), Content Focused (skills needed by specific subject/grade levels), and Enhanced/Pedagogical (skills to create lessons delivering information in new and effective ways)	Induction (basic operational skills determined by the user's skill level), Content Focused (skills needed by individual practitioner's subject/grade levels), and Enhanced/Pedagogical (skills to create lessons delivering content for needs of individual practitioner)
Content	After induction, training sessions adapted for content levels (mathematics, science, language arts, special education, etc.)	After induction, training individualized by practitioner, in according to principles of adult education
Evaluation	Group surveys or return-on-investment studies	Individual surveys and interviews/focus groups
Cost	Tuition charges for college courses; instructor/vendor-trainer charges for professional development	Stipends for facilitators/mentors; resources and materials; possible stipends for participants; possible membership fees for online learning portals such as PD360.

The model provides an on-going, long-range, sustained plan for providing scaffolded professional development that meets the needs of teachers in various content areas with a wide range of skill levels using instructional technologies, especially interactive whiteboards (see Figure 1). The model addresses the barriers to incorporating technology into the classroom, including time, lack of technological skill, insufficient professional development, lack of confidence, and technical difficulties (Bingimlas,

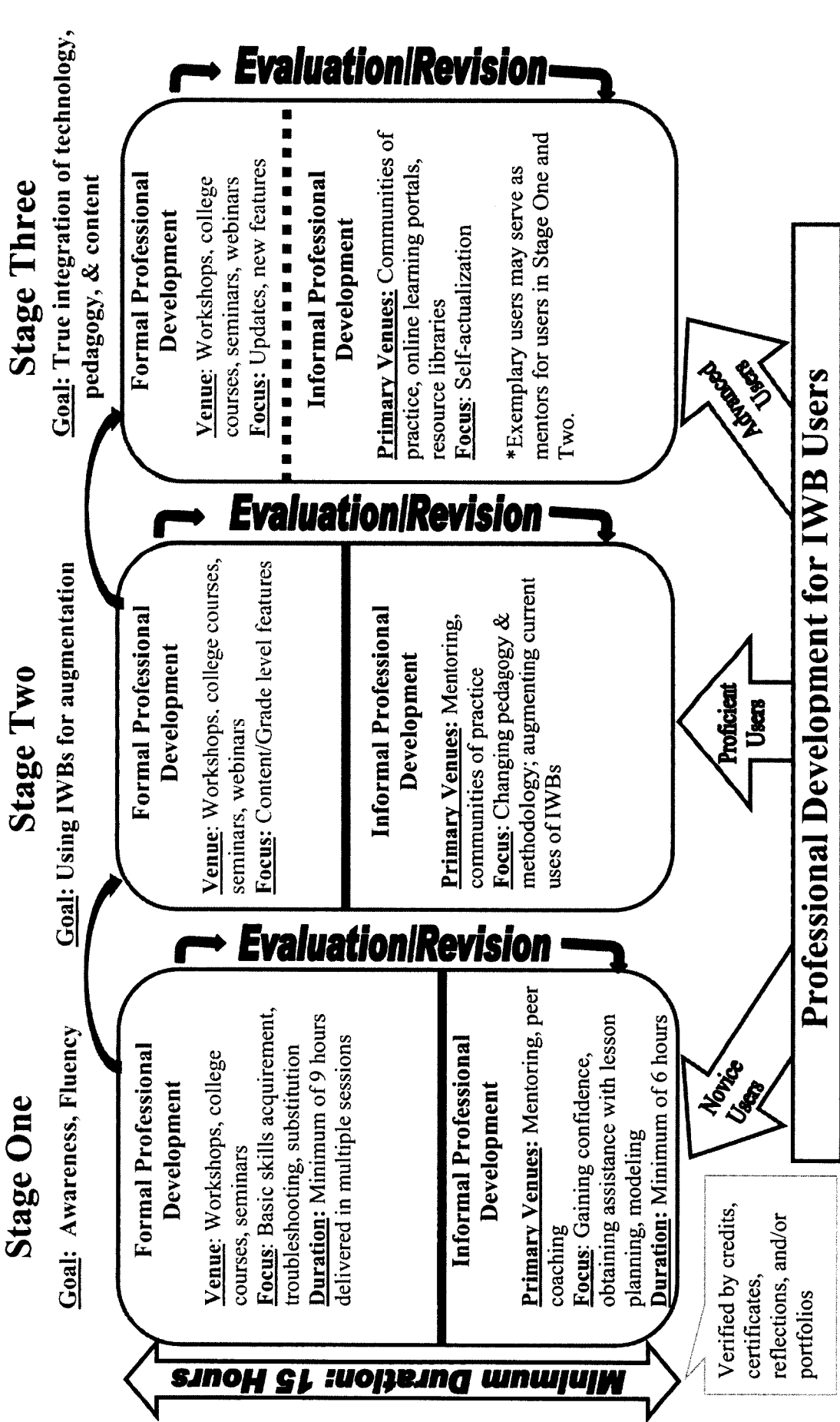


Figure 1. Proposed Professional Development Model. This model provides a proposed model for professional development for teachers for incorporating IWBs into the K-12 classroom.

2009; Goktas, Yildirim, & Yildirim, 2009; Gulbahar & Guven, 2008; Kopcha, 2012; Martin et al., 2010; Martin, Khaemba, & Chris, 2011; Rooney, 2011; Todorova & Osburg, 2010). The components of scaffolded professional development implementation, followed by self-reflection and continuous evaluation of the professional development plan, are delivered in stages. Individual learning styles are addressed through the development of individual learning plans and a combination of formal and informal professional development. The model incorporates best practices regarding the amount of professional development required for effectiveness, which can be monitored and validated in a variety of ways, including training logs, course credits, training certificates, personal reflections, and observations. Also in keeping with best practices, teachers are able to exercise autonomy in selection of professional development activities, which has been deemed a critical element for effective adult education (Batchelor, 2011; Bubb & Earley, 2007; Enns, 2007; Lai, 2010; Tienken & Achilles, 2005; Trotter, 2006).

The model calls for scaffolding and sequencing of training so teachers first learn basic skills through formal professional development, reinforced by other informal professional development. Scaffolding, a highly effective method of providing initial support which gradually lessens as teacher skills and pedagogy increase (Bannister, 2010; Bingimlas, 2009; Cowan, 2013; DeSantis, 2012; Martin et al., 2010; Ohio Department of Education, 2008; Ugur, 2007; Westera, 2004), is provided as teachers sequence through three stages of professional development. The three stages correspond to the technological skill level, confidence in use of technology, and individual needs of teachers. Teachers are able to enter professional development at the appropriate stage based on their own knowledge and skills. Each stage allows for individualization and

choice and each stage addresses common barriers discouraging participation in professional development.

### **Overview of Model**

Professional development in Stage One provides introductory skills in the use of interactive whiteboards. The goal of Stage One training is awareness of the many capabilities of the boards, the attainment of basic operational skills, and knowledge of basic troubleshooting techniques—all of which have been deemed essential for gaining fluency and confidence (Alach, 2011; Association of Latino Administrators and Superintendents, 2011; Bahadur & Oogarah, 2013; Boran, 2010; Chen & Chang, 2006; Hallinan, 2009; Hooker, 2008; Mills & Schmertzing, 2005; Minor, Losike-Sedimo, Reglin, & Royster, 2013; Park & Ertmer, 2008; Slay et al., 2008; Technology in Education Task Force, 2004), as well as necessary for using instructional technology in a way that increases student achievement (Murcia & McKenzie, 2009). After Stage One training, all teachers should have, at a minimum, reached the substitution level as outlined by Puentadura (2010, 2012), whereby teachers can fluently use interactive whiteboards as a direct tool substitute both with and without functional improvement, thereby enhancing instruction. As Lee (2009) noted, substituting the new technology to do things that the old technologies could do, such as writing on the IWB just like writing on a regular whiteboard, is a normal step in the learning continuum.

Both formal and informal training is provided in Stage One, since research has indicated that a combination of both methods is best (Cassandra Drennon & Associates, 2005; Center for Implementing Technology into Education, 2012; Parise & Spillane, 2010). Formal training in the form of workshops, college courses, or seminars is made

available to teachers because formal training systematically allows the user to begin to accumulate the basic skills needed for all users in a timely manner (American Federation of Teachers, 2008; Guzman & Nussbaum, 2009; Hazel Associates, 2006), serves to inspire teachers (Shareski, 2004) and boost confidence levels (Benedetto, 2005; Smith & Kritsonis, 2006), and has been shown to be effective in teaching skills (Kennedy, 2005; Tienken & Achilles, 2005). The experts in the field can be college instructors (with training delivered through distance learning if desired), trainers provided by vendors, or master teachers using the train-the-trainer model (American Federation of Teachers, 2008; Bannister, 2010; Chen & Chang, 2006; Lee, 2009; Murcia & McKenzie, 2009; Trombley, 2012), depending on the available resources and constraints. This is combined with informal learning techniques, which can meet the needs of individual teachers who do not all learn at the same rate or through the same style (American Federation of Teachers, 2008; Bannister, 2010; Cooper, 2008). Emphasis is placed on mentoring and peer coaching. Instructional Technology Resource Teachers can serve as mentors because they have the expertise, are readily available, and can assume these duties as part of job responsibilities, thereby reducing training costs. Mentoring and peer coaching provide opportunities for mutual learning, reduce isolation, provide social and academic support, and have the advantages of being easy to structure, cost effective, and job-embedded (Beglau et al., 2011; Bill and Melinda Gates Foundation, 2012; Carter-Ward, 2006; Cheetham & Chivers, 2001; Cooper, 2008; Gulamhussein, 2013; Kennedy, 2005; Literacy and Numeracy Secretariat, 2007; Mizell, 2010; Oigara & Wallace, 2012; Ottenbreit-Leftwich, 2010).



Formal professional development is validated by college credits, certifications, and attendance sheets. Informal training is validated by logs of hours spent in mentoring and peer coaching, by personal reflections, and by journals (Nightingale, 2006). As Colardyn and Bjornavold (2004) noted, validation is important for the learner to show that he/she has obtained the skills and knowledge necessary for the job, and important for the employer, so he/she will not duplicate the training.

Time spent in Stage One training activities should equal a minimum of nine hours of formal training and six hours of informal training spread out over the school year. This number of hours was based on guidelines provided by NCLB regulations mandating that training sessions be sustained and no shorter than three hours, on research indicating that one-shot trainings are ineffective, on best practices suggesting that training be on-going and involve both formal and informal learning methods, and on the typical training length for basic skill training by vendors for incorporating IWBs into the classroom (Bannister, 2010; Darling-Hammond, 2009; Gulamhussein, 2013; SMART Technologies, 2014b; Virginia Department of Education, 2004b). Because school divisions spent more than 15 hours per year on average on professional development (Lim, Abas, & Mansor, 2010), training of this duration would fit into the professional development plans of most schools, with additional time remaining for training in other areas.

After each stage of training, teachers are surveyed to determine the effectiveness of the professional development being provided because the goal of professional development is to bring about change in teacher knowledge, skills, behaviors, or attitudes (Center for Technology in Learning, 2009; Ertmer et al., 2012; Lim, Abas, & Mansor, 2010; Tienken & Achilles, 2005). Surveys that measure perceptions and attitudes

(Johnson, 2011) can be distributed to participants in paper-and-pencil format or electronically. Survey results will then be analyzed. Based on the results, changes can be made in format, delivery, training methods, and amount of training offered, as recommended by Haslam (2010) in his professional development guide utilized by Maryland. Self-reflection, necessary to bring about a change in pedagogy, is encouraged through journaling, group discussion at faculty or department/grade level meetings, and study groups (Center for Implementing Technology into Education, 2012; Lim, Abas, & Mansor, 2010; Murcia & McKenzie, 2006). The three-stage model allows for a systematic, progressive professional development program that scaffolds and differentiates training so learners are provided support and follow-up training as needed (Guzman & Nussbaum, 2009; Hennessy & London, 2013; Hooker, 2008; Madden et al., 2009; Martin et al., 2010).

Stage One training is intended for novice users to ensure that they can use the technology. Once technical proficiency has been achieved, the training emphasis shifts to pedagogy (Baran, 2010; Cowan, 2013; Manny-Ikan et al., 2011; Pass, 2008). To differentiate training by skill level, more advanced users may enter at either Stage Two or Stage Three because all three stages are offered concurrently. This flexibility also allows new users entering the school division to enter training at the appropriate level. A long-term plan is necessary to ensure the success of any IWB initiative, but schools have not always developed such a plan (Bannister, 2010; Center for Implementing Technology in Education, 2012; Meyer, Vines, & Shankland, 2012). Often training was provided for new technologies during the year of implementation, but no further training was provided and schools did not achieve effective implementation (Center for Implementing

Technology in Education, 2012). This means that new teachers entering the system who are not familiar with interactive whiteboards or not familiar with the type of interactive whiteboard selected by the school division might receive no training for incorporating IWBs into the classroom, not even basic skills. Furthermore, teachers who received basic skills training might never receive further training and thus revert to old teaching methods.

Professional development in Stage Two provides more specialized training appropriate for specific content and/or grade level, because research has indicated that teachers want and need training in individual content areas (Bannister, 2010; Batchelor, 2011; Buabeng-Andoh, 2012; Cooper, 2008; Curwood, 2011; Hayes, 2010; Lai, 2010; Ohio Department of Education, 2008; Scott & Mouza, 2007). For example, mathematics teachers will learn features such as the ruler, the calculator, the protractor, the compass, and backgrounds such as graph paper. Teachers in primary grades will learn how to access the handwriting templates, the clock for teaching how to tell time, and coins for counting money. The goal of Stage Two training is to have teachers go beyond substituting the IWB for the regular whiteboard/chalkboard, and reach at least the augmentation level (Puentedura, 2010; 2012) whereby teachers are adding functionality to lessons by incorporating such features as the timer, built-in weblinks, and drag-and-drop elements. Teachers are also learning to change pedagogy and methodology to incorporate IWBs seamlessly into the curriculum, rather than as an add-on to a lesson (Cowan, 2013).

Stage Two training also incorporates both formal and informal professional development. Teachers engage in formal training, including college courses, seminars,

and workshops. Workshops may include a refresher on basic skills as deemed necessary (Center for Implementing Technology into Education, 2012; Trombley, 2012). Many makers of IWBs, including SMART and Promethean, offer online professional development courses for improving skills (Bannister, 2010; Promethean, 2014; SMART Technologies, 2014b). Other companies, such as InFoCor (2012) provide training for using instructional technologies, including IWBs. Master teachers and ITRTs can serve as instructors for workshops and seminars, thereby minimizing the cost.

Informal professional development incorporates mentoring and communities of practice. These methods of professional development take advantage of the social aspect of learning, reduce feelings of isolation, provide opportunities for teachers to share teaching methods and strategies, and encourage changes in teaching pedagogy (Little, 2006; Meyer, Vines, & Shankland, 2012; Murcia & McKenzie, 2009; New York State Education Department, 2009b; Türel & Johnson, 2012). ITRTs can serve as teacher mentors to minimize costs of training. This is important since all of these have been identified as major barriers for incorporating instructional technologies into the classroom (Buabeng-Andoh, 2012).

Total hours of Stage Two professional development conform to best practices of being ongoing and sustained (American Federation of Teachers, 2008; Gulamhussein, 2013; Lee, 2009; Trombley, 2012), totaling 15-hours of professional development in keeping with NCLB guidelines, with 6-hours devoted to formal training. Participants have the opportunity to choose activities that meet individual needs and address individual learning styles, thus following principles of adult learning, and allowing more

opportunities for informal learning (Lai, 2010; Lee, 2005; New York State Education Department, 2009b; Tienken & Achilles, 2005; Trotter, 2006).

Stage Three training is intended for teachers who already possess basic skills and fluency with IWBs; however, research suggests that both beginning and experienced instructional technology users can benefit from professional development (Buabeng-Andoh, 2012). Stage Three provides teachers with even more choices and flexibility in professional development options, which adult learners need (Bannister, 2010; Beglau et al., 2011; Knowles, 1980). Less reliance is placed on formal training, which is needed mainly for teaching new features and software updates of the IWBs. By this stage, teachers should have reached the point of self-actualization (Puentedura, 2010, 2012) and are in charge of their own learning. Teachers at this phase can develop their own personal growth plan (Berry, Daughtrey, Darling-Hammond, & Cook, 2012; Cassandra Drennon & Associates, 2005; Governor's Commission on Training America's Teachers, 2006; Louisiana Department of Education, 2013) to address individual needs, interests, and deficits (Kenndey, 2005).

Individual study combined with collaboration becomes important, so informal learning focuses on becoming a member of a community of practice, utilizing the resource library, and taking advantage of online learning portals to gather ideas for incorporating IWBs effectively in the classroom. School-based and division-based communities of practice, facilitated by ITRTs, master teachers, and/or department/grade level chairpersons, have the advantage of being not only job-embedded, but also capitalize on the social aspect of learning allowing teachers to be engaged with colleagues and share expertise (American Federation of Teachers, 2008; Beglau et al.,

2011; Curwood, 2011; Essig, 2011; New York State Education Department, 2009b). Online communities of practice allow for the exchange of ideas and lesson plans for incorporating IWBs getting different viewpoints and perspectives from around the world (Beglau et al., 2011; Booth, 2012; Herrington, Herrington, Kervin, & Ferry, 2006) and a growing number of teachers have reported going online for assistance in incorporating technology into the classroom (Bill and Melinda Gates Foundation, 2012; Ertmer et al., 2012). Online portals also allow teachers to share ideas and resources for enhanced classroom activities using IWBs and provide “real-time support for individuals and groups that can ably serve as a catalyst for growth” (Beglau et al., 2011, p. 7). Time during the school day, which could be common planning times, faculty meetings, or professional development days, should be designated for networking, reflecting, and sharing to encourage teachers to integrate new skills and knowledge (American Federation of Teachers, 2008; Banister, 2010; Lee, 2009; Kaplan, Chan, Farbman, & Novoryta, 2014).

In addition to providing training on new features and software updates, Stage Three professional development would provide professional development on how to create lessons that incorporate IWBs into instruction. Training would show teachers how to create a library of resources, archive lessons, incorporate links to source material, develop learning games, and create multimodal lessons (Beauchamp, 2004; O’Connor, 2011; Rimes, 2012; Winkler, 2011). Teachers would learn how to capture lessons using screen saving tools and audio capture software, which could be used for anytime learning for students (Rimes, 2012). Training would also show teachers how to use the IWBs with ancillary devices, including slates that would allow the teacher to move around the room

while using the IWB, scanners to import images into lessons, and student response systems that allow the teacher to check for understanding (Beauchamp, 2004; O’Conner, 2011; Rimes, 2012). As Beauchamp noted (2004), the emphasis has shifted to how to promote learning rather than on how to use the IWBs, and by this stage, the teacher uses the IWB spontaneously. Stage Three training would also show teachers how to encourage students to use the IWBs.

Total hours of Stage Three professional development still conforms to best practices of being ongoing and sustained as suggested by research (Alach, 2011; American Federation of Teachers, 2008; Kaplan, Chan, Farbman, & Novoryta, 2014; Martin, 2009), totaling 15 hours, verified by course credits, certificates, personal reflections, and/or portfolios (Louisiana Department of Education, 2013). Teachers in all stages can exceed the minimum hours of training, or school divisions may require more hours depending on the resources available and the needs of individual staff members.

The professional development model is evaluated in several ways to determine whether the training program is meeting the needs of teachers, and adjustments are made as needed. Because the overall goal of IWB professional development is to bring about changes in teacher practices and attitudes, show teachers how to integrate IWBs into lessons seamlessly, and improve student achievement, a method needs to be put into place to see if these goals are being accomplished (American Federation of Teachers, 2008; Bowe & Pierson, 2008; Gaytan & McEwen, 2010; New York State Education Department, 2009b; Woodall, 2012). The teachers are surveyed and results will provide data regarding teacher attitudes and practices (Berry, Daughtrey, Darling-Hammond, & Cook, 2012; Ohio Department of Education, 2008). This would give teachers an

opportunity to express their level of satisfaction with the type and amount of professional development provided. Routine classroom observations by ITRTs, department chairpersons, and principals determine whether teachers are integrating IWBs into the classroom in a meaningful way that results in student engagement (Carter-Ward, 2006). Student performance indicators, such as benchmark and standardized tests, are used to indicate whether student learning is taking place (Goodall et al., 2005; Maine Department of Education, 2010). While increases in student achievement cannot be solely attributed to professional development for incorporation of IWBs into the classroom due to numerous other variables that could affect student performance, consistent improvements across multiple classrooms and/or schools would tend to suggest that the professional development had an effect on teacher effectiveness and thereby student performance. Administrators can conduct further research and identify trends and patterns in student achievement before and after implementation of the professional development model.

### **Research Design**

This study used a survey design, drawing data from members of the Virginia Society for Technology in Education who serve as instructional technology resource teachers, to obtain feedback concerning the proposed model for incorporating interactive whiteboards into the K-12 classroom. After content validation by a panel of experts and a pilot study, surveys were distributed to participants. Descriptive data were collected, analyzed, and interpreted. Recommendations for changes to the model were derived from the data and a final model was produced. Suggestions for further research were then made.



