EXPLORING INTERACTIVE WHITEBOARD USE IN THE

4 – 6 GRADE CLASSROOM USING GAGNE'S

NINE EVENTS OF INSTRUCTION

by

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ABSTRACT

The purpose of this study was to examine how interactive whiteboards are being used for instruction in classrooms using the framework of Gagné's nine events of instruction. According to Gagné's instructional theory, there are nine events that need to occur in instruction to create optimal conditions for learning. Interactive whiteboards were created for the specific purpose of instruction and have the potential to revolutionize instructional practice of classroom teachers (Betcher & Lee, 2009). As the use of interactive whiteboards for instruction grows, it is important to know if the whiteboards are being used to create conditions for learning. This study adds to the current knowledgebase and may help decision makers determine if they should invest in interactive whiteboards for their classrooms. For schools or districts that have already made significant investments in interactive whiteboards, this study helps shape the professional development plans to improve instruction using the interactive whiteboard. Twenty-five teachers from fourth-, fifth-, and sixth-grade classrooms responded to an open-ended questionnaire on the use of the interactive whiteboard for instruction. Eight of these teachers also participated in a classroom observation and follow-up interview. The findings from this study revealed that the use of the interactive whiteboard is a valuable tool for creating Gagne's conditions for learning. Participants recognized that the interactive whiteboard provides flexibility in the presentation of lessons and the promise of increased student engagement. Participants stressed the need for time to explore the whiteboard's available features, plan for instruction and share best practices. The majority of the teachers did not ask for more training on the software, but requested time to learn

from other teachers on the instructional use of the whiteboard. The subjects most often taught

using the interactive whiteboards are language arts, math and science.

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This dissertation is dedicated to my husband, Randy, and my sons, Hunter, Joshua, and Jordan. May faith and love strengthen and encourage you to accomplish your dreams.

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CHAPTER I:

INTRODUCTION

Introduction

An interactive whiteboard is a relatively new teaching tool that has the possibility of

changing the way instruction is delivered (Betcher & Lee, 2009). There have been technological

advances that have had some impact on the classroom such as film, radio, and the personal

computer. The use of these technologies in education was a result of the technology being widely

used in society and classroom use was secondary. The interactive whiteboard was created for the

specific purpose of instruction and has the potential to revolutionize instructional practice of

classroom teachers (Betcher & Lee, 2009).

An interactive whiteboard, also called an electronic whiteboard, is a display and input

device that is connected to a computer that projects an image on the board. The board serves as

an input device allowing the teacher to control the computer from the screen, show visual aids in

addition to annotating over the projected image or manipulating objects similar to a mouse. The

board also comes with software that allows the teacher to produce interactive lessons or lesson

templates for repeated use. The structure of these lessons is similar to a PowerPoint slideshow

that allows the teacher to sequence instruction but is more powerful because it also allows for

manipulation (hide, reveal, spotlight, etc.) of an object within the lesson.

The potential for interactive whiteboards to revolutionize instruction is derived from

several factors. One important factor is the fact that the technology tool may be easily used by

teachers with various teaching styles for any level of instruction. The interactive whiteboard may

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be used as effectively in a kindergarten classroom as it is in an advanced Calculus class. The interactive whiteboard may also be used to support whole-group, small-group, or individual instruction. The technology may also serve as the best catalyst for increasing the use of technology for instruction. According to Becta (2007), the British education authority,

> The sharp rise in the use of ICT resources in the curriculum has been driven to a large extent by the adoption of interactive whiteboards and related technology. Interactive whiteboards are a popular technology, in heavy demand by schools and practitioners. They offer transparent benefits to learning and teaching. That is, it is easy for institutions and teachers to recognize how interactive whiteboards enrich and enhance learning and teaching – something which may not always be so immediately transparent to practitioners in the case of other technologies. (p. 66)

Although the improved learning and teaching seem to be transparent, it is important to know how teachers are actually using the interactive whiteboard in the classroom.

Statement of the Problem

Today's students are digital learners who are more responsive to audio and visual stimuli than students of the past. The current generation of learners value curiosity, discovery and exploration (Palfrey & Gasser, 2008; Tapscott, 2009). They want to collaborate on projects and interactions using technology for immediate, real-time information (Palfrey & Gasser, 2008). They also want to participate in activities outside of the classroom walls with technologies that allow them to reach out to the whole world (Tapscott, 2009).

In addition to the changing characteristics of the learner, we now live in a time of high stakes testing and a strong focus on student achievement. It is vital that teachers use all of the tools available to create conditions to maximize student learning, thereby increasing student achievement. Over the past five to seven years the interactive whiteboard has emerged as a new instructional tool and is being used in many K-12 classrooms (McIntyre-Brown, 2011). The

opportunity to change instruction to meet the needs of the student may be facilitated by the use of the interactive whiteboard for instruction.

School systems are spending large amounts of money to fund the placement of interactive whiteboards into the classroom. In addition to the cost of the equipment, there have been significant investments in the ongoing professional development of teachers on the use of the interactive whiteboards (Betcher & Lee, 2009). It is important to find how these boards are being used to create conditions for learning. Has the use of the interactive whiteboards changed the way in which teachers deliver instruction? Are there particular content areas or characteristics of the user that contribute to if and how the boards are being utilized in the classroom?

Theoretical/Conceptual Framework

According to Robert Gagné's instructional theory there are nine events that need to occur in instruction to create optimal conditions for learning (Gagné, 1985). Gagné continued his work on defining conditions for learning as the use of computers increased in educational settings. He expanded his work to include several books on instructional technology and, eventually, he authored books on instructional design. Although the foundation of Gagné's theory was proposed before computers became widely used in education, the basic principles still apply. According to Wayne Nelson (2000), "in order to meet the needs of subsequent generations of learners, it is necessary to base new developments in Instructional Technology on sound theoretical principles such as those provided by Gagné" (p. 246). Gagné's theory was chosen for this study because the interactive whiteboard may be used to implement each of the nine steps. The nine events of instruction are a fundamental part of a foundational instructional theory that has been utilized for planning instruction for well over thirty years (Richey, 2000; Smith &

Ragan, 2000) and are widely used today as one of the key elements in all levels of instructional design.

This study examined how teachers are using the interactive whiteboards to create conditions for learning within the theoretical framework defined by Gagné's nine events of instruction. Gagné's theory is more aligned with a theory of instruction instead of a learning theory (Gagné, 1985). According to Robert Gagné, there are nine events of instruction that are necessary to create conditions for learning: 1) gain attention, 2) inform learners of the objectives, 3) stimulate recall of prior learning, 4) present the content, 5) provide learning guidance, 6) elicit performance, 7) provide feedback, 8) assess performance, 9) enhance retention and transfer. These nine events do not have to occur in a sequential fashion although some of them are used as steps to build up to the introduction of a new topic. The steps may occur out of order or a series of steps may be repeated within the process before all nine of the steps are achieved. In Gagné's view, effective instruction must reach beyond traditional learning theories and provide a framework to transition from simple to complex skills (Gagné, 1985).

For learning to occur, it is first necessary to gain the attention of the learner. This step may be accomplished with videos, audio, animation, etc. It is not only necessary to gain the attention of the learners but to also make them curious so that they will be engaged in the topic or concept.

It is human nature to want to know what to expect. Therefore, it is necessary to inform the students about what the expected outcome of the learning activity will be. This should not be accomplished by stating formal behavioral objectives but in a format that is easy for the students to understand.

For a lesson to be successful, it is helpful to stimulate recall of prior learning. This step will allow the student to access prior knowledge and draw comparisons or add to concepts already learned. It is easier for the learner to encode and store information in long term memory when new information is connected with prior knowledge or experience (Gagné, 1985).

Presenting the content of the lesson should be addressed by using a variety of instructional methods to appeal to the varied learning styles of the students. The instructor should pay careful attention to organization of new content in addition to presenting the content in a manner that is engaging to the learner.

Providing guidance for the learner will help the learner practice the new skill or explore the new content in a way that facilitates learning while having the support of the instructor. After providing guided instruction, the teacher should provide an opportunity for the students to apply their new knowledge or skills. Applying knowledge allows the learner to respond to the new information that will increase the likelihood of retention. Equally important at this stage is the necessity for the teacher to provide feedback to the learner and provide any additional guidance. This feedback is formative in nature and is not to be confused with an official evaluation. Each time new content is provided, these three previous steps, providing guidance, allowing students to apply knowledge, and providing feedback, may occur numerous times depending on concept difficulty to increase student learning.