## Population

In order to refine the model for incorporating interactive whiteboards into K-12 classrooms, data were collected from members of the Virginia Society for Technology in Education (VSTE) who are employed as Instructional Technology Resource Teachers in Virginia public schools. Participants were purposefully selected from this group for two reasons:

1. VSTE is an organization dedicated to promoting instructional technology into the classroom and to providing professional development for incorporating technology into the classroom (Virginia Society for Technology in Education, 2011); therefore, members join because they have an interest in and knowledge of instructional technology. The practice of deliberately and strategically selecting participants from groups or organizations related to the focus of the research has been recognized as an effective way to secure knowledgeable survey participants (Dattalo, 2010; Family Health International, 2005; Glasow, 2005; Layder, 2012; Mugo, 2002; Teddlie & Yu, 2007; Tongco, 2007).
- 2) ITRTs are the instructional technology professionals who are tasked by Virginia Department of Education (2008a) guidelines with the primary duty of training teachers to integrate instructional technology, both hardware and software, effectively into the curriculum. As of 2006, all Virginia school divisions had at least one ITRT and 83 percent of divisions had met the targeted ratio of one ITRT per 1,000 students (VDOE, 2008a). As providers of professional development (Coffman, 2009; Hooker, 2006; Office of Educational Technology, n.d.; Virginia Department of Education, 2008a), ITRTs often use the train-the-trainer model

(Charlottesville City Schools, 2010; Grunwald Associates, 2010; Kennedy, 2005; Rice & Bain, 2013; Schrock, 2012; State Technology Directors Association, 2009a), and could provide insight into the type, amount, and effectiveness of professional development needed by teachers, as well as identifying best practices.

Five participants were solicited from each of the eight school regions in the state of Virginia ( $N = 40$ ). Total number of participants was limited to 40 participants; this was slightly higher than the average purposive sample, which Teddlie and Yu identified as 30 participants. Researchers often establish small quotas when the target population is a very specific group with many similar experiences (Battaglia, 2008; Layder, 2012; Melnick, Colombo, Tashjian, & Melnick, 1991; Public Works and Government Services Canada, 2014). Mason (2010) concurred, noting “expertise in the chosen topic can reduce the number of participants needed in a study” (p. 2). Moreover, Privitera (2014) noted that small sample sizes are sufficient for “theoretical generalization” (p. 238) to determine whether survey results were consistent with data obtained from the review of literature. According to Eisenhart (2009), theoretical generalizations, which are used to refine existing theories, are valid as long as the sample study has been representatively selected. As Mason (2010) noted, more data do not always result in more information. The quota system, often utilized when identifying participants with specific characteristics (Audience Dialogue, 2011; Battaglia, 2005; Burns & Bush, 2003; Mack, Woodsong, MacQueen, Guest, & Namey, 2005), was instituted to solicit participation from each of the eight Virginia school districts (see Table 2). This allowed for perspectives

from varied geographic locations, including urban and rural schools, while exceeding the typical quota sample size of 30.

Table 2

*Virginia Schools Districts by Regions*

Regions	School division
Region 1	Charles City County, Chesterfield County, Colonial Heights City, Dinwiddie County, Goochland County, Hanover County, Henrico County, Hopewell City, New Kent County, Petersburg City, Powhatan County, Prince George County, Richmond City, Surry County, Sussex County
Region 2	Accomack County, Chesapeake City, Franklin City, Hampton City, Isle of Wight County, Newport News City, Norfolk City, Northampton County, Poquoson City, Portsmouth City, Southampton County, Suffolk City, Virginia Beach City, Williamsburg City, York County
Region 3	Caroline County, Colonial Beach City, Essex County, Fredericksburg City, Gloucester County, King George County, King William County, King and Queen County, Lancaster County, Mathews County, Middlesex County, Northumberland County, Richmond County, Spotsylvania County, Stafford County, West Point County, Westmoreland County
Region 4	Alexandria City, Arlington County, Clarke County, Culpeper County, Fairfax City, Fairfax County, Falls Church City, Fauquier County, Frederick County, Loudoun County, Madison County, Manassas City, Manassas Park City, Orange County, Page County, Prince William County, Rappahannock County, Shenandoah County, Warren County, Winchester City
Region 5	Albemarle County, Amherst County, Augusta County, Bath County, Bedford City, Bedford County, Buena Vista City, Campbell County, Charlottesville City, Fluvanna County, Greene County, Harrisonburg City, Highland County, Lexington City, Louisa County, Lynchburg City, Nelson County, Rockbridge County, Rockingham County, Staunton City, Waynesboro City
Region 6	Alleghany County, Botetourt County, Covington City, Craig County, Danville City, Floyd County, Franklin County, Henry County, Martinsville City, Montgomery County, Patrick County, Pittsylvania County, Roanoke City, Roanoke County, Salem City
Region 7	Bland County, Bristol City, Buchanan County, Carroll County, Dickenson County, Galax City, Giles County, Grayson County, Lee County, Norton City, Pulaski County, Radford City, Russell County, Scott County, Smyth County, Tazewell County, Washington County, Wise County, Wythe County
Region 8	Amelia County, Appomattox County, Brunswick County, Buckingham County, Charlotte County, Cumberland County, Greensville County, Halifax County, Lunenburg County, Mecklenburg County, Nottoway County, Prince Edward County

### **Instrument Design**

A survey was developed to gather the professional opinions of ITRTs regarding a proposed model for incorporating IWBs into the K-12 classroom. The survey was selected as the best means to gather data and to document responses from practitioners in the field (Bless, Higson-Smith, & Kagee, 2006; Diem, 2002; Glasow, 2005; Jackson, 2009; Phellas, Bloch, & Steale, 2012; Richards & Morse, 2013). The instrument for this study was an online self-selecting non-probability survey. This online purposive sample survey was selected because of the rapid response time, the ability to reach any number of participants, and the low cost of distribution (Fairfax County Department of Neighborhood and Community Services, 2012; Fox, 2010; Fricker, 2008; Phellas, Bloch, & Steale, 2012; Ross, Clark, Padgett, & Renckly, 2002; Sukamolson, 2007; Trochim, 2006). The survey also provided the participants with time to formulate responses, allowed the respondents to answer at their own convenience, and reduced the influence of the researcher on the respondents (Brüggen, Wetzels, & de Ruyter, 2011; Trochim, 2006; Yount, 2006).

The survey, consisting of 41 questions, was composed of structured multiple-choice Likert-scale items as well as unstructured open-ended text boxes allowing respondents to provide additional comments (Crewsell & Clark, 2006; Driscoll, Appiah-Yeboah, Salib, & Rupert, 2007; Office of Quality Improvement, 2010; Polland, 2005). This combination of structured and unstructured responses was deemed a practical way to collect both quantitative and qualitative data in a survey format that had the advantage of being intuitive and easy to understand (Clark & Libarkin, 2011; Driscoll et al., 2007; Phellas, Bloch, & Steale, 2012). Structured survey questions allowed the researcher to

summarize numerous responses, to finalize results of statistical tests, to explain phenomena being studied in an objective manner, to collect data from participants across the state, and to generalize findings (Clark & Libarkin, 2011; Creswell, 2003; Harwell, 2011; Krosnick & Presser, 2010; Sukamolson, 2007). Unstructured questions removed constraints by allowing participants the opportunity to expand responses or to provide information when all possible responses could not be listed (ACET, Inc., 2013; Creswell & Clark, 2006; Office of Quality Improvement, 2010; Polland, 2005). The survey (see Appendix A) collected perceptions of the benefits of professional development, the use of both formal and informal training, and the identification of best practices. Basic demographic data were collected to verify that participants from various regions and school divisions were surveyed.

Research to investigate the three research objectives for this study identified six key variables to be included in a model of professional development for incorporating IWBs into the K-12 classroom: type of professional development provided for incorporating IWBs into the classroom (including teacher preferred methods of training), amount of professional development provided for teachers, method of evaluation (including self-evaluation), best practices, validation through portable credentials, and cost. The review of literature suggested that all six variables needed to be addressed to achieve maximum benefits from professional development for incorporating IWBs into the classroom. Table 3 provides a content matrix of research objectives, key variables, and major references. Professional development was classified by type as either formal or informal. Sub-categories of informal professional development for incorporating instructional technologies, especially IWBs, into the classroom were identified from the

literature review and included mentoring, peer coaching, communities of practice, collaboration time, professional resource libraries, observation, and online educational portals. Amount of professional development was identified by the literature review as a variable affecting effective incorporation of IWBs into classrooms. The literature review identified evaluation as a vital element of any training program and suggested that programs be constantly revised to meet needs of participants. Individual reflection on trainings was identified as an important part of the evaluative process. Best practices suggested that effective professional development be on-going, job-embedded, individualized, scaffolded, hands-on, and content specific. Research indicated that any professional development model should include basic skills and troubleshooting guidelines. Other considerations for any model included the need to factor in the cost of providing professional development, methods of overcoming barriers for engaging in professional development, and identifying a method of validating training through some type of portable credential.

Table 3

*Research Objectives (RO) Content Matrix*

Concept measured	Observable measures/ recordable	Literature review
RO <sub>1</sub> Best practices for formal PD for incorporating IWBs into the classroom	Formal training	Beith, 2006; Celik, 2012; Center for Technology in Learning, 2009; Choy et al., 2006; Churches, 2007; Curwood, 2011; Ertmer, 2005; Hennessy & London, 2013; Hew & Brush, 2007; Hezel & Associates, 2006; Jones & Vincent, 2006; Kopcha, 2012; Mariam, Caffarella, & Baumgartner, 2007; Mills & Schmertzing, 2005; Mizell, 2010; National Staff Development Council; 2009; Opfer & Pedder, 2010; Ottenbreit-Leftwich,

Table 3 (continued)

Concept measured	Observable measures/ recordable	Literature review
RO <sub>2</sub> Best practices for informal PD for incorporating IWBs into the classroom		2010; Scott & Mouza, 2007; Slay et al., 2008; Snow-Renner & Lauer, 2005; Trombley, 2012
	College courses	Choy, Chen, Bugarin, & Broughman, 2006; Cocoran, 1995; Elmore, 2002; Goble & Horm, 2010; Harwell, 2003; Hezel Associates, 2006; Kennedy, 2005; Martin, Khaemba, & Chris, 2011; Opfer & Pedder, 2010; Parise & Spillane, 2010; Teclehaimanot & Lamb, 2006
	Workshops	Beith, 2006; Choy, Chen, Bugarin, & Broughman, 2006; Cocoran, 1995; Goble & Horm, 2010; Gulamhussein, 2013; Harwell, 2003; Hezel Associates, 2006; Lai, 2010; Martin, Khaemba, & Chris, 2011; Shareski, 2004; Teclehaimanot & Lamb, 2006
	Seminars/ conferences	Beith, 2006; Choy, Chen, Bugarin, & Broughman, 2006; Cocoran, 1995; Harwell, 2003; Hezel Associates, 2006; Jones, 2007; Martin, Khaemba, & Chris, 2011; State Educational Technology Directors Asso., 2008a; Teclehaimanot & Lamb, 2006; Winzenried, Dalgarno, & Tinkler, 2010
	Vendor provided	Celik, 2012; Jones & Wincent, 2006; SMART Technologies, 2014b
	Train-the-trainer	CDW-G, 2012; Coffman, 2009; Rice & Bain, 2013; SETDA, 2008a; Virginia Department of Education, 2008a
	Informal	American Society for Training and Development, 2008; Burns, 2008; Carrera, 2006; CDW-G, 2012; Cheetham & Chivers, 2001; Center for Technology in Learning, 2009; Hoekstra et al., 2009; Hooker, 2008; Jang, 2010; LaBaron & McDough, 2009; Martin, Khaemba & Chris, 2011; Nagel, 2008; Scrimshaw, 2014; SETDA, 2008a; Winzenried et al., 2010; Yang, 2009

Table 3 (continued)

Concept measured	Observable measures/ recordable	Literature review
RO <sub>2</sub> Best practices for informal PD for incorporating IWBs into the classroom	Informal	American Society for Training and Development, 2008; Beeland, 2004; Burns, 2008; Carrera, 2006; CDW-G, 2012; Cheetham & Chivers, 2001; Center for Technology in Learning, 2009; Hoekstra et al., 2009; Hooker, 2008; Jang, 2010; LaBaron & McDough, 2009; Martin, Khaemba & Chris, 2011; Nagel, 2008; Ringstaff & Kelley, 2002; Scrimshaw, 2014; State Educational Technology Directors Association, 2008a; Winzenried et al., 2010; Yang, 2009
	Mentoring	Betcher & Lee, 2009; Center for Technology in Learning, 2009; Chuang et al., 2003; Hooker, 2008; LeBaron & McDonough, 2009; Mizell, 2010; Oigara & Wallace, 2012; Rudnesky, 2004, 2006; Thompson, 2006; Vincent & Jones, 2007; Zhao & Bryant, 2006
	Peer coaching	Barnes, 2005; Barron, Dawson, & Yendol-Hoppey, 2009; Center for Technology in Learning, 2009; Glover et al., 2007; Gulbahar & Guven, 2008; Hezel Associates, 2006; Ishizuka, 2004; Jang, 2010; SMART Technologies, 2009
	Communities of practice	Center for Implementing Technology in Education, 2009; Cogill, 2008; Grover, 2010; Haldane, 2010; Naylor et al., 2008; Todorova & Osburg, 2010
	Collaboration time	Grover, 2010; Haldane, 2010; Morgan et al., 2005; Murcia & McKenzie, 2008
	Professional resource libraries	Hooker, 2008; Jones, 2007; Morgan et al., 2005; Oakleaf, 2010; Phelps et al., 2004; Sandholtz & Reilly, 2004



Table 3 (continued)

Concept measured	Observable measures/ recordable	Literature review
RO <sub>3</sub> Integrate best practices for professional development into a model for incorporating IWBs into the classroom	Observation	Byrne et al., 2010; Cowan, 2013; Davidson, 2009; Goktas et al., 2009; Grover, 2010; Hooker, 2008; Literacy & Numeracy Secretariat, 2007; Murcia & McKenzie, 2008; Oigara & Wallace, 2012; SMART Technologies, 2012; Trombley, 2012
	Online educational portals	Beglau et al., 2011; Bill & Melinda Gates Foundation, 2012; Ferriter, 2009; Foley & Chang, 2006; Greaves et al., 2010; Herrington, Herrington, Kervin, & Ferry, 2006; Hines, 2008; PBS & Grunwold Associates LLC, 2011; Salazar et al., 2010
	New trends/ combined formal and informal	Beglau et al., 2011; Beith, 2006; Curwood, 2011; DeSantis, 2012; Eib & Cox, 2003; Ertmer et al., 2012; Fox, Deanery, & Wilson, 2010; Greaves et al., 2010; Guzman & Nussbaum, 2009; Hayes, 2010; Hennessy & London, 2013; Jenson et al., 2002; Kennedy, 2009; Lai, 2010; Martin, Khaemba, & Chris, 2011; Murcia & McKenzie, 2008; Trombley, 2012; Sweeney, 2006
	On-going/follow-up	Alach, 2011; Bannister, 2010; Barnett, 2003; Bowe & Pierson, 2008; Brent & Johnson, 2011; Greaves et al., 2010; Hennessy & London, 2013; Koenraad, 2008; Mizell, 2010; Zevenbergen & Lerman, 2007
Theories of adult learning	Beach, 2012; Bothwick & Pierson, 2008; Hague & Logan, 2009; Knowles, 1985; Lai, 2010; Madden et al., 2009; Rudnesky, 2006; Shaha & Ellsworth, 2013	

Table 3 (continued)

Concept measured	Observable measures/ recordable	Literature review
	Hands-on	Alanis, 2004; Blazer, 2008; Center for Technology in Learning, 2009; Ertmer, 1999; Foltos, 2003b; Gorder, 2008; Hennessy & London, 2013; Hunter, 2001; Keller, 2002; Rodriguez & Knuth, 2000; Teclehaimanot & Lamb, 2005
	Systemic and standardized	Ala-Mutka, 2010; Kennedy, 2005; Liu & Batt, 2007; McNamara, 1997
	Amount of training/duration	Armstrong et al., 2005; BECTA, 2003; Benedetto, 2005; Burns, 2008; CDW-G, 2006; Celik, 2012; Center for Technology in Learning, 2009; Curwood, 2011; Ertmer, 2005; Gray et al., 2010; Harwell, 2003; Hennessy & London, 2013; Hezel Associates, 2006; Hoekstra et al., 2009a; Kennewell, 2006; Lewin, Scrimshaw, Somekh, & Haldane, 2009; Martin, Khaembra, & Chris, 2011; Miller, Glover, & Averis, 2004, 2008; OFSTED, 2004; Schuck & Kearney, 2007; State Educational Technology Directors Association, 2010
	Individualized by content and skill level	Bennett & Cole, 2005; Bubb & Earley, 2007; Ehman, Bonk, & Yamagata-Lynch, 2005; Florida Regional Workforce Boards, 2005; Grover, 2010; Gulamhussein, 2013; Mazzella, 2011; Mizell, 2010; Ottenbreit-Leftwich, 2010; Phelps et al., 2004; Shaha & Ellsworth, 2013; Todorova & Osburg, 2010
	Scaffolding/stages	Bannister, 2010; Bingimlas, 2009; DeSantis, 2012; Dickey, 2008; Dunne, 2002; Epper & Bates, 2001; Espinosa & Chen, 1996; Fox, Mears, & Pearson, 2010; Hennessy & London, 2012; Iowa Department of Education, 2002; Kobelsky, Larosiliere, & Plummer, 2012; Lowden, 2005; Martin et al., 2010; Mertens & Flowers, 2004; Puentedura, 2010, 2012; Sparks & Loucks-Horsley 1989; Sweeney; 2006; Tafel, 2008; Westera, 2004

Table 3 (continued)

Concept measured	Observable measures/ recordable	Literature review
	Troubleshooting	Boran, 2010; Ringstaff & Kelley, 2002; Rodriguez & Knuth, 2000; Technology in Education Task Force, 2004
	Job-embedded	American Federation of Teachers, 2008; Blazer, 2008; Center for Technology in Learning, 2009; Croft, Coggshull, Dolan, Powers, & Killion, 2010; Greaves et al., 2010; Hunzicker, 2010; Literacy and Numeracy Secretariat, 2007; National Institute for Excellence in Teaching, 2012; NEA Foundation for the Improvement of Education, 2000; Owston, 2007; Rock, 2002; Tafel, 2008; Vega, 2013; Walker, 2013
	Evaluation/ reflection	Brown, 2005; DiGregorio & Sobel-Lojeski, 2010; Gaytan & McEwen, 2010; Halliday-Wynes & Beddie, 2009; Haslan, 2010; Hazel Associates, 2006; Hooker, 2008; Lawless & Lowden, 2005; Madden et al., 2010; Martin et al., 2010; McKenzie, 2001; McNamara, 2008; Miles et al., 2005; Noeth & Volkov, 2004; Noyce, 2006; Pellegrino, 2007; Porter, Garet, Desimone, & Birman, 2003; Ringstaff & Kelley, 2002; Schmidt, 2011; SMART Technologies, 2011; Winkler, 2011
	Overcoming barriers	Abadiano & Turner, 2004; Bill & Melinda Gates Foundation, 2014; Bingimlas, 2009; Borthwick & Pierson, 2008; Burns, 2010; CAELA Network, 2010; Davidson, 2009; Drage, 2010; Feist, 2003; Johnson, 2014; Kedzior & Fitfield, 2004; Lucilio, 2013; Mizel, 2010; Nugent, 2007; Overbay, Patterson, & Grable, 2009; Plair, 2008; Smith et al., 2003

Table 3 (continued)

Concept measured	Observable measures/ recordable	Literature review
	Procedure for credentialing/ validation	Carrera, 2006; Halliday-Wynes & Beddie, 2009; LeBron & McDough, 2009; Liu & Batt, 2007; Mazza, 2007
	Cost	Alach, 2011; Bannister, 2010; Betcher & Lee, 2009; Boser, 2013; Brent & Johnson, 2011; Cuthell, 2006; Diaz, 2001; Dillon, 2007; Dunne, 2002; Global Education, 2008; Goldberg, 2005; Greaves et al., 2010; Hill, 2008; Hooker, 2008; National Education Association, 2000; OFSTED, 2004; Redhead, 2001; SMART Technologies, 2006, 2009

Research Objective 1, “Identify best practices for providing teacher professional development that incorporates formal training,” was addressed by Survey Questions 11, 12, and 33. Formal professional development opportunities were identified as the following: a) college courses, b) conferences and seminars, and c) workshops, including those provided by vendors, ITRTs, and master teachers (often using the train-the-trainer model). Participants had an opportunity to elaborate on the effectiveness of formal training in an open-ended comment box.

Research Objective 2, “Identify best practices for providing teacher professional development that incorporates informal training,” was addressed by Survey Questions 20-25. Surveys gather ITRT perceptions regarding informal learning practices in the following: mentoring, peer coaching, communities of practice, collaboration time, professional resource libraries, and online educational portals.

Research Objective 3, “Integrate best practices for professional development into a model for incorporating instructional technologies, particularly interactive whiteboards, into the K-12 classroom,” was addressed by Survey Questions 1-3, 4-8, 9-10, 13-19, 26-32, 34-36. Perceptions were collected regarding elements to be included in the model, including need for a plan that was ongoing, hands-on, systematic, scaffolded, job-embedded, cost effective, consistent with theories of adult education, incorporating both formal and informal trainings, individualized by content and skill level, of sufficient duration for the effective accumulation of skills and fluency, providing basic troubleshooting tips, options to minimize or eliminate barriers to participation in professional development, evaluation to ensure model improvement and teacher reflection, and resulting in appropriate credentials/validation. Open-ended questions were included to enable survey recipients to make comments and suggestions regarding the proposed model, including elements to be added to the proposed model.

Demographic information was solicited in Survey Items 37-40. Data included region number, the size of the division, the location by both region and setting (urban, suburban, rural), and socioeconomic status. Sizes of school divisions were classified as large if student population exceeded 10,000 and small if below 5,000 (Rodgers, 1986, Spar, 2006). As Spar (2006) noted, size of divisions across Virginia ranged greatly, from a small county near the Allegheny Mountains with only two schools and a population of approximately 300 students, to a large school division in Northern Virginia, with over 160 thousand students and approximately 200 schools. Divisions were classified as urban (cities and towns) and rural following usual state and national guidelines established in 2006 (National Center for Education Statistics, n.d.; Virginia Department

of Education, 2008a; 2010b). Schools were classified by socioeconomic status based on free-and-reduced lunch data. Schools with over 50% free-and-reduced were identified as high poverty schools (Tilley, 2011). The final survey question was optional and gathered contact information for those respondents who wished to participate in the drawing for the WalMart gift card.

Prior to distribution, the instrument was reviewed by a panel of experts consisting of a master teacher, an instructional technology resource teacher, a data administrator, and an instructional technology supervisor. All these members of the panel were proficient in the use of interactive whiteboards. A final member of the panel was the Director of Institution Research and Analysis for a historic private college in Virginia. This member was familiar with interactive whiteboards as well. Finally, the survey was distributed to a pilot group consisting of three ITRTs to verify clarity of the survey instrument (Kasunic, 2005; Mora, 2011). The surveys were reviewed for design best practices, including content, internal, and face validity (Mora, 2011; Polland, 2005; Radhakrishna, 2007). Recognized best practices for developing effective surveys, as identified by a literature review (Check & Schutt, 2012; Harwell, 2011; Kasunic, 2005; Krosnick & Presser, 2010; National Council of Teachers of English, 2007; National Nursing Staff Development Organization, 2005; Office of Quality Improvement, 2010; Polland, 2005; Schmitt, n.d.), included the following:

1. Content—quality questions that address research objectives
2. Ease of understanding—clarity
3. Consistent rating scale
4. Logical order

5. Unbiased language/no leading questions
6. Appropriate length
7. Reasonable number of choices
8. Appealing format

The panel found the survey to be acceptable in all areas and found the survey to have content and face validity. Suggestions were made to improve the clarity of two items. Both suggestions were accepted (see Table 4) in accordance with best practices in survey design (Office of Quality Improvement, 2010; Walonick, 2012).

Table 4

*Recommended Changes to Survey Questions*

Question stem	Original item	Recommended change
Professional development for incorporating IWBs into the classroom. . .	should be delivered in a formal manner that enables users to become proficient in a more timely manner than a self-study method.	should be delivered at least partially in a formal manner enabling users to become proficient in a more timely manner than a self-study method.
	that is delivered through informal venues should be validated through the awarding of portable credentials (such as recertification points).	should be validated by portable credentials (such as recertification points) for both formal and informal venues.

The reliability of the survey instrument, which refers to the ability of the survey to measure consistency (Cohen & Lea, 2004; Dancey, Reidy, & Rowe, 2012; Gebotys, 2003; Lodico, Spaulding, Voegtler, 2006; Parsian & Dunning, 2009), was determined by the test-retest method (Key, 1997; Kimberlin & Winterstein, 2008; Office of Quality

Improvement, 2010; Rattray & Jones, 2007), whereby the members of the pilot group completed the survey two times. The test-retest method of reliability was selected for its simplicity, convenience, directness, and timeliness (Office of Quality Improvement, 2010; Rattray & Jones, 2007; Wuensch, 2012). The pilot group consisted of three instructional technology resource teachers in three separate school divisions. The interval between survey administrations was two weeks, which was in keeping with best practices for allowing a time lapse between tests (Kimberlin & Winterstein, 2008). The responses to both surveys were analyzed using Cronbach's Alpha. The correlation coefficient was .889. A reliability coefficient above 0.7 is considered an acceptable standard, while anything over 0.8 is highly acceptable (Burns & Burns, 2008; Dancey, Reidy, & Rowe, 2012; Wuensch, 2012).

### **Method of Data Collection**

With the cooperation of the VSTE Board, participants were recruited through a flyer distributed (see Appendix B) electronically to VSTE members who serve as ITRTs in all eight regions of Virginia, inviting them to participate in the survey for incorporating IWBs into the K-12 classroom. Those interested in participating in the survey were asked to sign up on a Googledoc (see Appendix C) or to email the researcher for the link to an online survey. Those willing to participate were sent a Request for Participation in Research Study letter (see Appendix D) that explained the purpose and procedures for participating in the study and were given the link to the survey, which utilized the online survey tool Survey Monkey™. Participants were promised confidentiality, which would be ensured by collecting the responses through a password-protected online tool, downloading information electronically onto password protected spreadsheet, and



electronically shredding all information at the conclusion of the study. Respondents were asked to complete the survey within 10 days and were offered the incentive of being included in a drawing for a \$100 Walmart card for participation. After 10 days, reminders were sent (see Appendix E).

Participants were self-selected, drawn from each of the eight regions encompassing the state so that members of the each region had an equal chance of being included and thereby checking reliability of responses (Fricker, 2008; Jackson, 2009). Pushing surveys using direct e-mail addresses, offering incentives for participation, promising confidentiality, and sending reminder notices were all methods identified for boosting survey responses (Iarossi, 2006; Nulty, 2008; Ross, Clark, Padgett, & Renckly, 2002; Whelan, 2007).

The survey population was delimited to only ITRTs in Virginia; however, job descriptions for teachers serving as teacher instructional technology specialists were comparable nationwide (Bureau of Labor Statistics, 2014; Teacher Certification Degrees, 2015). While survey participants were composed of ITRTs with varying degrees of experience, computer fluency, and skills, all were members of VSTE and all had similar responsibilities as outlined in the job requirements developed by the Virginia Department of Education (2008a). Another limitation of the survey was that no attempt was made to develop a training model for any specific brand of IWB; however, while the boards vary in size, price, and attachments (Nadel, 2012), there are enough similarities in the boards and how they are used to allow for transfer of training skills from one brand to another (Betcher & Lee, 2009; Kollie, 2008b). Therefore the type of board that participants were used to using would not impact responses to survey questions.

### Statistical Analyses

Returned surveys were compiled and survey data were entered into an Excel spreadsheet. These data were then imported into SPSS® for statistical analysis. An initial screening was done of all surveys to ensure respondents included region. Three surveys were excluded for failure to denote region. A count was conducted to ensure that the number (*n*) of final participants met the quota. Demographic data were reviewed to identify sample distribution (Wild, 2006) and verify all eight regions were represented. Sampling stopped when quotas for each region were reached.

The survey contained 41 items. The first 33 items on the survey used a five-point Likert scale with 1 representing strongly disagree, 2 representing disagree, 3 representing neither agree nor disagree, 4 representing agree, and 5 representing strongly agree. Question 34 was a Likert-type item that asked the respondent to describe feelings about professional development for incorporating IWBs into the classroom (1 = Formal PD is more effective than informal, 2 = Formal PD and informal PD are equally effective, 3 = No opinion on the effectiveness of either informal or formal PD, 4 = Individual choice of professional development method because some people learn best through formal PD while others prefer informal PD, and 5 = Informal PD is more effective than formal). Question 35, also a Likert-type question, asked respondents to approximate the number of hours of professional development (formal and/or informal) needed for providing rigorous, effective, professional development for incorporating IWBs into the K-12 classroom (1 = No PD needed, 2 = From 0 to 6 hours, 3 = From 6 to 14 hours, 4 = From 14 to 20 hours, and 5 = More than 20 hours). Four questions provided text boxes which

allowed respondents to give qualitative data, including Question 36, which provided participants an opportunity to comment on the proposed model.

The researcher conducted descriptive analyses, including frequency distributions and measures of central tendency. Frequency distributions, indicating the number of occurrences of responses (Cohen, Manion, & Morrison, 2007; Suhr, 2003), were conducted to determine perceptions of participants concerning best practices for utilizing both formal and informal professional development for incorporating IWBs into the classroom, the benefits of professional development, and the design of a professional development model. The median, often used with Likert data (Allen & Seaman, 2007; Hon, 2010; Jaggi, 2003; Patel, 2009; Steinsaltz, 2011) and Likert-type data (Boone & Boone, 2012) was calculated to determine the level of agreement for statements concerning best practices, benefits of training, and development of the training model (Sullivan, 2008). Frequency distributions were calculated on demographic data to ensure the population had a representative sampling of participants (Donnelly, 2007). The mean was calculated to determine central tendency (Boone & Boone, 2012). The standard deviation was calculated to ensure construct validation (Othman, Yin, Sulaiman, Ibrahim, & Razha-Rashid, 2011), consistency (Sclove, 2001), and to indicate the span of the responses (Germuth, 2012).

Several questions provided a linked open-ended text box to gather qualitative data concerning the training model. Responses were gathered and coded, using the content matrix developed to design the survey to categorize information into themes and patterns (Adams, Khan, Raeside, & White, 2007; Hancock, Ockleford, & Windridge, 2009; Taylor-Powell & Renner, 2003). The content matrix was deemed a systematic way to

identify the primary topic(s) of each response and identify trends (Gläser & Laudel, 2013; Graham, 1998; Saldaña, 2009) as they related to providing training for incorporating interactive whiteboards into the classroom.

Table 5 indicated tests performed on data collected from survey. All data were analyzed and compared to the information gleaned from the review of literature to determine whether changes needed to be made to the proposed model for providing effective professional development for incorporating IWBs into the K-12 classroom.

### **Summary**

The primary purpose of this research was to develop an effective professional development model including both formal and informal training for incorporating IWBs into the K-12 classroom. Chapter III provided an overview of the methods and procedures utilized in this study to collect and analyze data for this research study. A rationale for the use of quantitative and qualitative research for the study was given. A description of the target population to be studied (e.g., ITRTs in Virginia) was provided. A proposed model for providing professional development for teachers for incorporating IWBs into the classroom was developed. Survey questions were developed to obtain data about best practices for incorporating IWBs into the K-12 classroom utilizing a variety of professional development options and to provide feedback concerning the proposed professional development model. A description of the survey design was given as well as a survey question content matrix, aligning the survey questions to the measurable/recordable concepts appearing in the research paper. Connections were made

Table 5

*Data Analysis of Surveys*

Survey questions	SQ	Question/ (data type)	Number/ Count of each response for level of agreement	Percentages/ Percent of responses for each level of agreement	Mean/ Measure of central tendency, simple average of responses	Statistical analysis/ Indications	Median/ Value at the midpoint of the frequency distribution	SD/ Variation from the mean of agreement/ disagreement	Coding/ Perceptions of respondents
Importance of adopting PD Plan	1-2	Likert (interval)	X	X	X	X	X	X	
Importance of ongoing PD	3	Likert (interval)	X	X	X	X	X	X	
Best practices for formal PD	11-12 33	Likert (interval)	X	X	X	X	X	X	
Model elements hands-on/active	4	Likert (interval)	X	X	X	X	X	X	
Job embedded	5	Likert (interval)	X	X	X	X	X	X	
Time for reflection, practice, exploration	6	Likert (interval)	X	X	X	X	X	X	
Scaffolded PD	7	Likert (interval)	X	X	X	X	X	X	
Theories of adult ed.	8	Likert (interval)	X	X	X	X	X	X	
Sustained PD	9	Likert (interval)	X	X	X	X	X	X	

Table 5 (continued)

Survey questions	SQ	Question/ (data type)	Statistical analysis/ Indications					Coding/ Perceptions of respondents
			Number/ Count of each response for level of agreement	Percentages/ Percent of responses for each level of agreement	Mean/ Measure of central tendency; simple average of responses	Median/ Value at the midpoint of the frequency distribution	SD/ Variation from the mean of agreement/ disagreement	
Formal & informal	10	Likert (interval)	X	X	X	X	X	X
Differentiated PD	13-14 18	Likert (interval)	X	X	X	X	X	X
Formal for Time	15	Likert (interval)	X	X	X	X	X	X
Beyond fluency	16	Likert (interval)	X	X	X	X	X	X
Troubleshooting	17	Likert (interval)	X	X	X	X	X	X
Credentialing	19	Likert (interval)	X	X	X	X	X	X
Evaluation	26-30	Likert (interval)	X	X	X	X	X	X
Cost/Budget	31	Likert (interval)	X	X	X	X	X	X
Overcoming Barriers	32	Likert (interval)	X	X	X	X	X	X
Best method of PD	34	Likert-type (interval)	X	X				X
Training Duration	35	Likert-type (interval)	X	X				X
Model Reflection	36	Open-ended						X
Demographic data	37-41	MC (ordinal)	X					

between the survey questions and the literature review. The method of validation for the survey and the distribution of the survey were identified. A table identified the tests performed related to the data collected and the reasons for selecting these tests.

Confidentiality of information by participants was explained. Delimitations and limitations of the survey were identified and explained. All data collected in this study were used to address the research questions and were reported in Chapter IV.

## CHAPTER IV

### FINDINGS

The purpose of this research study was to develop a model for providing effective professional development for teachers for incorporating IWBs into the K-12 classroom.

To guide this study, the following research objectives were established:

RO<sub>1</sub>: Identify best practices for providing teacher professional development that incorporates formal training.

RO<sub>2</sub>: Identify best practices for providing teacher professional development that incorporates informal training.

RO<sub>3</sub>: Integrate best practices for professional development into a model for incorporating instructional technologies, particularly interactive whiteboards, into the K-12 classroom.

This chapter reported the data collected to refine the professional development model.

Response rate, survey responses, statistical analyses, and a summary of findings were presented.

#### Response Rate

The study sought five VSTE members who served as ITRTs from each of the eight geographic regions of Virginia to participate in a survey to collect information related to the proposed model for instructional technology professional development and further to refine the model. The survey response rate was 100% ( $N = 40$ ) by study participants.



## Survey Responses

Participants responded to 41 questions to gather information to accomplish the study's three research objectives. Responses were recorded and analyzed. Following are the research question findings.

### **Research Objective 1—Identify best practices for providing teacher professional development that incorporates formal training.**

Survey Questions 11, 12, and 33 addressed this research objective. For all three questions, participants identified their level of agreement using a five-point Likert scale, with 1 representing strongly disagree, 2 representing disagree, 3 representing neither agree nor disagree, 4 representing agree, and 5 representing strongly agree.

Survey Question 11 asked if professional development for incorporating IWBs into the classroom “should foster awareness of the many IWB features, which is best facilitated by formal training.” Survey responses found that 22.5% ( $n = 9$ ) strongly agreed, 67.5% agreed ( $n = 27$ ), 5% neither agreed nor disagreed ( $n = 2$ ), and 5% ( $n = 2$ ) disagreed that formal professional development was an integral component for incorporating IWBs into the K-12 classroom. The mean was 4.63, the median was 5, and the standard deviation was .69, indicating participants overall agreed that professional development was an integral component of incorporating IWBs.

Survey Question 12 asked if professional development for incorporating IWBs into the classroom “should be delivered through formal venues such as workshops, seminars, or college courses, which is the best way for teachers to acquire basic skills/proficiency for using IWBs.” Fifteen percent ( $n = 6$ ) of participants strongly agreed, 50% ( $n = 20$ ) agreed, 17.5% ( $n = 7$ ) neither agreed nor disagreed, 15% ( $n = 6$ ) disagreed, and 2.5% ( $n = 1$ ) strongly disagreed. The mean was 3.60 and the median was 4,

indicating that a majority of participants felt that formal professional development was the best way to acquire basic skills for using IWBs. The standard deviation was 1.01. The high standard deviation indicated that there was a wider variation of responses in the group (Rumsey, 2011).

Survey Question 33 asked respondents to indicate their level of agreement with the following statement: “Formal training, including college courses, seminars/conferences, workshops (including those provided by vendors, ITRTs, and master teachers) for incorporating IWBs can be very effective.” Responses found that 67.5% ( $n = 27$ ) strongly agreed, 27.5% ( $n = 11$ ) agreed, and 5% ( $n = 2$ ) neither agreed nor disagreed. The mean was 4.63, the median was 5, and the standard deviation was .59, which indicated that formal training was perceived to be effective for helping teachers incorporate IWBs into the classroom.

This question provided participants the option to make comments, which were analyzed to isolate themes. Ten respondents made comments. One theme from participant responses was that formal professional development was an important part of IWB training. Six participants stated that formal training was necessary, but added stipulations. One of these participants added that formal training was not sufficient by itself, and needed to be coupled with informal professional development. Another commented that formal training was effective because it could be mandated easier. Two respondents feared that teachers would be either unmotivated or lack the time to participate in informal training if training were left up to teachers. Five of the respondents referred to the need for formal training that individualized instruction by proficiency level and/or subject/grade level. Two participants noted the need for training to be continuous, with

one respondent noting that training should be ongoing and another stating that follow-up training should be provided, especially for incorporating instruction for add-on devices such as electronic response devices, often referred to as “clickers.” (See Appendix F for complete responses.)

**Research Objective 2—Identify best practices for providing teacher professional development that incorporates informal training.**

Survey Questions 20 through 25 addressed Research Objective 2. Participants identified their level of agreement using a five-point Likert scale, with 1 representing strongly disagree, 2 representing disagree, 3 representing neither agree nor disagree, 4 representing agree, and 5 representing strongly agree. Survey participants recognized the benefit of providing informal professional development for incorporating IWBs into the K-12 classroom.

Survey Question 20 asked if professional development for incorporating IWBs into the classroom “can be delivered through a mentoring program, since mentoring is an effective method of professional development.” Fifteen percent ( $n = 6$ ) strongly agreed, 53.5% agreed ( $n = 21$ ), 20% ( $n = 8$ ) neither agreed nor disagreed, and 12.5% ( $n = 5$ ) disagreed. The mean was 3.70, the median was 4, and the standard deviation was .88. Responses indicated that most respondents agreed that mentoring was an effective method of training teachers to use IWBs. The standard deviation reflected a fairly wide range of opinions on the effectiveness of mentoring.

Survey Question 21 asked if professional development for incorporating IWBs into the classroom “can be delivered effectively through peer coaching.” Ten percent ( $n = 4$ ) strongly agreed, 57.5% ( $n = 23$ ) agreed, 25 % ( $n = 10$ ) neither agreed nor disagreed, and 7.5% ( $n = 3$ ) disagreed. The mean was 3.70, the median was 4, and the standard

deviation was .76. Responses indicated that most respondents felt peer coaching could be an effective method of training, although one-fourth of the participants had no opinion concerning its effectiveness.

Survey Question 22 asked if professional development for incorporating IWBs into the classroom “should incorporate teacher collaboration, which is an effective method of professional development.” Responses included 27.5% ( $n = 11$ ) strongly agreeing, 65% ( $n = 26$ ) agreeing, and 7.5% ( $n = 3$ ) neither agreeing nor disagreeing. The mean was 4.20, the median was 4, and the standard deviation was .56. Responses indicated that most participants agreed that teacher collaboration was an effective training method.

Survey Question 23 asked if professional development for incorporating IWBs into the classroom “can be facilitated effectively by joining a community of practice.” Responses included 7.5% ( $n = 3$ ) strongly agreeing, 47.5% ( $n = 19$ ) agreeing, 30% ( $n = 12$ ) neither agreeing nor disagreeing, 12.5% ( $n = 5$ ) disagreeing, and 2.5% ( $n = 1$ ) not responding. Mean was 3.51, median was 4, and standard deviation was .82. Responses indicated that the greatest number of respondents agreed that joining a community of practice could be an effective training method.

Survey Question 24 asked if professional development for incorporating IWBs into the classroom “can be facilitated effectively through independent study using materials from a professional resource library.” Ten percent ( $n = 4$ ) strongly agreed, 32.5% agreed ( $n = 13$ ), 22.5% ( $n = 9$ ) neither agreed nor disagreed, 32.5% ( $n = 13$ ) disagreed, and 2.5% ( $n = 1$ ) did not respond. Mean was 3.21, median was 3, and standard deviation was 1.03. While slightly more respondents felt that use of a professional

resource library would be an effective professional development method, the high standard deviation denoted the wide range of opinions of its effectiveness and the median of three suggested a lack of confidence in this method.

Survey Question 25 asked if professional development for incorporating IWBs into the classroom “can be delivered effectively by utilizing an online learning portal (discussion board, wiki, blog, etc.).” Fifteen percent ( $n = 6$ ) strongly agreed, 32.5% ( $n = 13$ ) agreed, 17.5% ( $n = 7$ ) neither agreed nor disagreed, 27.5% ( $n = 11$ ) disagreed, 5% ( $n = 2$ ) strongly disagreed, and 2.5% ( $n = 1$ ) not responding. Mean was 3.25, median was 3, and standard deviation was 1.17. Responses indicated that while the most often selected response agreed that online learning portal could be effective professional development method, almost as many respondents disagreed. The high standard deviation reflected the wide range of responses.

**Research Objective 3—Integrate best practices for professional development into a model for incorporating instructional technologies, particularly interactive whiteboards, into the K-12 classroom.**

Responses were collected from survey participants to obtain feedback on best practices for incorporating IWBs into the classroom to be used to refine the professional development model. Survey Questions 1 through 10, 13 through 19, 26 through 32, and 34 through 36 addressed Research Objective 3. Participants identified their level of agreement using a five-point Likert scale, with 1 representing strongly disagree, 2 representing disagree, 3 representing neither agree nor disagree, 4 representing agree, and 5 representing strongly agree.

Survey Question 1 asked if professional development for incorporating IWBs into the classroom “should be carefully planned prior to implementation of the boards.”

Responses noted that 67.5% ( $n = 27$ ) strongly agreed, 27.5% ( $n = 11$ ) agreed, and 5% ( $n = 2$ ) neither agreed nor disagreed. The mean was 4.63, median was 5, and standard deviation was .59. Responses indicated belief in the importance of developing an implementation plan prior to deploying IWBs.