Assessing performance is the next step in creating a learning environment. The students must be given some type of final assessment with little coaching or guidance from the teacher. This final assessment will help the teacher to evaluate which students have learned the concept and which students require further instruction.

The last event of instruction is one of the most critical (Gagné, 1985). The last step is to enhance retention and transfer of knowledge. This step is similar to a review but also provides the students with methods for generalizing what they have learned to similar situations. These nine events of instruction will be used as a framework to gauge how the interactive whiteboards are being used for instruction.

Statement of Purpose

As funding becomes even more limited and effective use of instructional time is critical, it is important to know how using the interactive whiteboard supports teachers in creating effective conditions for student learning. Interactive whiteboards have been reported to make instruction more efficient (Smith, Hardman, & Higgins, 2006) while easily facilitating the scaffolding of concepts (Knight, Pennant, & Piggott, 2005; Smith, Higgins, Wall, & Miller, 2005; Schuck & Kearney, 2007; Wood & Ashfield, 2008; Zevenbergen & Lerman, 2008). The purpose of this study was to examine how the interactive whiteboard is being used in the classroom for instruction using the framework of Gagné's nine events of instruction. This information adds to the current knowledgebase and may help decision makers determine if they should invest in interactive whiteboards for their classrooms. Also, for schools or districts that have already made significant investments in interactive whiteboards, this study can help shape the professional development plans to improve instruction using the interactive whiteboard.

Significance of the Problem

High stakes testing and the requirement to meet Adequate Yearly Progress (AYP), as defined by the *No Child Left Behind Act*, have left schools struggling to meet the needs of all students in the most efficient and effective means possible. It is imperative that educators use the tools that assist in meeting the many different and ever changing styles of learning. Since the

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requirement to meet AYP goals has been implemented, educators need guidance to help them understand what instructional methods and tools are working successfully for other teachers. Also as the characteristics of learners change, as they have for the current digital generation, it is most important for us to reach the students using the types of video, simulation, animation, and graphics to which they respond instead of static information in a textbook (Palfrey & Gasser, 2008; Tapscott, 2009).

There are a limited number of studies on using interactive whiteboards to create conditions for learning. Of the studies that do exist, most of them have been conducted in the United Kingdom and very few have been conducted in the United States. The reason for this may be found in the fact that the United Kingdom leads the world in percentage of classrooms containing interactive whiteboards at 73% (McIntyre-Brown, 2011). Yet the installation of boards in United States classrooms is growing at an astounding rate. Having an interactive whiteboard in a United States classroom was practically unheard of in 2004. Yet only six years later, 38% of the classrooms in the United States have an interactive whiteboard (McIntyre-Brown, 2011). The rapid growth of this instructional tool in the United States requires more research to see how this technology is being used by the classroom teacher.

Research Questions

1. How do Gagné's nine events provide a useful framework for establishing learning conditions with an IWB in fourth-, fifth-, and sixth-grade classrooms;

2. Based on teacher reports, how does the use of the interactive whiteboard change instruction; and

3. Is the use of interactive whiteboards for instruction more prevalent in certain subject areas?

Assumptions of the Study

It was assumed that teacher responses on the survey and during the follow-up interviews would be honest and accurately reflect what is occurring in the classroom during instruction. It was also assumed that what occurs during classroom observations is typical of what occurs in the classroom on a regular basis. Care was taken to make sure the participants know that they should conduct instruction as they would if they were not being observed.

Limitations of the Study

This study was conducted on a small group of teachers in a southeastern state. Because the study was going to be conducted in one geographical area, the ability to generalize results may not be accurately applied to other educational settings in other parts of the country or the world.

This study focused on instruction in fourth through sixth-grade classrooms using the interactive whiteboard. The surveys and interviews relied solely upon teachers' perceptions of instruction and their own instructional practices. Even though the teacher may feel very positive about instruction, his or her perception may not actually translate into increased student learning as reflected on standardized tests.

Operational Definition of Terms

Learning - a process that leads to a change in a learner's disposition and capabilities that can be reflected in behavior (Gagné, 1985).

Instruction - a set of events embedded in purposeful activities that facilitate learning (Gagné, Wager, Golas, & Keller, 2005).