Survey Question 2 asked if professional development for incorporating IWBs into the classroom “is instrumental to the success of any IWB initiative.” Responses noted that 72.5% ( $n = 29$ ) strongly agreed, 27.5% ( $n = 10$ ) agreed, and 2.5% ( $n = 1$ ) disagreed. The mean was 4.68, the median was 5, and the standard deviation was .62. Responses indicated that respondents realized the importance of providing professional development for any IWB initiative.

Survey Question 3 asked if professional development for incorporating IWBs into the classroom “must be ongoing to be effective.” Responses noted that 52.5% ( $n = 21$ ) strongly agreed, 40% ( $n = 16$ ) agreed, and 7.5% ( $n = 3$ ) disagreed. The mean was 4.38, the median was 5, and the standard deviation was .84. Responses indicated that effective professional development needed to be ongoing.

Survey Question 4 asked if professional development for incorporating IWBs into the classroom “should be hands-on and active rather than passive.” Responses noted that 72.5% ( $n = 29$ ) strongly agreed, 22.5% ( $n = 9$ ) agreed, and 5% ( $n = 2$ ) disagreed. The mean was 4.60, the median was 5, and the standard deviation was .72. Responses indicated that respondents believed that effective professional development should be hands-on and active.

Survey Question 5 asked if professional development for incorporating IWBs into the classroom “should be job embedded.” Responses noted that 42.5% ( $n = 17$ )

strongly agreed, 47.5% ( $n = 19$ ) agreed, 7.5% ( $n = 3$ ) neither agreed nor disagreed, and 2.5% ( $n = 1$ ) disagreed. The mean was 4.30, the median was 4, and the standard deviation was .72. Responses indicated that respondents favored professional development that was job embedded.

Survey Question 6 asked if professional development for incorporating IWBs into the classroom “should provide time for reflection, practice, and exploration.” Responses noted that 62.5% ( $n = 25$ ) strongly agreed, 35% ( $n = 14$ ) agreed, and 2.5% ( $n = 1$ ) neither agreed nor disagreed. The mean was 4.69, the median was 5, and the standard deviation was .55. Responses indicated that respondents felt that time for reflection, practice, and exploration was needed for effective professional development.

Survey Question 7 asked if professional development for incorporating IWBs into the classroom “should be scaffolded and delivered in stages spread out over time.” Sixty-five percent ( $n = 26$ ) strongly agreed, 30% ( $n = 12$ ) agreed, and 5% ( $n = 2$ ) neither agreed nor disagreed. Mean was 4.60, median was 5, and standard deviation was .59. Responses indicated that respondents endorsed training that was scaffolded and delivered in stages.

Survey Question 8 asked if professional development for incorporating IWBs into the classroom “should conform to theories of adult education by providing training choices for learning experiences.” Responses noted that 37.5% ( $n = 15$ ) strongly agreed, 55% ( $n = 22$ ) agreed, and 7.5% ( $n = 3$ ) neither disagreed nor disagreed. The mean was 4.30, the median was 4, and the standard deviation was .61. Responses indicated that respondents favored training that followed theories of adult education, which included providing choices for learning opportunities.

Survey Question 9 asked if professional development for incorporating IWBs into the classroom “should be sustained, since there is a direct link between time spent in professional development for incorporation of IWBs into the classroom and changes in teacher practice.” Fifty percent ( $n = 20$ ) strongly agreed and 50% ( $n = 20$ ) agreed. The mean was 4.50, median was 4.5, and standard deviation was .51. Responses indicated that respondents felt sustained training was needed to change teacher practice.

Survey Question 10 asked if professional development for incorporating IWBs into the classroom “should utilize a combination of formal and informal methods.” Fifty percent ( $n = 20$ ) strongly agreed, 47.5% ( $n = 19$ ) agreed, and 2.5% ( $n = 1$ ) neither agreed nor disagreed. The mean was 4.48, median was 4.5, and standard deviation was .55. Responses indicated that respondents favored a combination of formal and informal professional development.

Survey Question 13 asked if professional development for incorporating IWBs into the classroom “should be differentiated by skill level of participants.” Responses noted that 47.5% ( $n = 19$ ) strongly agreed, 40% ( $n = 16$ ) agreed, 10% ( $n = 4$ ) neither agreed nor disagreed, and 2.5% ( $n = 1$ ) disagreed. The mean was 4.33, median was 4, and standard deviation was .76. Responses indicated that respondents overall favored training differentiated by skill level of participants.

Survey Question 14 asked if professional development for incorporating IWBs into the classroom “should be differentiated by content or grade level of user, so that mathematics teachers are grouped with mathematics teachers, early elementary teachers with other early elementary school teachers, etc.” Responses were as follows: 32.5% ( $n = 13$ ) strongly agreed, 40% ( $n = 16$ ) agreed, 15% ( $n = 6$ ) neither agreed nor disagreed, 10%



( $n = 4$ ) disagreed, and 2.5% ( $n = 1$ ) strongly disagreed. The mean was 3.90, median was 4, and standard deviation was 1.06. Responses indicated that, while there was a wide range of responses, most respondents favored training that grouped trainees by content or grade level.

Survey Question 15 asked if professional development for incorporating IWBs into the classroom “should be delivered in a formal manner enabling users to become proficient in a more timely manner than a self-study method.” Twenty-five percent ( $n=10$ ) strongly agreed, 65% ( $n = 26$ ) agreed, 7.5% ( $n = 3$ ) neither agreed nor disagreed, and 2.5% ( $n = 1$ ) strongly agreed. The mean was 4.13, median was 4, and standard deviation was .65. Responses indicated that respondents recognized the benefits of formal professional development for teaching IWB skills in a more timely manner.

Survey Question 16 asked if professional development for incorporating IWBs into the classroom “should go beyond teaching just technical fluency, and should focus on areas such as designing lesson plans using IWBs.” Responses were as follows: 67.5% ( $n = 27$ ) strongly agreed, 27.5% ( $n = 11$ ) agreed, and 5% ( $n = 2$ ) neither agreed nor disagreed. The mean was 4.63, median was 5, and standard deviation was .59. Responses indicated that respondents favored training that included areas such as lesson planning as well as technical fluency.

Survey Question 17 asked if professional development for incorporating IWBs into the classroom “should include basic troubleshooting.” Sixty-five percent ( $n = 26$ ) strongly agreed, 30% ( $n = 12$ ) agreed, and 5% ( $n = 2$ ) neither agreed nor disagreed. The mean was 4.60, median was 5, and standard deviation was .59. Responses indicated that respondents felt training should include basic troubleshooting tips.

Survey Question 18 asked if professional development for incorporating IWBs into the classroom “should be individualized, since not all teachers require the same amount of time to acquire technology skills necessary to use IWBs.” Twenty-five percent ( $n = 10$ ) strongly agreed, 52.5% ( $n = 21$ ) agreed, 12.5% ( $n = 5$ ) neither agreed nor disagreed, and 10% ( $n = 4$ ) disagreed. The mean was 3.93, median was 4, and standard deviation was .89. Responses indicated that respondents felt effective professional development should be individualized by learner characteristics.

Survey Question 19 asked if professional development for incorporating IWBs into the classroom “should be validated by portable credentials (such as recertification points) for both formal and informal venues.” Responses were as follows: 22.5% ( $n = 9$ ) strongly agreed, 67.5% ( $n = 27$ ) agreed, and 10% ( $n = 4$ ) neither agreed nor disagreed. The mean was 4.13, median was 4, and standard deviation was .56. Responses indicated that respondents felt both formal and informal professional development should be validated with the awarding of portable credentials.

Survey Question 26 asked if professional development for incorporating IWBs into the classroom “should be evaluated routinely to determine its effectiveness.” Responses were as follows: 42.5% ( $n = 17$ ) strongly agreed, 50% ( $n = 20$ ) agreed, 5% ( $n = 2$ ) disagreed, and 2.5% ( $n = 1$ ) strongly disagreed. The mean was 4.25, median was 4, and standard deviation was .90. Responses indicated that a majority of respondents saw the benefit of evaluating professional development offered to teachers on a routine basis.

Survey Question 27 asked if professional development for incorporating IWBs into the classroom “should be evaluated through methods such as formal surveys and interviews to determine teacher satisfaction with the professional development provided

to them.” Responses included the following: 27.5% ( $n = 11$ ) strongly agreed, 52.5% ( $n = 21$ ) agreed, 10% ( $n = 4$ ) neither agreed nor disagreed, 7.5% ( $n = 3$ ) disagreed, and 2.5% ( $n = 1$ ) strongly disagreed. The mean was 3.95, median was 4, and standard deviation was .96. Responses indicated that opinions of respondents varied, with mixed opinions concerning the benefits of formal evaluation.

Survey Question 28 asked if professional development for incorporating IWBs into the classroom “should be evaluated through return-on-investment studies to determine if the expense of the professional development has yielded results in student achievement.” Survey results were as follows: 15% ( $n = 6$ ) strongly agreed, 40% ( $n = 16$ ) agreed, 30% ( $n = 12$ ) neither agreed nor disagreed, 10% ( $n = 4$ ) disagreed, and 5% ( $n = 2$ ) strongly disagreed. The mean was 3.71, median was 4, and standard deviation was 1.05. Responses indicated that opinions of respondents varied concerning the benefits of return-on-investment studies, although the majority did agree ( $n = 22$ ).

Survey Question 29 asked if professional development for incorporating IWBs into the classroom “can be evaluated through informal interviews or routine classroom observation by administrators, peers, and/or ITRTs to determine the effectiveness of professional development.” Survey responses were as follows: 35% ( $n = 14$ ) strongly agreed, 62.5% ( $n = 25$ ) agreed, and 2.5% ( $n = 1$ ) disagreed. The mean was 4.30, median was 4, and standard deviation was .61. Responses indicated that respondents supported evaluation of professional development through informal interviews and classroom observations.

Survey Question 30 asked if professional development for incorporating IWBs into the classroom “should provide opportunities for teachers to reflect on their practice

and evaluate their learning.” Survey responses were as follows: 40% ( $n = 16$ ) strongly agreed, 57.5% ( $n = 23$ ) agreed, and 2.5 ( $n = 1$ ) disagreed. The mean was 4.33, median was 4, and standard deviation was .73. Responses indicated that respondents felt reflection and self-evaluation were needed for effective professional development.

Survey Question 31 asked if professional development for incorporating IWBs into the classroom “must reflect budget constraints.” Survey responses were as follows: 22.5% ( $n = 9$ ) strongly agreed, 37.5% ( $n = 15$ ) agreed, 32.5% ( $n = 13$ ) neither agreed nor disagreed, 5% ( $n = 2$ ) disagreed, and 2.5% ( $n = 1$ ) strongly disagreed. The mean was 3.73, median was 4, and standard deviation was .96. Responses indicated that respondents overall felt professional development needed to reflect budget.

Survey Question 32 asked if professional development for incorporating IWBs into the classroom “should provide options that overcome or minimize barriers to participation, including time, conflict with work schedule, geographic location, personal relevance, individual learning styles, and cost.” Survey responses were as follows: 40% ( $n = 16$ ) strongly agreed, 55% ( $n = 22$ ) agreed, and 5% ( $n = 2$ ) neither agreed nor disagreed. The mean was 4.35, median was 4, and standard deviation was .58. Responses indicated that respondents thought professional development opportunities should be planned to help overcome barriers to participation.

Survey Question 34 asked “Which of the following responses best describes your feelings about PD for incorporating IWBs into the classroom?” Respondents selected one of five multiple choice options, with 1 representing no opinion, two representing informal professional development was more effective than formal, 3 representing individual choice, 4 representing formal and informal PD were equally effective, and 5 representing

formal PD was more effective than informal. Responses were as follows: 7.5% ( $n = 3$ ) noted formal professional development was more effective, 55% ( $n = 22$ ) noted formal and informal professional development were equally effective, 30% ( $n = 12$ ) noted that method of professional development should reflect individual choice, and 7.5 % ( $n = 3$ ) noted informal professional development was more effective than formal. The most often selected response indicated that respondents felt that informal and formal professional development were equally effective.

Survey Question 34 included a text box for respondents to provide additional comments. Eleven responses were collected. Two major themes emerged from these responses. One theme was the belief that effective professional development combined both formal and informal methods. Three responses included the following: “I think initial formal training is a good idea, followed up by informal, PLC [personalized learning community] or individual training”; “Unfortunately some teachers need to be ‘pushed’ into the training and need formal professional development to get started and embrace the introduction of IWB's”; and “Having the formal—presenting the new skill and then the informal—giving teachers time to practice and collaborate what they have just learned.”

A second theme was that training should be individualized and differentiated by skill level and content area. Three responses were as follows: “Over the years, I have found that it is highly beneficial to conduct trainings by content, especially where Math is concerned. . . . Additionally, I conduct beginner and intermediate training sessions”; “I feel that it is more effective in small groups and similar skill levels”; and training is dependent on “teacher’s needs and comfort level with technology.” A fourth comment

pointed out that professional development had to be individualized to accommodate preferred learning styles. (See Appendix G for complete responses.)

Survey Question 35 asked respondents “approximately how many hours of professional development (formal and informal) are needed for providing rigorous, effective professional development for incorporating IWBs into the classroom?”

Respondents selected one of five multiple choice options, with 1 representing no professional development needed, 2 representing 0 to 6 hours, 3 representing 6 to 14 hours, 4 representing 14 to 20 hours, and 5 representing more than 20 hours. Responses were as follows: 25% ( $n = 10$ ) for 0 to 6 hours, 42.5% ( $n = 17$ ) for 6 to 14 hours, 12.5% ( $n = 5$ ) for 14 to 20 hours, 17.5% ( $n = 7$ ) for more than 20 hours, and 2.5% ( $n = 1$ ) giving no response. Responses indicated that opinions varied concerning the amount of training needed, although the most often selected response was 6 to 14 hours. (See Table 6 for a summary of all survey responses.)

Respondents also had the option to provide feedback regarding how many hours of professional development—in both formal and informal training—were needed for incorporating IWBs into the K-12 classroom. Twelve responses were collected. While all participants indicated a need for professional development for successful implementation of IWBs, opinions varied on the amount of training needed. Responses from five participants suggested that the amount of training should vary according to several variables, including general technological proficiency and motivation. (See Appendix H for complete comments.)

Table 6

*Data Analysis of Survey Questions*

Q#	Survey questions	Number and percentage of responses					Statistical analysis/ Indications			Standard deviation
		Strongly agree	Agree	Neither agree/ Disagree	Disagree	Strongly disagree	No response	Mean	Median	
1	Should be carefully planned prior to implementation of the boards	27 67.5%	11 27.5%	2 5%	0 0.0%	0 0.0%	0 0.0%	4.63	5	.59
2	Is instrumental to the success of any IWB initiative	29 72.5%	10 25%	0 0.0%	1 2.5%	0 0.0%	0 0.0%	4.68	5	.62
3	Must be ongoing to be effective	21 52.5%	16 40%	0 0.0%	3 7.5%	0 0.0%	0 0.0%	4.38	5	.84
4	Should be hands-on and active rather than passive	29 72.5%	9 22.5%	2 5%	0 0.0%	0 0.0%	0 0.0%	4.60	5	.57
5	Should be job embedded	17 42.5%	19 47.5%	3 7.5%	1 2.5%	0 0.0%	0 0.0%	4.30	4	.72
6	Should provide time for reflection, practice, and exploration	25 62.5%	14 35%	1 2.5%	0 0.0%	0 0.0%	0 0.0%	4.69	5	.55
7	Should be scaffolded and delivered in stages spread out over time	26 65%	12 30%	2 5%	0 0.0%	0 0.0%	0 0.0%	4.60	5	.59
8	Should conform to theories of adult education by providing training choices for learning experiences	15 37.5%	22 55%	3 7.5%	0 0.0%	0 0.0%	0 0.0%	4.30	4	.61

Table 6 (continued)

Q#	Survey questions	Statistical analysis/ Indications						Standard deviation		
		Number and percentage of responses								
		Strongly agree	Agree	Neither agree/ Disagree	Disagree	Strongly disagree	No response	Mean	Median	
9	Professional development for incorporating IWBs into the classroom . . . Should be sustained, since there is a direct link between time spent in professional development for incorporation of IWBs into the classroom and changes in teacher practice	20 50%	20 50%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	4.50	4.5	.51
10	Should utilize a combination of formal and informal methods	20 50%	19 47.5%	1 2.5%	0 0.0%	0 0.0%	0 0.0%	4.48	4.5	.55
11	Should foster awareness of the many IWB features, which is best facilitated by formal training	9 22.5%	27 67.5%	2 5%	2 5%	0 0.0%	0 0.0%	4.08	4	.69
12	Should be delivered through formal venues such as workshops, seminars, or college courses, which is the best way for teachers to acquire basic skills/proficiency for using IWBs	6 15%	20 50%	7 17.5%	6 15%	1 2.5%	0 0.0%	3.60	4	1.01
13	Should be differentiated by skill level of participants	19 47.5%	16 40%	4 10%	1 2.5%	0 0.0%	0 0.0%	4.33	4	.76
14	Should be differentiated by content or grade level users, so mathematics teachers are grouped with mathematics teachers, elementary teachers with other elementary school teachers	13 32.5%	16 40%	6 15%	4 10%	1 2.5%	0 0.0%	3.90	4	1.06



Table 6 (continued)

Q#	Survey questions	Number and percentage of responses					Statistical analysis/ Indications		Mean	Median	Standard deviation
		Strongly agree	Agree	Neither agree/ Disagree	Disagree	Strongly disagree	No response				
15	Professional development for incorporating IWBs into the classroom . . . Should be delivered in a formal manner enabling users to become proficient in a more timely manner than a self-study method	10 25%	26 65%	3 7.5%	1 2.5%	0 0.0%	0 0.0%	4.13	4	.65	
16	Should go beyond teaching just technical fluency, and should focus on areas such as designing lesson plans using the IWBs	27 67.5%	11 27.5%	2 5%	0 0.0%	0 0.0%	0 0.0%	4.63	5	.59	
17	Should include basic troubleshooting	26 65%	12 30%	2 5%	0 0.0%	0 0.0%	0 0.0%	4.60	5	.59	
18	Should be individualized, since not all teachers require the same amount of time to acquire technology skills necessary to use IWBs	10 25%	21 52.5%	5 12.5%	4 10%	0 0.0%	0 0.0%	3.93	4	.89	
19	Should be validated by portable credentials (such as recertification points) for both formal and informal venues	9 22.5%	27 67.5%	4 10%	0 0.0%	0 0.0%	0 0.0%	4.13	4	.56	
20	Can be delivered through a mentoring program, since mentoring is an effective method of professional development	6 15%	21 52.5%	8 20%	5 12.5%	0 0.0%	0 0.0%	3.70	4	.88	

Table 6 (continued)

Q#	Survey questions	Statistical analysis/ Indications							Mean	Median	Standard deviation
		Number and percentage of responses									
		Strongly agree	Agree	Neither agree/ Disagree	Disagree	Strongly disagree	No response				
21	Professional development for incorporating IWBs into the classroom ... Can be delivered effectively through peer coaching	4 10%	23 57.5%	10 25%	3 7.5%	0 0.0%	0 0.0%	3.70	4	.76	
22	Should incorporate teacher collaboration, which is an effective method of professional development	11 27.5%	26 65%	3 7.5%	0 0.0%	0 0.0%	0 0.0%	4.20	4	.56	
23	Can be facilitated effectively by joining a community of practice	3 7.5%	19 47.5%	12 30%	5 12.5%	0 0.0%	1 2.5%	3.51	4	.82	
24	Can be facilitated effectively through independent study using materials from a professional resource library	4 10%	13 32.5%	9 22.5%	13 32.5%	0 0.0%	1 2.5%	3.21	3	1.03	
25	Can be delivered effectively by utilizing an online learning portal (discussion board, wiki, blog, etc.)	6 15%	13 32.5%	7 17.5%	11 27.5%	2 5%	1 2.5%	3.25	3	1.17	
26	Should be evaluated routinely to determine its effectiveness	17 42.5%	20 50%	0 0.0%	2 5%	1 2.5%	0 0.0%	4.25	4	.90	
27	Should be evaluated through methods such as formal surveys and interviews to determine teacher satisfaction with the professional development provided to them	11 27.5%	21 52.5%	4 10%	3 7.5%	1 2.5%	0 0.0%	3.95	4	.96	

Table 6 (continued)

Q#	Survey questions	Number and percentage of responses					Mean	Median	Standard deviation	
		Strongly agree	Agree	Neither agree/Disagree	Disagree	Strongly disagree				
28	Should be evaluated through return-on-investment studies to determine if the expense of the PD has yielded results in student achievement	6 15%	16 40%	12 30%	4 10%	2 5%	0 0.0%	3.51	4	1.05
29	Can be evaluated through informal interviews or routine classroom observations by administrators, peers, and/or ITRTs to determine the effectiveness of PD	14 35%	25 62.5%	0 0.0%	1 2.5%	0 0.0%	0 0.0%	4.30	4	.61
30	Should provide opportunities for teachers to reflect on their practice and evaluate their learning	16 40%	23 57.5%	0 0.0%	1 2.5%	0 0.0%	0 0.0%	4.33	4	.73
31	Must reflect budget constraints	9 22.5%	15 37.5%	13 32.5%	2 5%	1 2.5%	0 0.0%	3.73	4	.96
32	Should provide options that overcome or minimize barriers to participation in professional development, including time, conflict with work schedule, geographic location, personal relevance, individual learning styles, and cost.	16 40%	22 55%	2 5%	0 0.0%	0 0.0%	0 0.0%	4.35	4	.58

Table 6 (continued)

Q#	Survey questions	Statistical analysis/ Indications						Mean	Median	Standard deviation
		Number and percentage of responses								
		Strongly agree	Agree	Neither agree/ Disagree	Disagree	Strongly disagree	No response			
33	Professional development for incorporating IWBs into the classroom ...  Formal training, including college courses, seminars/ conferences, workshops (including those provided by vendors, ITRTs, and master teachers) for incorporating IWBs can be very effective.	27 67.5%	11 27.5%	2 5%	0 0.0%	0 0.0%	0 0.0%	4.63	5	.59
(No stem for question)										
		Number and Percentage of Responses						Mean	Median	Standard Deviation
		Formal PD More Effective Than Informal	Formal & Informal Equally Effective	Individual Choice	Informal More Effective Than Informal	No Opinion	Did Not Respond			
34	Which of the following responses best describes your feelings about PD for incorporating IWBs  (No stem for question)	3 7.5%	22 55%	12 30%	3 7.5%	0 0.0%	0 0.0%	N/A	N/A	N/A
		No PD Is Needed	0 to 6 Hrs.	6 to 14 Hrs.	14 to 20 Hrs.	More Than 20 Hrs.	Did Not Respond			
35	Approximately how many hours of PD (formal & informal) are needed for providing rigorous, effective PD for incorporating IWBs into the classroom ?	0 0.0%	10 25%	17 42.5%	5 12.5%	7 17.5%	1 2.5%	N/A	N/A	N/A

Survey Question 36 was an open-ended question which asked respondents to do the following: “Review the proposed model for professional development for incorporating IWBs into the classroom and provide comments and/or recommendations for changes. List any other elements that should be included in a training model.” Responses were collected and analyzed, and several themes emerged for refining the professional development model. Twenty-five responses were collected.