Scaffolding – "tiered assignments that build up students' understanding incrementally" (Linder, Abbott, & Fromberger, 2006, p. 239).

Interactive whiteboard - a display and input device that is connected to a computer that also projects an image on the board. The board serves as an input device allowing the teacher to control the computer from the screen, show visual aids in addition to annotating over the projected image or manipulating objects similar to a mouse. For the purpose of this study, when the term "interactive whiteboard" is used the researcher is referring to not only the hardware but also the most important component, the software that is packaged with the board. The features included in the operating software are the key element that allows teachers to use the board as more than just a touch screen and a projector. It is also called an electronic whiteboard.

Digital resources - rich media objects (maps, video, images, simulations, and so forth) as well as text. These digital resources may reside in or outside digital libraries and include those developed by individual scholars and by other entities (Harley, 2007).

Online portal – a web site specifically designed for the exchange of digital resources used for instruction. The Alabama Learning Exchange (ALEX) is a project by the Alabama Department of Education that was designed to index and share educational materials through a time-saving, one-stop resource for educators (http://alex.state.al.us/index.php). Other examples would be SMART Exchange (http://exchange.smarttech.com) which is a web site where teachers can share resources for the SMART brand of interactive whiteboards and Promethean Planet (http://www.prometheanplanet.com) which is a web site for sharing resources for the Promethean brand of interactive whiteboards.

Flipchart – the name of the type of file created by the Promethean software for use on the Promethean interactive whiteboard. A "flipchart" (.flp) is to Promethean software what a "document" (.doc) is to Microsoft Word software.

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Notebook – the name of the type of file created by the SMART software for use on the SMART interactive whiteboard.

Summary

Chapter I contains basic introductory information about the purpose and significance of the study. Chapter II contains an examination of the relevant literature. Current studies demonstrate that the changes in instruction should be driven by pedagogy not hardware. The pedagogy discussed in this study is viewed from the framework of Gagné's nine instructional events. Each of these events may be achieved with the use of the interactive whiteboard in the classroom. Current research describes various methods of using the interactive whiteboard for instruction. The methods outlined in the research were aligned with the nine events of instruction. Teaching experience, content area being taught, and amount of professional development will be discussed.

Chapter III contains information on the methodology used to conduct this study. This chapter describes the participants and how they were chosen for the study. Information is also included on how data were collected and analyzed. Chapter IV reveals the information that was gained from the survey, observations made by the researcher, interviews, and all significant findings. Chapter V discusses the findings of the study and what they mean to educators in terms of use of the interactive whiteboard for instruction.

CHAPTER II:

REVIEW OF RELATED LITERATURE

Introduction

This review of the literature will begin by discussing what current research says about instruction using interactive whiteboards and how planning a lesson using an interactive whiteboard is different than planning a lesson that does not use the interactive whiteboard. The researcher will also discuss why Gagné's nine events of instruction was chosen as a theoretical foundation and follow this discussion with examples of how the interactive whiteboards are currently being used for instruction to facilitate the nine events. To conclude, the researcher will discuss how content area, and professional development influence the use of the interactive whiteboard in the classroom.

Planning for Instruction

Teachers have reported that when they first started using interactive whiteboards, the planning for a lesson containing digital resources took more time than planning a traditional lesson that did not use the interactive whiteboard (Glover, Miller, Averis & Door, 2007; Haldane, 2007; Higgins, 2010; Lee & Boyle, 2003; Smith et al., 2005). However, although initially it took more time to plan, when teaching the same content the next time, the teachers reported less time needed for planning because the resources had been saved digitally for easy access and reused with some updating or modifying (Glover et al., 2007; Kennewell, Tanner, Jones, & Beauchamp, 2008; Lee & Boyle, 2003; Schuck & Kearney, 2007; Smith et al., 2005; Wood & Ashfield, 2008; Zevenbergen & Lerman, 2008). "It can be reflected on and refined

prior to first delivery of the topic and prior to subsequent occasions when they cover the same content with different groups" (Haldane, 2007, p. 266). A teacher may build a vast set of lessons that can be opened and edited easily over the course of a few years (Kennewell et al., 2008; Zevenbergen & Lerman, 2008). An additional benefit offered by the ability to digitally save lessons is the flexibility offered by being able to retrieve previous lessons or "flip" back and forth within a lesson to remediate and re-teach as necessary (Knight et al., 2005; Smith et al., 2005). The ability to easily revisit prior lessons through the use of the interactive whiteboard software makes it easy to build upon prior knowledge and scaffold student learning (Knight et al., 2005; Schuck & Kearney, 2007; Wood & Ashfield, 2008).

Teachers report that using an interactive whiteboard in their classroom facilitates the pacing and sequencing of instruction (Kennewell & Beauchamp, 2003; Knight et al., 2005; Schuck & Kearney, 2007; Smith et al., 2005; Smith et al., 2006; Wood & Ashfield, 2008; Zevenbergen & Lerman, 2008). This characteristic of the interactive whiteboard led to streamlined lessons (Smith et al., 2006) and allowed for smoother transitions between activities within the lesson (Kennewell & Beauchamp, 2003; Smith et al., 2005; Zevenbergen & Lerman, 2008). Teachers reported that the use of the technology required them to be more reflective about their teaching practices and encouraged them to develop lessons to target verbal, visual and kinesthetic learners (Glover et al., 2007; Kennewell & Beauchamp, 2003). A teacher stated that lessons "are now properly planned because of trying to incorporate a verbal explanation, a visual example, kinesthetic learning through movement" (Glover et al., 2007, p.14).

Teacher planning for lessons using the interactive whiteboard was also assisted by the ease of sharing resources with teachers within their school or district by posting lessons on a shared workspace on the network (Glover et al., 2007; Haldane, 2007; Lee & Boyle, 2003;

Nevin, Thousand & Villa, 2009; Smith et al., 2005). Also, with the ease of sharing and collaborating using the Internet, there are numerous online portals for sharing digital resources for the interactive whiteboard. Although there has been limited research on the specific sharing of resources for the interactive whiteboards, there have been several studies that focus on teachers who collaborate online to support a portal for the posting of digital resources or learning objects (Lefoe, Philip, O'Reilly & Parrish, 2009; Nevin et al., 2009; Recker, Dorward, Mao, Leu, Palmer, Halioris & Park, 2005;). It was discovered when teachers collaborate through an online portal, they build on one another's strengths, learn new pedagogical skills from other teachers, and improve on their own instructional practices (Nevin et al., 2009; Recker et al., 2005). Teachers posted resources such as flipcharts (Promethean) or notebooks (SMART) from lessons that the contributing teacher had previously planned. Other teachers had access to the online portal to download the resources created by their fellow teachers throughout the world and used these resources for instructional planning. Rarely were the resources used without modification; however, the easy access helped the downloading teacher to take a foundational work and make it fit their own teaching ideas (Lefoe et al., 2009).

Gagné's Nine Events of Instruction

This qualitative study will approach instruction using Gagné's nine events of instruction that create conditions for learning. This portion of Gagné's instructional theory was chosen for this study because the interactive whiteboard offers many features that may be used to implement each of the nine steps. Following a discussion of Gagné's theory, specifically the nine events of instruction, descriptions of the many ways interactive whiteboards are being used in the classroom will be connected to the events of instruction.

Gagné was one of the first educational psychologists to bring together all of the components of an instruction theory, from setting goals to assessing performance (Smith & Ragan, 2000). There has not been much research on the validity of Gagné's nine events of instruction as a whole. According to Smith and Ragan (2000), "this must in part be due to Gagné's assertion that instruction must not necessarily include all events on all occasions, as learners are often able to supply the processing that the events evoke without external prompting" (p. 183). There are some studies that have sought to validate particular components of the nine events. Schimmel's study (as cited in Richey, 2000) found that all components of the nine events were not necessarily equal. He found that feedback was more important than presenting the learning objectives and that feedback confirming student action was more important than providing the correct answer as feedback. Martin, Klein, and Sullivan (2004) found that instruction that contained all of the events (full program) significantly improved student attitudes when compared to instruction that left out the objective, examples, review, and practice (lean program). Martin and Klein (2008) found that while presenting the learning objective, practice and review were all important events, "practice was the one consistently effective instructional element for enhancing student achievement and attitude" (p. 187). Overall it is believed that Gagné's work has had "a strong impact on the practice of instructional design, including the ways that software is designed and hardware is utilized for instruction" (Nelson, 2000, p. 232). According to Richey (2000), Gagné's approach "is foundational to most instructional design models and is, by and large, still dominant among current designers who have been formally trained in the field" (p. 271).