First, respondents reiterated the need for training that was individualized by subject/grade level, proficiency level, and/or teacher needs. Seven respondents highlighted the importance of individualizing training to fit the needs of learners.

A second theme that emerged was time. Four respondents referenced the barrier of time, both for learners and trainers. Time issues included finding time for teachers to attend training, stress resulting from not enough time to accomplish everything, and the time required to serve as technology mentors/peer coaches.

A third theme involved the amount of time to be devoted to professional development. Eight respondents commented on the number of hours that should be devoted to professional development, with conflicting responses regarding the amount of time considered necessary to complete stages of training. Four respondents suggested that the required number of training hours should be differentiated by needs of learners.

Four respondents identified issues that they thought had not been directly or adequately addressed by the model. One respondent noted that the model did not address the need to secure administrative support and participation. Two respondents addressed the issue of determining how learners were assigned to one of the three stages of instruction. Two respondents referred the issue of getting teachers motivated to train and

incorporate IWBs into the classroom. While the proposed model does address motivation to some degree with the awarding of portable credentials such as recertification points, no direct mention to motivation was included.

Nine respondents directly noted approval of the model as presented. One respondent stated that the model seemed “a little busy.” One respondent suggested eliminating peer coaching, one respondent suggested combining Stages One and Two, and one respondent suggested that Stage One should be entirely formal. (See Appendix I for complete responses.)

### **Additional Survey Questions**

Survey Questions 37 through 40 were added to the survey to gather demographic information from participants. This information was gathered to ascertain whether respondents represented a variety of school divisions.

Survey Question 37 asked: “Which of the following best describes the size of your division?” Respondents could select “Small” (fewer than 5,000 students), “Midsize” (between 5,000 and 10,000 students), and “Large” (over 10,000 students). Responses included 15 small school divisions, 5 midsize school divisions, and 20 large school divisions.

Survey Question 38 asked: “Which of the following best describes your school?” Respondents could select “Urban,” “Suburban,” or “Rural.” Responses included 14 urban schools, 10 suburban schools, and 16 rural schools.

Survey Question 39 asked: “Which of the following best describes your school?” Respondents could select “High Poverty” (over 50% free and reduced lunch), “Average Income” (between 30 percent and 50 percent free and reduced lunch), and “Affluent”

(less than 30% free and reduced lunch). Responses included 2 affluent school systems, 14 average income school systems, and 24 high poverty school systems. (See Table 7 for a summary of demographic data.)

Table 7

*Demographics of Survey Participants*

Community setting	Number	Size of division	Number	Socio-economic status	Number
Urban	14	Small	15	Affluent	2
Suburban	10	Midsized	5	Average Income	14
Rural	16	Large	20	High Poverty	24

Survey Question 40 asked: “Which region includes your school division?”

Responses included Regions 1 through 8. This item was included to verify that five ITRTs from each region had been included in the study.

Survey Question 41 asked: “If you would like to be included in the drawing for a \$100 Walmart gift card, please provide your name and email address below. All names will remain anonymous during and after the study.” This item was included to encourage participation in the study. Thirty-six respondents opted to participate in the drawing.

### Summary

Survey data revealed that responses of survey participants generally paralleled guidelines for instructional technology professional development derived from the review of literature, including the necessity to plan carefully and provide sufficient professional development in both formal and informal venues. Respondents indicated that professional

development for incorporating IWBs into the classroom should be ongoing, sustained, hands-on and active, job embedded, scaffolded, differentiated by skill level, differentiated by subject and/or grade level. Moreover, respondents indicated that professional development should provide time for reflection, practice, and exploration; conform to theories of adult education by providing choices; foster awareness of the many features of IWBs; and should be validated by portable credentials. Respondents recognized the value of formal training, agreeing that formal training was good for learning basics, including the many features of the IWBs, in a timely manner. Respondents also agreed that formal and informal professional development could be equally effective, that training should be individualized, and that training should be planned to minimize barriers for learner participation. Respondents also indicated that training should go beyond technical fluency and include developing lesson plans to incorporate IWBs into the classroom and to provide basic troubleshooting tips.

While recognizing the effectiveness of informal professional development, respondents' views of the effectiveness of the types of informal methods varied. According to survey responses, collaboration was the most favored method of professional development, with 92.5% either strongly agreeing or agreeing. This was followed by mentoring and peer coaching, with 67.5% of respondents either strongly agreeing or agreeing. Fifty-five percent of respondents either strongly agreed or agreed that communities of practice were effective, 47.5% of respondents either strongly agreed or agreed that online learning portals were effective, and 42.5% of respondents either strongly agreed or agreed that independent study utilizing a resource library was effective.



Responses concerning amount of professional development needed varied greatly. While 97.5% of respondents agreed that professional development was necessary for effective integration of IWBs into the classroom, responses varied as to the amount of professional development needed. Responses ranged from minimal training (0 to 6 hours) to more intense training (over 20 hours). The most common response was 6 to 14 hours.

Responses also varied with regard to the need to consider budget constraints when planning professional development. While 60% of respondents either strongly agreed or agreed that budget must be considered when planning professional development, 32.5% (approximately one-third of respondents) neither agreed nor disagreed.

Respondents favored evaluation of professional development, with 92.5% of respondents either strongly agreeing or agreeing that routine evaluation of training was necessary. However, respondents' views varied regarding the type of evaluation needed, with 97.5% either strongly agreeing or agreeing that informal interviews and routine observations by administrators, peers, and/or ITRTs were effective; 80% of respondents either strongly agreed or agreed that formal surveys and interviews were effective; and 55% of respondents either strongly agreed or agreed that return-on-investment studies were needed. Engaging in self-reflection and evaluation was found to be effective, with 97.5% of respondents either strongly agreeing or agreeing.

Suggestions for changes/additions to the model included addressing the need to secure administrative buy-in, the process for determining the appropriate stage of professional development for each participant, and the need to consider motivation for learners to participate in professional development. One suggestion was made to eliminate peer coaching, one suggestion was made to combine Stages One and Two, and

one respondent commented that the proposed model was “busy.” Nine of 25 respondents expressed approval of the proposed draft as presented.

Chapter V will offer conclusions derived from this research. A final professional development model will be presented. Recommendations will also be given for future professional development opportunities for incorporating instructional technologies, such as interactive whiteboards, into the classroom. Suggestions for further study will be given.

## CHAPTER V

### SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter provided a summary of the study. Conclusions drawn from survey data were given for each research objective and a revised model for providing professional development for incorporating IWBs into the K-12 classroom was presented. Suggestions were given for future research.

#### Summary

The purpose of this research study was to develop a model for providing effective professional development for teachers for incorporating IWBs into the K-12 classroom. The following research objectives were established:

- RO<sub>1</sub>: Identify best practices for providing teacher professional development that incorporates formal training.
- RO<sub>2</sub>: Identify best practices for providing teacher professional development that incorporates informal training.
- RO<sub>3</sub>: Integrate best practices for professional development into a model for incorporating instructional technologies, particularly interactive whiteboards, into the K-12 classroom.

A model of professional development for incorporating interactive whiteboards into the K-12 classroom was developed. The model was designed based on best practices identified in the literature and further refined using data collected from a survey of instructional technology resource teachers (ITRTs) using survey research techniques.

This study was delimited geographically to include input from only Virginia (ITRTS) who belong to the Virginia Society for Technology in Education (VSTE). The following limitations existed within this study:

1. It utilized data from Instructional Technology Resource Teachers of varying degrees of experience, computer fluency, and skills.
2. No attempt was made to develop a training model for any one specific brand of interactive whiteboard. The study population was composed of five VSTE members who also serve as ITRTs from each of the eight regions of Virginia ( $N = 40$ ).
3. Study population was self-selected.

The review of literature outlined the ongoing debate concerning the effectiveness of instructional technology, including IWBs, on student achievement. While many researchers supported the idea that instructional technology had a positive effect on student achievement, others found no correlation between use of instructional technology and student achievement (Boser, 2013; Chatterji & Jones, 2012). Many researchers concluded that instructional technology was merely a tool that improved student performance only when it was used correctly (November, 2010; Sweeney, 2006). Research further suggested that teachers needed carefully-planned professional development to incorporate instructional technologies such as IWBs into the K-12 classroom (Bingimlas, 2009; Culp, Honey, & Mandinach, 2005; DeSantis, 2012). Studies also suggested that professional development was more effective when it combined both formal and informal venues (Fox, Deaney & Wilson, 2012; McNally, 2006). The review of literature found that there were benefits and drawback associated with various methods

of informal professional development (Celik, 2012; Fox et al., 2010), which included mentoring, peer coaching, collaboration opportunities, online learning portals, professional libraries for independent study, and communities of practice.

Best practices for providing effective professional development were identified (Batchelor, 2011; Enns, 2007). Research suggested that professional development should be ongoing (Gulamhussein, 2013; Hennessy & London, 2013), sustained (DeSantis, 2012; Mizell, 2010), job embedded (Bannister, 2010; Center for Technology in Learning, 2009), scaffolded and delivered in stages spaced out over time (Bingimlas, 2009; Hennessy & London, 2013), differentiated by technology skill (Ottenbreit-Leftwich, 2010; Young, Marotta & Dardenne, 2010), differentiated by subject/grade level (Bannister, 2010; Batchelor, 2011), individualized (Banyard & Underwood, 2008; Betcher & Lee, 2009), validated by portable credentials (Carrera, 2006; Liu & Batt, 2007), and provide time for reflection, practice, and exploration (Betcher & Lee, 2009; Brent & Johnson, 2011). Studies indicated that professional development should conform to theories of adult education by providing choices (Beach, 2012; Bubb & Earley, 2007). Effective professional development for incorporating IWBs should include basic troubleshooting tips (Boran, 2010; Martin et al., 2010), provide opportunities for evaluation (Blazer, 2008; Gaytan & McEwen, 2010 ) and personal reflection (Betcher & Lee, 2009; Brent & Johnson, 2011), go beyond technical fluency to facilitate changing pedagogy and lesson planning (Boran, 2010; Campbell & Kent, 2010), reflect budget constraints (Betcher & Lee, 2009; Brent & Johnson, 2011), and minimize barriers to participation (Bill & Melinda Gates Foundation, 2012; Center for Technology in Learning, 2009). Barriers were identified as time, conflict with work schedule,

geographic location, personal relevance, individual learning styles, and cost (Bill & Melinda Gates Foundation, 2012; Center for Technology in Learning, 2009). Finally, an overview of new trends in professional development that combined formal and informal training was presented (Gulamhussein, 2013; Center for Technology in Learning, 2009; Hennessy & London, 2013).

A proposed model for providing professional development for incorporating instructional technology, specifically IWBs, was developed based on best practices identified in the review of literature. A survey was designed to solicit perceptions from ITRTs regarding best practices for delivering professional development for using instructional technologies in the K-12 classrooms.

The survey was composed of 35 Likert-scale and Likert-type items (measuring level of agreement with statements). Three of these items provided the option to give comments concerning best practices. Item 36 was an open-ended question that allowed participants an opportunity to comment on or make recommendations for changes to the proposed model. A panel of experts reviewed the survey to check for validity and then the survey was pilot tested by three ITRTs. The survey was checked for reliability using the test-retest method. Assistance in distributing surveys was provided by the Virginia Society for Technology in Education executive board.

Descriptive data were calculated, including counts, percentages, means, medians, and standard deviations to determine level of agreement with statements. Responses to open-ended questions were collected and analyzed to identify trends regarding perceptions of professional development for incorporating IWBs into the K-12 classroom. Analysis of data supported research from the review of literature concerning

the importance of both formal and informal professional development and best practices for incorporating IWBs into the K-12 classroom. Nine of twenty-five respondents expressed approval of the proposed draft as presented. Suggestions for refining the model included providing for administrative participation and support, fostering motivation, and a method for determining appropriate stage of training for learners. Utilizing independent research through a professional resource library was not viewed as a viable professional development option by over half of respondents.

### **Conclusions and Refined Model**

The purpose of this study was to develop a model for providing professional development for teachers for incorporating instructional technology, particularly interactive whiteboards, into the K-12 classroom. The study results confirmed that professional development was instrumental for the success of an IWB initiative and that professional development should be carefully planned prior to implementation. Study results also reinforced the need for a model that reflected training best practices and which utilized both formal and informal training methods.

Research Objective 1 was “identify best practices for providing teacher professional development that incorporates formal training.” The review of literature indicated that formal professional development was a very effective method for incorporating technology into the classroom (Kennedy, 2005; Mills & Schmertzing, 2005; Woodall, 2012). Survey participants concurred, with 95% ( $n = 38$ ) either strongly agreeing or agreeing (with mean of 4.63) that formal professional development was an integral component for incorporating IWBs into the K-12 classroom. Moreover, participants also indicated fostering awareness of the many features of the IWB was best

facilitated through formal professional development, with 90% ( $n = 36$ ) either strongly agreeing or agreeing (with mean of 4.08). Participants also indicated that formal professional development was the best way for teachers to acquire basic skills and proficiency with IWBs in a timely manner, with 65% ( $n = 26$ ) of participants either strongly agreeing or agreeing (with mean of 3.60). Open-ended responses indicated that, while formal professional development was vital for developing skills for incorporating instructional technologies into the classroom, it was not sufficient by itself. Responses echoed research findings, which have suggested that formal professional development was easier to mandate and monitor, trained teachers in a timely manner, helped develop fluency in using the instructional technologies (Al-Mutka, 2010; Gulamhussein, 2013; Hezel Associates, 2006; Woodall, 2012), and inspired teachers to use instructional technology devices (Beglau et al., 2011).

Research Objective 2 was “identify best practices for providing teachers professional development that incorporates informal training.” Survey participants recognized the benefit of providing informal professional development for incorporating IWBs into the K-12 classroom. However, opinions varied as to the effectiveness of various methods of informal professional development. Responses from both closed and open-ended questions indicated that respondents favored some methods of informal professional development more than others. Respondents indicated that teacher collaboration was an effective method of professional development teacher collaboration, with 92.5% ( $n = 37$ ) strongly agreeing or agreeing (with mean of 4.2). Respondents agreed that mentoring was effective, with 67.5% ( $n = 27$ ) strongly agreeing or agreeing



(mean of 3.70). Respondents agreed that peer coaching was effective, with 67.5% ( $n = 27$ ) strongly agreeing or agreeing (mean of 3.70).

Survey responses revealed that 53% ( $n = 22$ ) of respondents either strongly agreed or agreed that joining a community of practice was an effective professional development method. The mean was 3.51, suggesting that respondents overall were unsure of the effectiveness of using communities of practice as a method of professional development. However, over half of respondents did believe in the effectiveness of professional learning communities ( $n = 22$ ). In addition, a growing body of research has touted the benefits of communities of practice as a method of professional development (Center for Implementing Technology in Education, 2009; Todorova & Osburg, 2010), suggesting that communities of practice support active learning, foster collegiality, provide ongoing support for teachers, and positively impact student learning (Al-Freih, 2010; Blankenship & Ruona, 2007). According to Helsing and Lemons (2008), communities of practice have been increasing in popularity among school divisions. Therefore communities of practice remained an option for informal training in the refined model.

Utilizing an online learning portal such as discussion board, wiki, or blog was considered an effective method of professional development by 47.5% of respondents, which represented slightly less than half of participants ( $n = 19$ ). The mean was 3.25. Approximately half of participants were unsure of the benefits of professional development. While online learning portals have been used for some time, they are still relatively new and underutilized as professional development vehicles (Cater, Davis, Leger, Machtmes, and Arcemont, 2013; Ferriter, 2009; Mapuva, Stoltenkamp, & Muyengwa, 2010). Even though research has found online learning portals to be effective

for delivering professional development, not all teachers may have had opportunities to use them. As Blankenship and Ruona (2007) noted, failure to use new methods may be related to school culture, leadership, and organization. Respondents may have been drawing upon their own experiences or lack of experiences with this training method, or they may have been expressing their own biases and preferences for methods of informal learning. Because of the potential of online learning portals, their growing popularity, the need to provide professional development choices for adult learners, and the support of almost half of respondents, online learning portals were also retained in the list of training options included in the refined model.

Approximately 40% of respondents ( $n = 17$ ) indicated that independent study using materials from a professional resource library was a valuable professional development method, with 42.5% either strongly agreeing or agreeing. The mean was 3.21, suggesting an overall lack of support for the effectiveness of professional resource libraries. Even though research has shown the effectiveness of professional resource libraries as a means of delivering professional development (Jenkins & Yoshimura, 2010; Oakleaf, 2010), the Internet and online resources have reduced reliance on traditional library resources (Hargadon, 2010). Maintenance of a resource library would also require significant investments in time, money, and effort. Library resources would also need to be updated frequently. According to Nace (2013), professional resource libraries “are not consistently maintained and often lose their appeal shortly after launch” (para. 2). This training option was removed from the refined model.

Survey results confirmed the research advocating the effectiveness of informal professional development for providing professional development for incorporating

instructional technologies into the K-12 classroom (Anagnou & Fragoulis, 2014; Gulamhussein, 2013; Walker, 2013). Informal professional development has been found to be effective (Carrera, 2006; Hooker, 2008), flexible (Bull et al., 2008; Cross, 2007), generally job embedded (Bill and Melinda Gates Foundation, 2012; Center for Technology in Learning, 2009), more in tune with theories of adult learning (Elmore, 2002), and the preferred method of learners (Hoekstra et al., 2009). Therefore informal professional development opportunities, including collaboration, mentoring, peer coaching, and online learning portals were kept in the refined professional development model.

Research Objective 3 was “integrate best practices for professional development into a model for incorporating instructional technologies, particularly interactive whiteboards, into the K-12 classroom.” The development of a model for providing professional development for incorporating IWBs into the K-12 classroom was an outgrowth of the review of literature which suggested that training should be carefully planned prior to the implementation of the whiteboards and was instrumental to the success of any IWB initiative (Karabenick & Conley, 2012; Mizell, 2010). Respondents concurred and 95% ( $n = 38$ ) of survey respondents either strongly agreed or agreed that training should be planned prior to implementation (with mean of 4.63) and 97.5% either strongly agreed or agreed (with mean of 4.68) that training was instrumental to the success of any IWB initiative. The refined model provided an outline for planning training.

Responses regarding best practices for professional development for incorporating instructional technology into the classroom also aligned with research. Studies found that

effective training should be ongoing (Gulamhussein, 2013). Participants' responses concurred, with 92.5% ( $n = 37$ ) strongly agreeing or agreeing that professional development must be ongoing to be effective (mean of 4.38). Thus the refined model retained training spread out over the year, to be delivered in three stages.

Research indicated that effective professional development should be job embedded (American Foundation of Teachers, 2008; Blazer, 2008; Literacy & Numeracy Secretariat, 2007). Respondents agreed with the research, and 90% ( $n = 36$ ) of responses indicated that respondents either strongly agreed or agreed that professional development should be job embedded (with mean of 4.30). The refined model preserved the many opportunities for job-embedded professional development, including mentoring, peer coaching, collaboration, online portals, and communities of practice. The refined model also retained formal training, which could also be job embedded (workshops, seminars, and online classes).

Research suggested that professional development should provide time for reflection, practice, and exploration (Betcher & Lee, 2009; Brent & Johnson, 2011). Respondents concurred, with 97.5% ( $n = 39$ ) of respondents either strongly agreeing or agreeing (mean of 4.69). The many training options, the on-going nature of the training, and the routine evaluations of trainings, which allowed time for reflection, practice, and exploration, were retained in the refined model.

Research has indicated that professional development should be scaffolded and delivered in stages spread out over time (Bannister, 2010; Hennessy & London, 2012). Respondents agreed, with 95% ( $n = 38$ ) strongly agreeing or agreeing (mean of 4.60). The proposed model called for learners to be grouped in training according to ability

groups so that adequate supports can be provided. Training was also spread out over time so that learners had opportunities for collaboration and practice. The three stages of training, which allowed for scaffolding, were retained in the refined model.

Theories of adult education suggested that adult learners needed to have choices for professional development (Bubb & Earley, 2007; Enns, 2007). Respondents agreed, with 92.5% ( $n = 37$ ) strongly agreeing or agreeing (mean of 4.30). The refined model retained numerous choices for learners in both formal and informal venues.

Research has suggested that professional development should be sustained, since there is a direct link between time spent in professional development for incorporation of instructional technologies and changes in teacher practice (Bingimlas, 2009). This pertains to interactive whiteboard training as well (Bannister, 2010; Betcher & Lee, 2009; DeSantis, 2012). Respondents agreed, with 100% ( $n = 40$ ) either strongly agreeing or agreeing (mean of 4.50). The intent of the training model was to provide a systematic way for teachers to first acquire basic skills and fluency and progress to true integration and self-actualization. Therefore the refined model preserved training in three stages of 15 hours each delivered over time.

Research has found that professional development should utilize a combination of formal and informal methods (Beglau et al., 2011; DeSantis, 2012; Hennessy & London). Participants concurred, with 97.5% ( $n = 39$ ) strongly agreeing or agreeing (mean of 4.48). The refined model retained the use of both formal training and informal trainings.

Research has indicated that professional development should be differentiated by technology skill level of participants (Bubb & Earley, 2007; Grover, 2010; Gulamhussein, 2013). Respondents concurred, with 87.5% ( $n = 35$ ) strongly agreeing or

agreeing (mean of 4.33). The three stages of training correspond to skill level of learners. Novice users began with Stage One, proficient users entered at Stage Two, and advanced users entered at Stage Three. The three stages were retained in the refined model.

Research has suggested that professional development should be differentiated by content or grade level of users (Bannister, 2010; Batchelor, 2011). Respondents agreed, with 72.5% ( $n = 29$ ) either strongly agreeing or agreeing (mean of 3.90). The model included informal options that allowed for differentiation, including collaboration, communities of practice, and online portals. Learners also had the opportunity to sign up for workshops, seminars, and classes designed for specific content or grade level. Divisions could also offer differentiated formal training sessions. Opportunities for differentiation by content or grade level were maintained in the refined model.

Research has indicated that for true integration, professional development should go beyond teaching just technical fluency, and should focus on areas such as designing lessons plans using the IWBs (Boran, 2010; Campbell & Kent, 2010). Respondents concurred, with 95% ( $n = 38$ ) either strongly agreeing or agreeing (mean of 4.63). The three stages of the model were designed to move learners from technical fluency to self-actualization whereby they could design lesson plans that optimized the use of IWBs in the classroom. These stages were retained the refined model.

Providing basic troubleshooting tips was identified as a necessary element of professional development for incorporating IWBs into the classroom (Boran, 2010; Technology in Education Task Force, 2004). Respondents concurred, with 95% ( $n = 38$ ) either strongly agreeing or agreeing that professional development should include basic troubleshooting (mean of 4.60). While troubleshooting could be considered part of basic

fluency, responses suggested that it was important enough to be added to the Stage One goals of the refined model.

Research has indicated that professional development should be individualized because not all teachers respond to the same type of training, nor do they require the same amount of time to acquire technology skills necessary to use IWBs (Gulamhussein, 2013; Ottenbreit-Leftwich, 2010). Responses found that 77.5% ( $n = 31$ ) of respondents either strongly agreed or agreed. Mean was 3.93. Responses showed that 12.5% ( $n = 5$ ) of respondents neither agreed nor disagreed about the effectiveness of individualized professional development. However, a large body of research highlights the importance of individualizing professional development (Metiri Group, 2010). Personalized learning plans for teachers were identified as a growing trend (EdSurge, 2014; Metiri Group, 2010; Murray & Zoul, 2015), promoted by state departments of education such as Ohio (Ohio Department of Education, n.d.), New Jersey (New Jersey Department of Education, 2014), New Hampshire (New Hampshire Department of Education, 2012), and Vermont (Vermont Agency of Education, 2014). As Moroder (2013) noted, teachers and administrators encourage personalized learning for students, so it would be unreasonable to say it is not effective for teachers. The refined model retains the many options, both formal and informal, that would make individualization of professional development possible.

Research has suggested that professional development, both formal and informal, should be validated by portable credentials (Carrera, 2006; Liu & Batt, 2007; Watkins, Marsick, & de Álava, 2014). Respondents agreed, with 90% ( $n = 36$ ) either strongly agreeing or agreeing (mean was 4.13). The refined model retained the recommendation

that teachers be awarded portable credentials, such as recertification points, for participation in both formal and informal professional development.

Research has indicated that professional development opportunities should be designed to overcome barriers to participation (Bill and Melinda Gates Foundation, 2014; Bingimlas, 2009; Plair, 2008). Respondents agreed, with 95% ( $n = 38$ ) either strongly agreeing or agreeing (mean was 4.35). The numerous options and structure of the refined model minimize barriers, including time, conflict with work schedule, geographic location, personal relevance, individual learning styles, and cost.

Research has indicated that professional development should be routinely evaluated to determine its effectiveness (Blazer, 2008; Gaytan & McEwen, 2012). Respondents also saw the value of evaluation, with 92.5% ( $n = 37$ ) either strongly agreeing or agreeing (mean was 4.25). While participants saw the need for evaluation, opinions varied as to what type of evaluation was needed. Respondents indicated that professional development could be evaluated through informal interviews or routine classroom observations by administrators, peers, and/or ITRTs to determine the effectiveness of professional development, with 97.5% ( $n = 39$ ) either strongly agreeing or agreeing (with mean of 4.30). Eighty percent of respondents either strongly agreed or agreed that professional development should be evaluated through methods such as formal surveys and interviews to determine teacher satisfaction with the professional (with mean of 3.95). However, only 55% ( $n = 22$ ) of respondents strongly agreed or agreed that professional development should be evaluated through a return-on-investment study to determine if the expense of the professional development has yielded results in student achievement (with mean of 3.51). The proposed model of professional



development indicated that evaluation should be conducted after each stage but did not specify what method to use. The refined model retained evaluation after each stage and left the method unspecified. Each school division can then decide what method is best to meet individual needs.

Research over time has consistently identified budget as area of consideration when developing a professional development plan (Alach, 2011; Al-Weshail et al., 1996; Diaz, 2001). A majority of respondents recognized that budget constraints must be a consideration in planning professional development, and 60% ( $n = 24$ ) of respondents strongly agreed or agreed that professional development should reflect budget constraints, while 32.5% ( $n = 13$ ) neither agreed nor disagreed (with mean of 3.73). Moreover, in open-ended questions, only one respondent mentioned budget. Lower levels of agreement could be because trainers viewed securing the funding needed for professional development as an administrative function belonging to the employer/school division (Blank & Kershaw, 2009; Constantine, 2015). Budget considerations were not addressed in the refined model.

One area of controversy concerned the number of hours of professional development needed for implementing IWBs into the classroom. All respondents recognized that professional development was needed, but responses varied on the amount of training considered necessary in each stage: 25% ( $n = 10$ ) responded that 0 to 6 hours was sufficient, 42.5% ( $n = 17$ ) responded that 6 to 14 hours was sufficient, 12.5% ( $n = 5$ ) responded that 14 to 20 hours were needed, 17.5% ( $n = 7$ ) responded that 20 or more hours were needed, and 2.5% ( $n = 1$ ) did not respond. The review of literature suggested that training of less than 15 hours was not effective (Darling-Hammond, 2009;

Gulamhussein, 2013). Research has further indicated that “learning how to use technology is not the same as learning to teach with technology” (Mazzella, 2011, p. 45) and that high-quality professional development must be longer in duration to be effective (Borthwick & Pierson, 2008). The professional development model called for 15 hours in each stage, which is the equivalent of three one-credit college courses—one credit for each stage. Thus the 15 hours of training could be a one-credit course or other formal activities, or it could include hours spent in informal training, which would include peer collaboration and pedagogical instruction among others. Learners could always opt to participate in hours beyond the minimum. Therefore the three stages, each composed of 15 hours of training, were retained in the refined model.

Overall, responses from survey participants indicated a high-level of agreement with best practices as identified in research. Moreover, 9 out of the 25 open-ended responses concerning the proposed model were supportive of the proposed model; therefore, few changes were made. However, several elements were identified by respondents for inclusion in the model. These items included the following:

1. The need for administrative buy-in.
2. The method used to determine the level of training for learners and the possibility of “testing out.”
3. Motivational techniques.

Based on the responses by participants, several modifications were made in the proposed model. No changes were made in Stage One training other than adding “troubleshooting” to the Stage One goals because a majority of respondents agreed with research suggesting basic skills were best facilitated in a timely manner through formal

professional development. This training, which includes college courses, workshops, conferences, and/or vendor training, can be spread over an extended period of time allowing opportunities between formal training sessions for informal training, which would provide opportunities for practice and reflection.

More flexibility was added to Stage Two for choices for formal and informal training, as noted by the change from a solid to a broken line. This change was made because 55% ( $n = 22$ ) of the respondents indicated that formal and informal professional development methods were equally effective, while 32.5% ( $n = 13$ ) responded that training should reflect individual choice. This modification gave Stage Two learners more choice in their training, which is in keeping with principles of adult learning. This also addresses the issue of hours of training. While the hours of professional development have not been reduced, the number of hours that participants need to spend in formal training can be more flexible.

Only one change was made to Stage Three. In the refined model, the use of a professional resource library was removed as a training option.

The refined model addressed the issue of motivation, which four survey respondents identified as a key element in encouraging professional development in all stages. Research supported the idea that motivation plays an important role in getting participants to engage in and benefit from professional development (Murray & Zoul, 2015; Rzejak, Künsting, Lipowsky, Fischer, Dezhghi, & Reichardt, 2014; Selemani-Meke, 2013). Karabenick and Conley (2012) found a direct link to motivation and classroom enactment of skills and techniques presented in professional development activities, which translated into improved student achievement. Hunzicker (2010)

agreed, noting that professional development led to increased motivation to engage in the learning process. However, researchers have pointed out that teacher motivation for professional development is a very complex, varied, unstable, and many-faceted area (Miller, Bligh, Stanley, & al Shehri, 1998; McDonald, 2011) that has received little attention from researchers (McDonald, 2011; Rzejak et al., 2014; Schieb & Karabenick, 2011). The refined model reflected the need to provide motivation to keep teachers moving from one stage to the next.

The proposed model afforded learners in all stages with the opportunity to receive recertification points, gave the learner much autonomy and choice concerning types of professional development activities, provided training that is relevant to needs of the teacher, and allowed for individualization of training—all of which can motivate learners to participate (Angeline, 2014; Richardson, Karabenick, & Watt, 2014; Selemeni-Meke, 2013; Wlodkowski, 2003). Because motivation is such a complex and individualized issue, school divisions should employ as many motivational components as possible to encourage teachers to participate in professional development activities. Training should be carefully planned, so it has interest and utility value (Karabenick & Conley, 2012; Mizell, 2010). Other motivators could include offering stipends, giving teachers who participate in training additional technology (such as classroom response systems) to accompany the IWBs, allocating time during the school day to engage in professional development, and providing other tangible incentives such as meals during formal training sessions (Randall, 2008). Some divisions have already tried giving such incentives, including Dade County in Florida, which provided sabbaticals, offered reduced class loads, and gave stipends for participation in professional development

(Bransford, Brown, & Cocking, 2000). Another motivator could be personal recognition (Carlson & Gadio, 2002). The refined model did not identify specific motivators. Each division would determine its own motivators, based on individual needs, goals, and budget.

A final change was made to the proposed model to identify the method used for assigning learners to stages. Respondents asserted their belief in the importance of grouping learners by skill level. Open-ended responses also reinforced the need for training differentiated by skill level, with 3 respondents to Survey Question 34, 4 respondents to Survey Question 35, and 4 respondents to Survey Question 36 referring to this issue. One survey respondent noted that the model did not identify the process for assigning learners to the stages of training, which, considering the importance respondents placed on training by skill level, seemed to be a necessary component. Research findings have suggested that learners should be empowered and given the opportunity to exercise personal professional judgement and to help design their own training (Davidson, 2009; Murray & Zoul, 2015). Therefore the model was refined to indicate that learners would be allowed to self-select their stage of training (Conzemius & O'Neill, 2013) or divisions might establish criteria that would allow learners to opt-out of a stage of training. Some school divisions were already using the self-select process for professional development (Hewitt & Weckstein, 2011). For example, Mount Laurel Public Schools (2010) in New Jersey created a template for division schools to follow that incorporated many self-selection options for teacher professional development. Dominican High School, in Whitefish Bay, Wisconsin, is another school system that has provided opportunities for teachers to self-select. The school intended to begin designing

and teaching blended learning classes using Moodle. Teachers and other faculty members were given the self-select opportunity to enter either the Beginning Moodle Users or the Experienced Moodle Users group. A report by the Bill and Melinda Gates Foundation (2014) revealed the number of teachers using self-guided online professional development resources was growing and teachers have expressed a desire for more opportunities to participate in self-guided training. The report also noted teachers engaging in self-selected professional development reported a much higher satisfaction rate with their training.

Respondents could also be assigned to the appropriate stage of training using the opt-out/test-out method whereby teachers could skip Stage One or Stage Two by demonstrating the knowledge, skills, and fluency of a particular stage. Gray (2015) suggested that a school division could post a list of tasks that would demonstrate proficiency and have learners post evidence on the division learning management system. Some school divisions have tried variations of opt-out/test-out. In Pennsylvania, the East Stroudsburg Area School District (n.d.) developed a request form to get approval for alternate professional development that could be used to bypass a stage of training and substitute other professional development. Therefore the refined model added the method used to determine stage of training for learners.

See Figure 2 for the refined model for incorporating IWBs into the K-12 classroom. Appendix J details the proposed model.

### **Recommendations for Further Research**

Professional development has been identified as an important variable in the success of incorporating instructional technology into the K-12 classroom. This applies

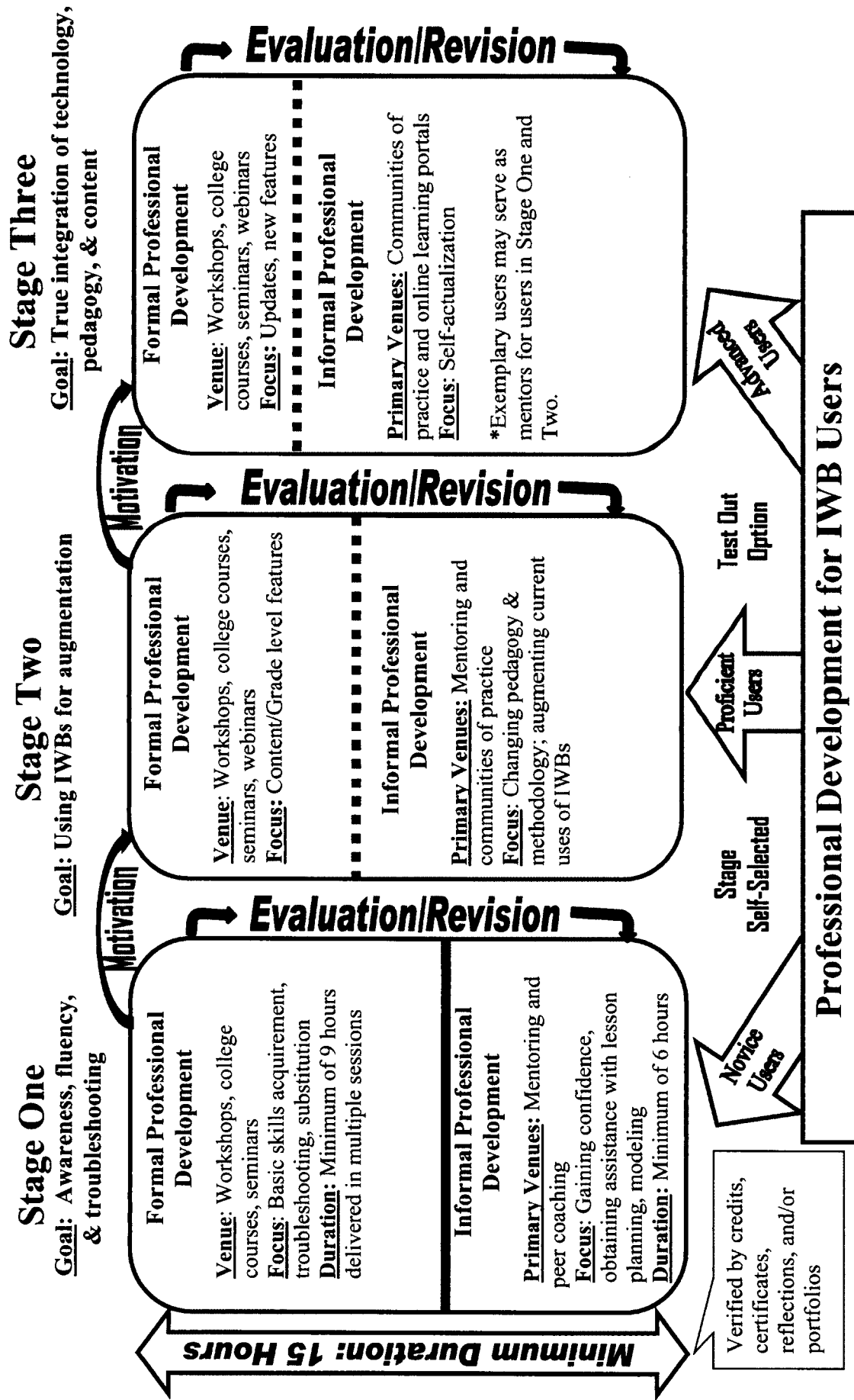


Figure 2. Professional Development Model. This model is for professional development for teachers for incorporating IWBs into the K-

12 classroom.

particularly to interactive whiteboards, because they are such complex and powerful tools for teaching and learning. In order to implement the findings of this study, the following recommendations were made:

1. It is recommended that school divisions invest more administrative time, money, and effort into designing professional development opportunities for incorporating instructional technologies, especially interactive whiteboards into the K-12 classrooms. While legislation such as NCLB has mandated professional development and given loose guidelines, it has been left up to school divisions to decide how to carry out these mandates. Detailed plans should be developed prior to the purchase and implementation of these devices to ensure that teachers are provided with the support that they need to use them to enhance student learning. Research has shown that while professional development has been identified as critical for any technology initiative, school divisions have failed to allocate funds to provide the sustained, ongoing, high-quality professional development necessary for successful integration. Part of the long term implementation plan should include strategies to minimize barriers to professional development. These barriers—which include time, conflict with work schedule, geographic location, personal relevance, individual learning styles, and cost—have long been identified, but they can be decreased with careful planning. Careful planning would also allow divisions to develop a motivational plan for encouraging participation in professional development.
2. It is recommended that the model developed as part of this study be adopted for use in K-12 classrooms. The model was developed based on best practices derived from a review of literature and refined through survey research based on responses from



I TRTs in Virginia. The model provided a sequential, scaffolded, detailed plan for training that includes both formal and informal professional development opportunities. The model can be modified to fit individual school systems with different needs and budgets. I TRTs could help implement the model. Knowledge of the model could be disseminated through organizations such as the International Society for Technology in Education (ISTE) or, the Virginia arm, VSTE, which assisted in recruiting participants for this study.

3. It is recommended that school divisions determine methods of evaluation for professional development offered to incorporate IWBs (or other technologies) into the K-12 classroom. The proposed model of professional development included ongoing evaluation to determine the value of the training, traditionally measured in terms of student achievement. This allows for improvements to be made in the professional development offered. Research has shown that much of the evaluation for professional development that takes place is superficial and seldom results in return-on-investment data.

This study also brought to light several issues recommended for further study.

These issues included the following:

1. A pilot program should be conducted using the finalized model for incorporating IWBs (or other instructional technologies) into the K-12 classroom to determine if the model provides enhanced professional development as evidenced by an increase in the level of learner satisfaction and an improvement in student achievement. If weaknesses are found, then the model can be further revised.

2. Further research should be conducted on optimizing time during the school day/year for providing teachers opportunities for formal professional development as well as for collaboration, observation, mentoring, participation in communities of practice, and conducting action research (Bransford, Brown, & Cocking, 2000). Research indicates that informal professional development can be very effective, including mentoring, peer tutoring, communities of practice, professional resource libraries, online portals, and collaboration time. Some school divisions have been attempting to use these informal professional development activities, and individual schools and divisions have reported some successes. Many school divisions have started using faculty meetings as opportunities for providing professional development rather than as a time for the principal to deliver information (Murray & Zoul, 2015). Other divisions have utilized methods such as brown-bag lunch sessions. For example, Hilliard City Schools in Ohio (2014) implemented Lunch and Learn sessions where teachers meet with ITRTs during lunch periods to receive one-on-one professional development for incorporating technology into the classroom. Some schools have instituted alternative scheduling, such as block scheduling, for creating opportunities for mentoring and action research (Small, 2000). Other schools have experimented with creating flexible schedules for teachers to allow for observation and mentoring (Glover & Mutchier, 2000; Leiseth, 2008), such as the four-day school week (Donis-Keller & Silvernail, 2009; Leiseth, 2008; Sheehy, 2013) and year-round schools (Dixon, 2011). However, the Bill and Melinda Gates Foundation (2014) reports that attempts to restructure professional development have been described as “not meeting teachers’ needs” (p. 3), which was attributed to “a problem of execution” (p. 5). This

- suggests that more research for finding opportunities for embedding formal and informal professional development into the school day/year needs to be conducted.
3. Research on ways to motivate teachers to participate in professional development was identified as a need. Currently this issue has received insufficient attention from researchers (McDonald, 2011; Rzejak et al., 2014; Schieb & Karabenick, 2011). Research by Karabenick and Conley (2011) found that teachers were motivated by stipends, credits, professional development that fulfilled licensing requirements, or training that enhanced their job security. However, as Murray and Zoul (2015) noted, not all learners are motivated by the same thing and they recommend tying “teacher learning plans to teacher motivation for learning” (p. 11). Research should be conducted on identifying successful motivational strategies and techniques used by school divisions.
  4. One way of motivating learners to participate in informal learning is the awarding of portable credentials. As Moroder (2014) noted, although there has been a “vast shift in how we pursue knowledge, little has changed with how we credential those who acquire knowledge. We still primarily credential learners based on seat time and credit hours, and often only recognize learning pursued through traditional pathways” (para. 7). Moroder pointed out that teachers engage in online learning with Twitter chats, edcamps, and MOOCs, among others. Various ways have been suggested for micro-credentialing, such as the issuing of badges (Boll, n.d.; Elkordy, 2012; Moroder, 2014). Research needs to be conducted to develop guidelines for alternative credentialing that ensure rigor, ease of use, scalability, and uniformity so badges/credentials will be recognized and accepted by educational institutions.

5. One survey respondent noted that administrative buy-in was crucial for any instructional technology professional development plan to work. This point was supported by research, which has indicated that administrators play a key role in the successful incorporation of instructional technology in the classroom (Harwell, 2006; Salpeter, 2003). Research has also suggested that administrators should be competent users of instructional technology, who can model the use of technological tools, and who will participate in professional development (Demski, 2012; Education Alliance, 2008; North Central Regional Technology in Education Consortium, 2001). As Webb (2011) noted, “Instructional leaders directly and indirectly determine the success or failure of teacher competencies in instructional technology” (p. 2). Webb further suggested that administrators, whom he identifies as the instructional leaders, needed to have a comprehensive understanding of the technology to be able to provide for successful technology integration. Moreover the Center for Implementing Technology in Education (2012) noted that administrators were important because they must provide the necessary resources, which included money, time, professional development opportunities, and staff. Further research should be conducted to develop a professional development model that incorporates administrators.
6. A final recommendation for future research would be to disaggregate survey data to determine whether the professional development needs of teachers for incorporating interactive whiteboards into the K-12 classroom differ depending upon socio-economic status, community setting, school division size, or geographic location.

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Appendix A

**Survey to Gather Data to Develop a Model for Providing Effective Professional Development for Incorporating Interactive Whiteboards in the K-12 Classroom**

**Purpose:**

You are being requested to participate in a research study designed to develop a model for providing effective professional development for teachers for incorporating IWBs into their K-12 teaching. Attached to this survey, you will find a proposed training model. Please review this model and complete the attached survey. Your participation will be greatly appreciated.

**PART I:**

**Directions:** Indicate your level of agreement with each of the following statements regarding Professional Development (PD) for incorporating interactive whiteboards (IWBs) into the classroom:

Statements

**Professional development for incorporating IWBs into the classroom. . .**

- |   | Strongly Agree           | Agree                    | Neither agree nor disagree | Disagree                 | Strongly Disagree        |
|---|--------------------------|--------------------------|----------------------------|--------------------------|--------------------------|
| 1. should be carefully planned prior to implementation of the boards.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. is instrumental to the success to any IWB initiative.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. must be ongoing to be effective.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. should be hands-on and active rather than passive.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. should be job-embedded.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. should provide time for reflection, practice, and exploration.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. should be scaffolded and delivered in stages spread out over time.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. should conform to theories of adult education by providing training choices for learning experiences.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. should be sustained, since there is a direct link between time spent in PD for incorporation of IWBs into the classroom and changes in teacher practice. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. should utilize a combination of formal and informal methods.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |

Statements	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
<b>Professional development for incorporating IWBs into the classroom...</b>					
11. should foster awareness of the many features of the IWB, which is best facilitated by formal training.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. delivered through formal venues such as workshops, seminars, or college courses, which is the best way for teachers to acquire basic skills and proficiency for using IWBs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. should be differentiated by technology skill level of participants.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. should be differentiated by content or grade level users, so that mathematics teachers are grouped with mathematics teachers, early elementary teachers with other elementary teachers, etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. should be delivered in a formal manner enabling users to become proficient in a more timely manner than a self-study method.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. should go beyond teaching just technical fluency, and should focus on areas such as designing lesson plans using the IWBs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. should include basic troubleshooting.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. should be individualized, since not all teachers require the same amount of time to acquire technology skills necessary to use IWBs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. should be validated by portable credentials (such as recertification points) for both formal and informal venues.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. can be delivered through a mentoring program, since mentoring is an effective method of professional development.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. can be delivered effectively through peer coaching.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. should incorporate teacher collaboration, which is an effective method of professional development.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. can be facilitated effectively by joining a community of practice.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. can be facilitated effectively through independent study using materials from a professional resource library.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. can be delivered effectively by utilizing an online learning portal (discussion board, wiki, blog, etc.).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



<b>Statements</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Neither agree nor disagree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
<b>Professional development for incorporating IWBs into the classroom...</b>					
26. should be evaluated routinely to determine its effectiveness.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. should be evaluated through methods such as formal surveys and interviews to determine teacher satisfaction with the professional development provided to them.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. should be evaluated through return-on-investment studies to determine if the expense of the professional development has yielded results in student achievement.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. can be evaluated through informal interviews or routine classroom observations by administrators, peers, and/or ITRTs to determine the effectiveness of professional development.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. should provide opportunities for teachers to reflect on their practice and evaluate their learning.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. must reflect budget constraints.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. should provide options that overcome or minimize barriers to participation in professional development, including time, conflict with work schedule, geographic location, personal relevance, individual learning styles, and cost.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**PART II**

Please select the answer to the following questions that best reflects your opinion on the following statement. Comment boxes will allow for additional comments.

**Statements or Questions with Comment Boxes**

33. Formal training, including college courses, seminars/conferences, workshops (including those provided by vendors, ITRTs, and master teachers) for incorporating IWBs into the classroom can be very effective.
- |                          |                          |                            |                          |                          |
|--------------------------|--------------------------|----------------------------|--------------------------|--------------------------|
| Strongly agree           | Agree                    | Neither agree nor disagree | Disagree                 | Strongly Disagree        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/> |

Additional Comments concerning formal training:

34. Which of the following responses best describes your feelings about PD for incorporating IWBs into the classroom
- |  |  |  |  |   |   |
|--|--|--|--|---|---|
| Formal PD is more effective than informal. | Formal PD is more effective than formal. | Informal PD is more effective than formal. | Formal PD and informal PD are equally effective. | No opinion on the effectiveness of either informal or formal PD | Individual choice, since some people learn best through formal PD while others prefer informal PD |
| <input type="checkbox"/>                   | <input type="checkbox"/>                 | <input type="checkbox"/>                   | <input type="checkbox"/>                         | <input type="checkbox"/>  | <input type="checkbox"/>  |

Additional Comments:

**Statements or Questions with Comment Boxes**

35. Approximately how many hours of PD (formal and/or informal) are needed for providing rigorous, effective, PD for incorporating IWBs into the classroom?
- |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| No PD is needed          | From 0 to 6 hours        | From 6 to 14 hours       | From 14 to 20 hours      | More than 20 hours       |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Additional Comments:

**PART III**

**Please read and respond to the question below.**

36. Review the proposed model for professional development for incorporating IWBs into the classroom and provide comments and/or recommendations for changes. List any other elements that should be included in a training model.

Comments:

**PART IV DEMOGRAPHIC INFORMATION:**

**Questions Regarding Respondent**

37. Which of the following best describes the size of your division?  
 Small (fewer than 5,000 students)  Midsize (between 5,000 and 10,000 students)  Large (over 10,000 students)   
 Urban (city/town)  Suburban  Rural
38. Which of the following best describes your school?  
 High poverty (over 50% free & reduced lunch)  Average income (between 30% and 50% free and reduced lunch)  Affluent (less than 30% free and reduced lunch)
39. Which of the following best describes your school?  
 Region 1  Region 2  Region 3  Region 4  Region 5  Region 6  Region 7  Region 8
40. Which region includes your school division?  
 Region 1  Region 2  Region 3  Region 4  Region 5  Region 6  Region 7  Region 8

**PART V OPTIONAL FOR INCLUSION IN DRAWING:**

41. If you would like to be included in the drawing for a \$100 Walmart gift card, please provide your name and email address below.  
 All names will remain anonymous during and after the study.

Name  Email address

*Please contact Elizabeth Jamerson at [ejame006@odu.edu](mailto:ejame006@odu.edu) or at 804-492-4212 if you have any questions concerning this survey.*

## Appendix B

### Flyer to Secure Self-Selecting Survey Participants

# VSTE Members Needed

## To Participate in Research Survey



### Survey Goal

Provide input that will help refine a proposed model of professional development for incorporating instructional technology, especially interactive whiteboards, into the K-12 classroom.

### Participant Criteria

In order to participate in the study, respondents should meet the following criteria:

- 1) Be a member of VSTE
- 2) Be an Instructional Technology Resource Teacher in a public school in Virginia
- 3) Have a desire to help develop an effective professional development model for incorporating instructional technology into the K-12 classroom

### Survey Requirements

Complete a survey designed to gather information about best practices for providing professional development and to comment on a proposed professional development model. Survey should take approximately 20 minutes.

### Incentives for Participation

- Personal satisfaction for furthering educational research
- Chance to enter a drawing for a \$100 Wal-Mart Gift Card

### Volunteer Process

Volunteers are asked to sign up on the Google doc listed below  
<https://docs.google.com/a/cucps.k12.va.us/document/d/1qW1Pyu9ycwzuX3Ttg8OA45HqKPW8myzpYGPVSXV5AXs/edit#>

OR

email Elizabeth Jamerson at [ejame006@odu.edu](mailto:ejame006@odu.edu)  
and more information as well as a link to an online survey will be given.

## Appendix C

**Sign-up Sheet for Survey Participants**

VSTE members who serve as ITRTs and are willing to participate in a survey to gather data to be used to refine a model for professional development for incorporating instructional technology, particularly interactive whiteboards, into the K-12 classroom are requested to sign below. You will then be sent a link to an online survey. Your participation is greatly appreciated.

	<b>NAME</b>	<b>EMAIL ADDRESS</b>	<b>CoSN MEMBER (Y/N)</b>
<b>Region 1</b>			
1.			
2.			
3.			
4.			
5.			
<b>Region 2</b>			
1.			
2.			
3.			
4.			
5.			
<b>Region 3</b>			
1.			
2.			
3.			
4.			
5.			
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	<b>NAME</b>	<b>EMAIL ADDRESS</b>	<b>CoSN MEMBER (Y/N)</b>
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## Appendix D

### Request for Participation in Research Study

[Date]

Dear Instructional Technology Resource Teacher:

You are being requested to participate in a research study designed to develop a model for providing effective professional development for teachers for incorporating interactive whiteboards (IWBs) into their K-12 teaching. Input from you will assist in developing best practices for developing future training programs. This study is being conducted in partial fulfillment of the requirements for the attainment of a doctoral degree from Old Dominion University.

While there are no direct benefits for taking part in this study, by participating you will be helping to expand the body of knowledge in the field and will have the opportunity to review the completed results of the study, since I would be happy to share the study results with any interested participants. There are limited risks of participating in the study. Individual names of respondents will remain anonymous. However, as an incentive to participate, those who chose to provide their name and email address will be entered into a drawing for a \$100 Walmart gift card. Names will be kept confidential during and after the study. Moreover, no school division will be identified individually. The research will be monitored by my ODU advisor, Dr. John Ritz, who is the Graduate Program Coordinator.

A Survey Monkey link is provided for your convenience. Please click the link and enter your responses to the questions. Your participation in the survey will be greatly appreciated. By returning this survey, you are giving permission to use this information in my research study. Please complete the survey by [Date].

If you have any questions, please do not hesitate to ask. I look forward to receiving your information.

[Survey Monkey Link](#)

Sincerely,

Elizabeth G. Jamerson  
Doctoral Student, Old Dominion University  
[ejame006@odu.edu](mailto:ejame006@odu.edu)

John M. Ritz  
Professor  
Old Dominion University



## Appendix E

### Follow-up Request to Participate in Research Study

[Date]

Dear Instructional Technology Resource Teacher:

Approximately 10 days ago I e-mailed you a link to an online survey, which is part of a research study designed to develop a model for providing effective professional development for teachers for incorporating interactive whiteboards (IWBs) into their K-12 teaching. I realize that educators have very hectic schedules, but I would greatly appreciate it if you could find the time to complete the survey, if you have not already done so, and give your opinions regarding best practices for developing a model of effective professional development.

While there are no direct benefits for participation in this study, by participating you will be helping to expand the body of knowledge in the field and will have the opportunity to review the completed results of the study, since I would be happy to share the study results with any interested participants. There are limited risks of participating in the study. Individual names of respondents will remain confidential. However, as an incentive to participate, those who chose to provide their name and email address will be entered into a drawing for a \$100 Walmart gift card. Names will be kept confidential during and after the study. Moreover, no school division will be identified individually. The research will be monitored by my ODU advisor, Dr. John Ritz, a senior professor and researcher.

A Survey Monkey link is provided for your convenience. Please click the link and enter your responses to the questions. Your participation in the survey will be greatly appreciated. By returning this survey, you are giving permission to use this information in my research study. Please complete the survey by [insert date] if at all possible.

#### Survey Monkey Link

If you have any questions, please do not hesitate to ask. I can be reached at [ejame006@odu.edu](mailto:ejame006@odu.edu) or by phone at 804-492-4212.

Sincerely,

Elizabeth G. Jamerson  
Doctoral Student, ODU  
[ejame006@odu.edu](mailto:ejame006@odu.edu)

John M. Ritz  
Professor  
Old Dominion University

## Appendix F

### Responses for Survey Question 33

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#### ITRT Comments on Formal Training for IWBs

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With the busy schedule of many teachers, if you leave it up to them to train themselves via webinar, online course, etc., many will not get the training.

The effectiveness of any training is very dependent on the trainer and the participants themselves. An independent course could be very effective for those who are interested in learning and a group training can be spoiled by unwilling participants. Also I think this study should have asked about IWBs in general. I personally think there is a lot of benefit from them for elementary school classrooms but the cost to use ratio is better spent on individual devices or trying to get closer to a one to one than on IWBs.

Because of some of the content-specific abilities of the IWBs, Math especially, training should be individualized by content. Additionally, the use of Senteos (clickers), should be a separate training from the IWB training.

I personally feel the IWB is one of the lowest forms of technology that should be used with our students. I think it is "old school." After 11 years working with IWBs the value of this tool is minimal in education.

Training needs to meet specific needs of subject/grade level.

Formal training can be effective for those who prefer to learn this way. In my experience, formal training alone is not effective though. Those who are hesitant usually use the formal training as the "buy in" for whether to use the IWB strategy. Once the participant believes in the benefit, then both formal and informal together work well. It is important that the training not be in isolation but relate to the teachers course content. Therefore, teachers should be grouped by content and come away with lessons they can use with their students.

This needs to be on going. Teacher[s] do not benefit as much through a "one and done" workshop. There needs to be follow up and continuous learning to stay current.

I have done many SMART and Promethean IWB training for conferences, colleges, and schools. I work hard to make my trainings affordable and hands-on.

While I agree with this statement, I do not feel it is solely the appropriate source of IWB training.

I feel that it is ore effective in smaller groups and similar skill level.

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## Appendix G

### Responses to Survey Question 34

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#### ITRT Comments on the Relative Benefits of Using Both Formal and Informal Training for Incorporating IWBs into the K-12 Classroom

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I think initial formal training is a good idea, followed up with informal, PLC or individual training (which is also much more cost effective).

Unfortunately some teachers need to be "pushed" into the training and need formal professional development to get started and embrace the introduction of IWB's. In the long run, however, I have found the greatest growth in my teachers with one-on-one informal training.

Over the years, I have found that it is highly beneficial to conduct trainings by content, especially where Math is concerned, due to the content-specific abilities that IWBs present. Additionally, I conduct beginner and intermediate training sessions. This has helped to increase the usage of IWBs beyond being a glorified projection screen.

Having the formal--presenting the new skill and then the informal--giving teachers time to practice and collaborate what they have just learned.

This can be mixed. It must be on going.

Depending on teacher's needs and comfort level with technology can effect [sic] this.

Teachers often listen more to their peers than to outside PD.

I believe it is the participant's own motivation, learning style, and desire that reflects the effectiveness of any PD.

Training (minimum of once a year) should be mandatory (or the teacher can "test out" by submitting a formal lesson plan.

While I agree with this statement, I do not feel it is solely the appropriate source of IWB training.

I feel that it is more effective in smaller groups and similar skill level.

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## Appendix H

### Responses to Survey Question 35

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#### I TRT Comments on the Number of Hours of Professional Development Needed for Incorporating IWBs into the K-12 Classroom

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On the low end of this [6 to 14 hours]. 3 or 4 two or three hour sessions.

It takes time and practice to create interactive activities for the various contents. Additionally, if you present everything that a IWB can do and expect the teachers to be able to jump right in, you will lose the majority of them. IWB use needs to be implemented at the rate which the teacher feels comfortable using; otherwise, they will only use it as a projection screen.

The answer to this question depends on the level of technology expertise the learner has therefore, there needs to be another choice given.

Basic things can be mastered quickly. Going back the 6 hours of training would be to master more complicated features.

100% of our classrooms include an IWB. Some teachers were required to "earn" their board through taking a course on how to effectively implement the IWB in the classroom. There are other teachers in the county that inherited an IWB or received one through new building budgets. I feel that the teachers that earned the IWB use them more effectively in the classroom than those that inherited them.

Like anything, practice after the training and then have another training helps teachers. Having teachers share lessons, train each other also help [sic] a lot.

Depends on if the teacher wants to learn.

I am basing this answer on a technology proficient person. Those who are less proficient I believe would need more, as would a more advanced person may need less.

Implementation and guidance and reinforcement of PD would increase effectiveness in my opinion; the old "Use it or lose it" theory.

Depending on the participants [sic] level of technology competency.

The training must be ongoing if you are taking into consideration that the incorporation will be continuous.

I have offered Community College classes on Activinspire and Promethean and the teachers still found much more to learn, but by learning the basics of the board and the software that comes with the board, then the teacher can learn more through the ITRT, instructional videos provided by the vender [sic], and step-by-step instructions.

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## Appendix I

### Responses to Survey Question 36

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#### ITRT Comments on or Recommendations for Changes to the Proposed Model for Professional Development for Incorporating IWBs into the K-12 Classroom

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This PD model takes into account the varied eeriest [sic] that teachers have using Interactive Whiteboards for teaching and learning. Many teachers don't like to attend training on topics they feel they have already mastered. Professional Learning Communities including grade level or subect teachers will be valuable as teachers can share lesson plans and activities using interactive whiteboards for teaching and learning.

The above plan looks to be effective. I would not make any changes.

I think the model is a great PD plan for incorporating IWBs in the classroom. I think the online learning is best used with those in the advanced users group. The greatest amount of formal training should be with beginning users.

I think the school division is spending a lot of money to implement these boards so they are trying to push the training to make sure the boards are being used. However, teachers already have a lot on their plate and you don't want them to start associating these boards with more work and painful required training because many will let that cloud their opinion of the board in general.

Comments [sic] need to start working with IWBs in undergraduate courses.

Seems well-thought out and a natural progression in use.

Looks good...just wondering who decides the level of user from novice to advance? Occasionally I am under the impression my teachers are further along than what I find when I work individually with the teacher.

Stage 1: Eliminate peer coaching. Based upon my years of IWB training, I strongly feel that all training in Stage 1 should be formal training.

The model would work.

There needs to be admin buy in. Without it you are wasting your time.

Stages one and two need to be done together. Just learning the features/basics of the IWB and expecting teachers to forge ahead with planning lessons with the completion of just Stage one is not logical. Teachers consistently think of how it applies to their content and how to use it in lessons. Stage three is a separate and could be done at the beginning to tap in to those advanced users in the lesson planning aspect of training.

I like the model and I agree that a re-evaluation needs to take place after each stage. I love the mentoring from the high end users.

Each level should include remediation of prior learning to enhance current instruction.

The model looks fantastic however, where is the motivation? Credits and certificates can provide some motivation however you may want to look to your stage 3 teachers to help in motivating the laggards. The people in stage three are not only going to provide a means to allow for mentors but, they also need to be held up as examples, key innovators, and leaders in the educational technology. Ed tech leadership needs to take place in the classroom, not just from ITRT's and above. You will have far more motivation with the teachers using the IWB's effectively in the classroom. ITRT's are great but, they tend to lose credibility because they are no longer "in the trenches" so to speak.

Some teachers may not need as many hours as others because teachers are all at different levels of technology skills. It is good to have a model to use for most teachers but feel free to differentiate for those teachers that need more or less training or can learn on their own.

I think 9 hours of college courses, workshops and seminars to become a Novice is too many hours. I've had Stage 2 and 3 seem on track and I would agree with the description given.

I really like this proposed model for professional development for incorporating IWBs into the classroom. I think it is important that all users travel through each stage of this model to demonstrate thoughtful applications and best practices of IWB in instruction.

I don't think you need to have a minimum number of hours because that is dependent on the learner. Each teacher will learn the skills at a different pace.

This is all great but as an ITRT, I can tell you that co-teaching followed by giving the teacher a lesson ready to go is the best way to get a teacher using an IWB. Once they are hooked, they will want to do more and more. If I set them in a class for more than 2 hours, I have lost them. Teachers who are good at technology will pick it up with an hour training. Teachers who struggle will need on going support but sitting them in a class all day will turn them off. Good luck with your project.

6 hours maximum for stage one. Teachers are stressed to balance work/life and 15 hours to learn the basics is far to [sic] long. I have taught and been a learner in stages one and two. Combined they take 15 hours.

It is a little busy and would be overwhelming to the average person to view and understand. I think the novice would need more time to learn and "play with" to get accustomed to it. The only thing that seems would be an issue would be time. Having the time for a mentor or peer coach to work with someone in informal pd would be difficult - at least in our division. Having step by step guides and how-to guides and how-to guides would be very helpful, especially for the novice.

The initial instruction of basic usage and reflection seem rather high to me. Using past participants who are proficient users as coaches and mentors is a meritorious use of human resources. Integrating specific content areas and creating lesson plans the participants can use on various levels of SAMR would be advantageous for the participants. As always, self-reflection of acquisition and implementation of skill is paramount.

I am not sure if this will be addressed in future questions, but I am interested in how the model could address the various IWB software and sites. Also, if there is a way to incorporate/use each of the technologies. I really like the proficient user Focus (both informal and formal). Our school's biggest problem is that the teachers use the board, but rarely do we see the students interacting with it. Somewhere along the line, teachers felt that the time it takes to get students to the board was not worth it. Lesson plans and training need to have that element first and foremost.

To increase motivation, students need to create IWB files that are relevant to them and their usage. If you are an advanced user, I feel that even less formal training is necessary. Advanced users adapt easily to new concepts and are often able to work out information on their own. They are more open to trying out these new concepts without direct instruction.

Looks good.

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## **Appendix J**

### **Overview of Model**

The benefits of interactive whiteboards have been hotly debated, with some researchers claiming that interactive whiteboards improve student achievement, while others claim that the technologies have no effect on student progress. Other researchers concluded that interactive whiteboards are tools which can improve student achievement only if they are used effectively. Research has further suggested that teachers need high quality professional development that incorporates both formal and informal elements to assist teachers incorporate interactive whiteboards into the K-12 classroom. The purpose of this study was to develop a model for providing effective professional development for teachers for incorporating interactive whiteboards into the K-12 classroom.

A proposed model of professional development was developed based on a review of literature. The model was then refined through a survey that gathered perceptions of effective training practices from members of the Virginia Society for Technology in Education who serve as instructional technology resource teachers.

The refined model incorporated both formal and informal training opportunities. The model also conformed to theories of adult education, was structured to allow for individualization, and was designed to accommodate learners in all content areas and with varying levels of expertise. Because best practices dictated that effective professional development should be ongoing and scaffolded, the final model was delivered in three stages spread out over time.



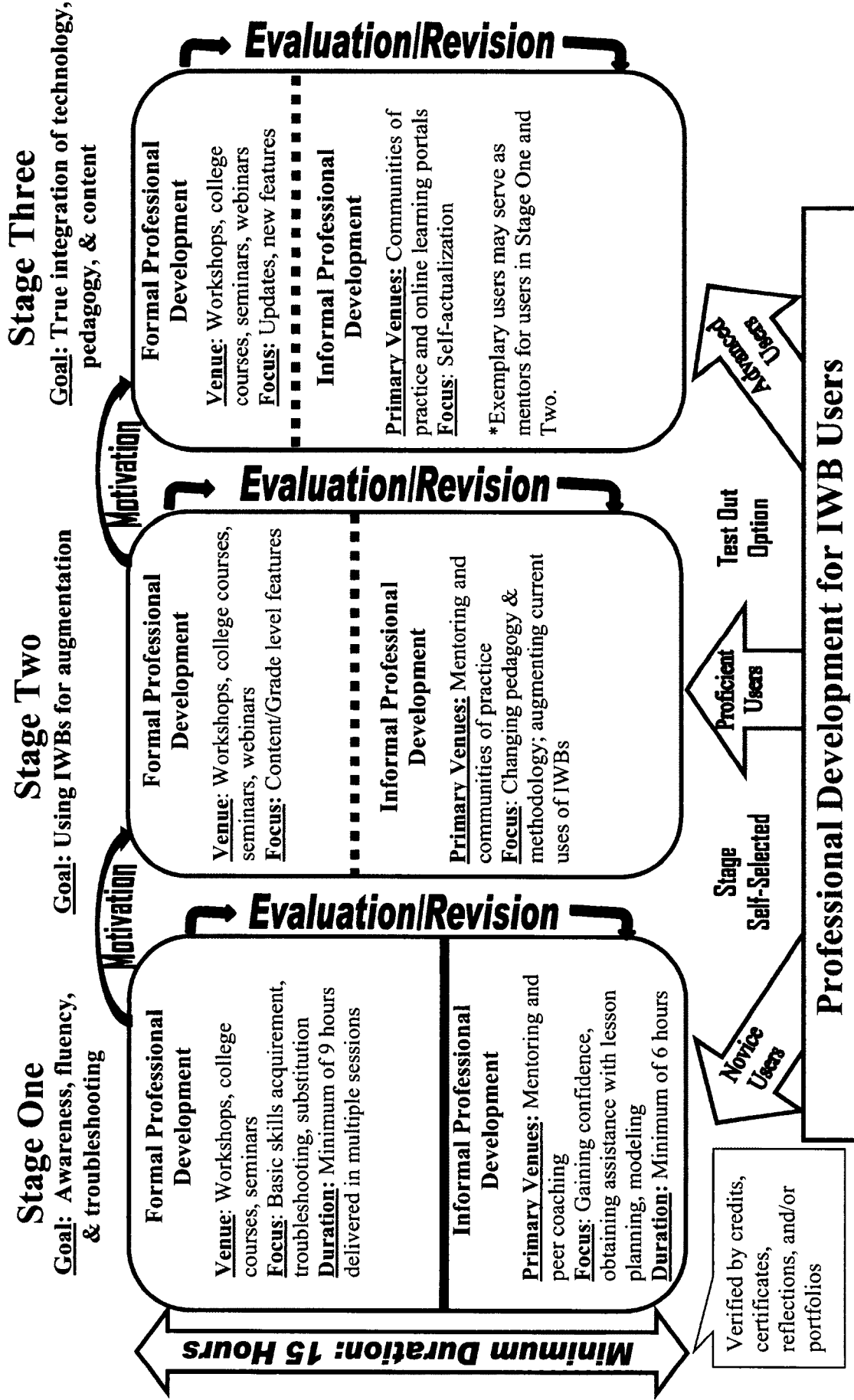


Figure 2. Professional Development Model. This model provides a model for professional development for teachers for incorporating IWBs into the K-12 classroom.

Professional development in Stage One provides introductory skills in the use of interactive whiteboards. The goal of Stage One training is awareness of the many capabilities of the boards, the attainment of basic operational skills, and knowledge of basic troubleshooting techniques—all of which have been deemed essential for gaining fluency and confidence (Alach, 2011; Association of Latino Administrators and Superintendents, 2011; Bahadur & Oogarah, 2013; Boran, 2010; Chen & Chang, 2006; Hallinan, 2009; Hooker, 2008; Mills & Schmertzing, 2005; Minor, Losike-Sedimo, Reglin, & Royster, 2013; Park & Ertmer, 2008; Slay et al., 2008; Technology in Education Task Force, 2004), as well as necessary for using instructional technology in a way that increases student achievement (Murcia & McKenzie, 2009). After Stage One training, all teachers should have, at a minimum, reached the substitution level as outlined by Puentadura (2010, 2012), whereby teachers can fluently use interactive whiteboards as a direct tool substitute both with and without functional improvement, thereby enhancing instruction. As Lee (2009) noted, substituting the new technology to do things that the old technologies could do, such as writing on the IWB just like writing on a regular whiteboard, is a normal step in the learning continuum.

Both formal and informal training is provided in Stage One, since research has indicated that a combination of both methods is best (Cassandra Drennon & Associates, 2005; Center for Implementing Technology into Education, 2012; Parise & Spillane, 2010). Formal training in the form of workshops, college courses, or seminars is made available to teachers because formal training systematically allows the user to begin to accumulate the basic skills needed for all users in a timely manner (American Federation of Teachers, 2008; Guzman & Nussbaum, 2009; Hazel Associates, 2006), serves to

inspire teachers (Shareski, 2004) and boost confidence levels (Benedetto, 2005; Smith & Kritsonis, 2006), and has been shown to be effective in teaching skills (Kennedy, 2005; Tienken & Achilles, 2005). The experts in the field can be college instructors (with training delivered through distance learning if desired), trainers provided by vendors, or master teachers using the train-the-trainer model (American Federation of Teachers, 2008; Bannister, 2010; Chen & Chang, 2006; Lee, 2009; Murcia & McKenzie, 2009; Trombley, 2012), depending on the available resources and constraints. This is combined with informal learning techniques, which can meet the needs of individual teachers who do not all learn at the same rate or through the same style (American Federation of Teachers, 2008; Bannister, 2010; Cooper, 2008). Emphasis is placed on mentoring and peer coaching. Instructional Technology Resource Teachers can serve as mentors because they have the expertise, are readily available, and can assume these duties as part of job responsibilities, thereby reducing training costs. Mentoring and peer coaching provide opportunities for mutual learning, reduce isolation, provide social and academic support, and have the advantages of being easy to structure, cost effective, and job-embedded (Beglau et al., 2011; Bill and Melinda Gates Foundation, 2012; Carter-Ward, 2006; Cheetham & Chivers, 2001; Cooper, 2008; Gulamhussein, 2013; Kennedy, 2005; Literacy and Numeracy Secretariat, 2007; Mizell, 2010; Oigara & Wallace, 2012; Ottenbreit-Leftwich, 2010).

Formal professional development is validated by college credits, certifications, and attendance sheets. Informal training is validated by logs of hours spent in mentoring, or peer coaching, by personal reflections, and by journals (Nightingale, 2006). As Colardyn and Bjornavold (2004) noted, validation is important for the learner to show

that he/she has obtained the skills and knowledge necessary for the job, and important for the employer, so he/she will not duplicate the training.

Time spent in Stage One training activities should equal a minimum of nine hours of formal training and six hours of informal training spread out over the school year. This number of hours was based on guidelines provided by NCLB regulations mandating that training sessions be sustained and no shorter than three hours, on research indicating that one-shot trainings are ineffective, on best practices suggesting that training be on-going and involve both formal and informal learning methods, and on the typical training length for basic skill training by vendors for incorporating IWBs into the classroom (Bannister, 2010; Darling-Hammond, 2009; Gulamhussein, 2013; SMART Technologies, 2014b; Virginia Department of Education, 2004b). Because school divisions spent more than 15 hours per year on average on professional development (Lim, Abas, & Mansor, 2010), training of this duration would fit into the professional development plans of most schools, with additional time remaining for training in other areas.

After each stage of training, teachers are surveyed to determine the effectiveness of the professional development being provided because the goal of professional development is to bring about change in teacher knowledge, skills, behaviors, or attitudes (Center for Technology in Learning, 2009; Ertmer et al., 2012; Lim, Abas, & Mansor, 2010; Tienken & Achilles, 2005). Surveys can be distributed to participants in paper-and-pencil format or electronically. Survey results will then be analyzed. Based on the results, changes can be made in format, delivery, training methods, and amount of training offered. Self-reflection, necessary to bring about a change in pedagogy, is encouraged through journaling, group discussion at faculty or department/grade level meetings, and

study groups (Center for Implementing Technology into Education, 2012; Lim, Abas, & Mansor, 2010; Murcia & McKenzie, 2006). The three-stage model allows for a systematic, progressive professional development program that scaffolds and differentiates training so learners are provided support and follow-up training as needed (Guzman & Nussbaum, 2009; Hennessy & London, 2013; Hooker, 2008; Madden et al., 2009; Martin et al., 2010). Learners can self-select their stage for training or could opt-out of any stage of training. To encourage learners to participate in professional development, school divisions will identify methods for motivation that could include recertification points, stipends, additional classroom equipment, or other enticements.

Stage One training is intended for novice users to ensure that they can use the technology. Once technical proficiency has been achieved, the training emphasis shifts to pedagogy (Baran, 2010; Cowan, 2013; Manny-Ikan et al., 2011; Pass, 2008). To differentiate training by skill level, more advanced users may enter at either Stage Two or Stage Three because all three stages are offered concurrently. This flexibility also allows new users entering the school division to enter training at the appropriate level. A long-term plan is necessary to ensure the success of any IWB initiative, but schools have not always developed such a plan (Bannister, 2010; Center for Implementing Technology in Education, 2012; Meyer, Vines, & Shankland, 2012). Often training has been provided for new technologies during the year of implementation, but no further training was provided and schools did not achieve effective implementation (Center for Implementing Technology in Education, 2012). This means that new teachers entering the system who are not familiar with interactive whiteboards or not familiar with the type of interactive whiteboard selected by the school division might receive no training for incorporating

IWBs into the classroom, not even basic skills. Furthermore, teachers who received basic skills training might never receive further training and thus revert to old teaching methods.

Professional development in Stage Two provides more specialized training appropriate for specific content and/or grade level, because research has indicated that teachers want and need training in individual content areas (Bannister, 2010; Batchelor, 2011; Buabeng-Andoh, 2012; Cooper, 2008; Curwood, 2011; Hayes, 2010; Lai, 2010; Ohio Department of Education, 2008; Scott & Mouza, 2007). For example, mathematics teachers will learn features such as the ruler, the calculator, the protractor, the compass, and backgrounds such as graph paper. Teachers in primary grades will learn how to access the handwriting templates, the clock for teaching how to tell time, and coins for counting money. The goal of Stage Two training is to have teachers go beyond substituting the IWB for the regular whiteboard/chalkboard, and reach at least the augmentation level (Puentedura, 2010, 2012) whereby teachers are adding functionality to lessons by incorporating such features as the timer, built-in weblinks, and drag-and-drop elements. Teachers are also learning to change pedagogy and methodology to incorporate IWBs seamlessly into the curriculum, rather than as an add-on to a lesson (Cowan, 2013).

Stage Two training also incorporates both formal and informal professional development. Teachers engage in formal training, including college courses, seminars, and workshops. Workshops may include a refresher on basic skills as deemed necessary (Center for Implementing Technology into Education, 2012; Trombley, 2012). Many makers of IWBs, including SMART and Promethean, offer online professional

development courses for improving skills (Bannister, 2010; Promethean, 2014; SMART Technologies, 2014b). Other companies, such as InFoCor (2012), provide training for using instructional technologies, including IWBs. Master teachers and ITRTs can serve as instructors for workshops and seminars, thereby minimizing the cost.

Informal professional development incorporates mentoring and communities of practice. These methods of professional development take advantage of the social aspect of learning, reduce feelings of isolation, provide opportunities for teachers to share teaching methods and strategies, and encourage changes in teaching pedagogy (Little, 2006; Meyer, Vines, & Shankland, 2012; Murcia & McKenzie, 2009; New York State Education Department, 2009b; Türel & Johnson, 2012). ITRTs can serve as teacher mentors to minimize costs of training. This is important because all of these have been identified as major barriers for incorporating instructional technologies into the classroom (Buabeng-Andoh, 2012).

Total hours of Stage Two professional development conform to best practices of being ongoing and sustained (American Federation of Teachers, 2008; Gulamhussein, 2013; Lee, 2009; Trombley, 2012), totaling 15-hours of professional development in keeping with NCLB guidelines, with 6-hours recommended for formal training. However, learners are given more flexibility in hours spent in formal or informal professional development. Learners have the opportunity to choose activities that meet individual needs and address individual learning styles, thus following principles of adult learning, and allowing more opportunities for informal learning (Lai, 2010; Lee, 2005; New York State Education Department, 2009b; Tienken & Achilles, 2005; Trotter, 2006) if desired.

Stage Three training is intended for teachers who already possess basic skills and fluency with IWBs; however, research suggests that both beginning and experienced instructional technology users can benefit from professional development (Buabeng-Andoh, 2012). Stage Three also provides learners with more choices and flexibility in professional development options, which adult learners need (Bannister, 2010; Beglau et al., 2011; Knowles, 1980). Less reliance is placed on formal training, which is needed mainly for teaching new features and software updates of the IWBs. By this stage, teachers should have reached the point of self-actualization (Puentedura, 2010, 2012) and are in charge of their own learning. Teachers at this phase can develop their own personal growth plan (Berry, Daughtrey, Darling-Hammond, & Cook, 2012; Cassandra Drennon & Associates, 2005; Governor's Commission on Training America's Teachers, 2006; Louisiana Department of Education, 2013) to address individual needs, interests, and deficits (Kennedy, 2005). Individual study combined with collaboration becomes important, so informal learning focuses on becoming a member of a community of practice and taking advantage of online learning portals to gather ideas for incorporating IWBs effectively in the classroom. School-based and division-based communities of practice, facilitated by ITRTs, master teachers, and/or department/grade level chairpersons, have the advantage of being not only job-embedded, but also capitalize on the social aspect of learning allowing teachers to be engaged with colleagues and share expertise (American Federation of Teachers, 2008; Beglau et al., 2011; Curwood, 2011; Essig, 2011; New York State Education Department, 2009b). Online communities of practice allow for the exchange of ideas and lesson plans for incorporating IWBs, as well as getting different viewpoints and perspectives from around the world (Beglau et al.,



2011; Booth, 2012; Herrington, Herrington, Kervin, & Ferry, 2006). Moreover, a growing number of teachers have reported going online for assistance in incorporating technology into the classroom (Bill and Melinda Gates Foundation, 2012; Ertmer et al., 2012). Online portals also allow teachers to share ideas and resources for enhanced classroom activities using IWBs and provide “real-time support for individuals and groups that can ably serve as a catalyst for growth” (Beglau et al., 2011, p. 7). Time during the school day, which could be common planning times, faculty meetings, or professional development days, should be designated for networking, reflecting, and sharing, which encourages teachers to integrate new skills and knowledge (American Federation of Teachers, 2008; Banister, 2010; Lee, 2009; Kaplan, Chan, Farbman, & Novoryta, 2014).

In addition to providing training on new features and software updates, Stage Three professional development would provide professional development on how to create lessons that incorporate IWBs into instruction. Training would show teachers how to create a library of resources, archive lessons, incorporate links to source material, develop learning games, and create multimodal lessons (Beauchamp, 2004; O’Connor, 2011; Rimes, 2012; Winkler, 2011). Teachers would learn how to capture lessons using screen saving tools and audio capture software, which could be used for anytime learning for students (Rimes, 2012). Training would also show teachers how to use the IWBs with ancillary devices, including slates that would allow the teacher to move around the room while using the IWB, scanners to import images into lessons, and student response systems that allow the teacher to check for understanding (Beauchamp, 2004; O’Conner, 2011; Rimes, 2012). As Beauchamp noted (2004), the emphasis has shifted to how to

promote learning rather than on how to use the IWBs, and by this stage, the teacher uses the IWB spontaneously. Stage Three training would also show teachers how to encourage students to use the IWBs.

Total hours of Stage Three professional development still conforms to best practices of being ongoing and sustained as suggested by research (Alach, 2011; American Federation of Teachers, 2008; Kaplan, Chan, Farbman, & Novoryta, 2014; Martin, 2009), totaling 15 hours, which is verified by course credits, certificates, personal reflections, and/or portfolios (Louisiana Department of Education, 2013). Teachers in all stages can exceed the minimum hours of training, or school divisions may require more hours depending on the resources available and the needs of individual staff members.

The professional development model is evaluated in several ways to determine whether the training program is meeting the needs of teachers, and adjustments are made as needed. Since the overall goal of IWB professional development is to bring about changes in teacher practices and attitudes, to show teachers how to integrate IWBs into lessons seamlessly, and to improve student achievement, a method must be put into place to see if these goals are being accomplished (American Federation of Teachers, 2008; Bowe & Pierson, 2008; Gaytan & McEwen, 2010; New York State Education Department, 2009b; Woodall, 2012). Type of evaluation is left up to the individual school divisions. One method is to survey teachers, either formally or informally. Results will provide data regarding teacher attitudes and practices (Berry, Daughtrey, Darling-Hammond, & Cook, 2012; Ohio Department of Education, 2008). Another method could be routine classroom observations by ITRTs, department chairpersons, and principals to determine whether teachers are integrating IWBs into the classroom in a meaningful way

that results in student engagement (Carter-Ward, 2006). Student performance indicators, such as benchmark and standardized tests, are used to indicate whether student learning is taking place (Goodall et al., 2005; Maine Department of Education, 2010). While increases in student achievement cannot be solely attributed to professional development for incorporation of IWBs into the classroom due to numerous other variables that could affect student performance, consistent improvements across multiple classrooms and/or schools would tend to suggest that the professional development had an effect on teacher effectiveness and thereby student performance. Administrators can conduct further research and identify trends and patterns in student achievement before and after implementation of the professional development model and conduct return-on-investment studies.



**Honors and Awards**

- Recipient of the 2007 Technology Leadership Award, given by the Southside Virginia Regional Technology Consortium
- Recipient of the Outstanding Alumni Teacher by Longwood University
- Recipient of the 2013 Phi Kappa Phi Scholarship for Distance Learners

**Civic and Professional Organizations:**

- Cumberland County Historical Society, Vice President (former President)
- Cumberland County Museum Board, Member (former Treasurer)
- Cumberland Ruritan Club, Member (former President)
- Golden Key, Member
- International Society for Technology in Education, Member
- National Education Association, Member
- Phi Kappa Phi, Member
- South Central Workforce Development Board, Executive Board Member, Chairman of Youth Committee
- Southside Virginia Regional Technology Consortium, Co-Chairman
- Virginia Society for Technology in Education, Member