Gagné proposed that learning occurs through a combination of internal and external processes (Gagné, 1985; Gagné & Driscoll, 1988; Gagné et al., 2005). Instructors cannot always

control the internal processes but may structure the external processes in a manner that creates conditions for learning (Gagné et al., 2005). To understand the external processes, presented as nine events of instruction, it is important to understand the internal processes that take place when learning occurs.

The internal processes involved in learning begin with reception of stimuli into through the senses followed by the registration of information by the senses (Gagné et al., 2005). New information is presented and entered into short term memory. The information in short term memory is connected to prior learning which should be followed by rehearsal. Rehearsal allows the information to be stored in long term memory. The information in long term memory is retrieved when response generation is required. The information is used to perform the new behavior or display of knowledge. The learner can use the new information to act upon or execute new behaviors.

Each of the nine events of instruction relate directly with the internal processes of learning (Gagné et al., 2005). The learner receives some type of sensory input to begin the process. The external task for the instructor is to gain the attention of the learner which may be accomplished using numerous methods. Two effective methods to achieve this goal are novelty and curiosity. Gaining attention is most effective when the instructor understands the characteristics of the learner or group of learners (Gagné, 1985). Methods for gaining attention in larger groups should be varied while small group or individual lessons may be more targeted (Gagné et al., 2005). Examples from current research describe ways teachers are using the interactive whiteboard to gain the attention of the learner.

The registration of information may be achieved by explaining the learning objectives to the student (Gagné et al., 2005). This step in the instructional process develops learner

expectations and clarifies the goals of the lesson. Not stating the objectives of the lesson could lead to miscommunication or misdirection of the student. It is important to be clear when communicating expectations. Not only will stating objectives keep the student on track but may also serve to keep the instructor on target.

Information is easier to retain when it has a connection to prior knowledge (Gagné et al., 2005). The next step for instruction is to recall prior knowledge to help the learner add to information that has already been encoded into long term memory (Gagné & Driscoll, 1988). This step may be accomplished by asking a recognition or recall question.

The next step is to introduce the new material, concept or skill. It is important to target and emphasize the most important parts of the new information (Gagné et al., 2005). If using voice to relay information, tone should change to emphasize the most important aspects of the lesson. If using text to relay information, the instructor should use bold, italics, underlining, etc. to call attention to the most important parts. When using visuals such as photos, videos or graphics, it is helpful to pause, rewind, highlight, circle or spotlight the vital components to be emphasized. The type of examples used to demonstrate a concept should be varied and numerous. Concept presentation should follow one of two patterns: explain the concept followed by examples or show many examples, then explain the concept (Gagné & Driscoll, 1988; Gagné et al., 2005). Also, the retention and transfer of new knowledge will be increased by presenting the information using more than one of the senses (Gagné, 1985). Presenting new information using various media is especially useful in whole class instruction where there are many different learning styles (Betcher & Lee, 2009).

Once the new information has been presented, the instructor must provide learning guidance. "The essence of learning guidance is to provide support for learners in making

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connections between what they know and what is being learned" (Gagné et al., 2005, p. 198).

Learning guidance is also known as scaffolding (Nelson, 2000). The teacher does not directly

provide answers but guides the direction of thought or action of the learner to keep the learner on

track. During the guidance process the teacher does not include direct instruction but serves as a

facilitator allowing students to explore and make their own connections among prior knowledge

and new material. The amount of guidance necessary may depend upon the ability of the learner

and the difficulty of the concept.

Following guided learning, learners should be given an opportunity to display or

demonstrate what they have just learned (Gagné et al., 2005). Eliciting performance from

learners serves two purposes: first it provides them an opportunity to retrieve what they have

learned from long term memory and second the performance serves as a confirmation that what

has been learned is correct and complete.

Even when the process was followed step by step with every part being implemented just

as planned, often learning did not occur until the learner had an opportunity to perform or act on

the new information and received corrective feedback from the instructor (Gagné et al., 2005).

There are numerous ways to deliver feedback and the effectiveness depends upon the content and

the disposition of the learner. A good instructor will have various methods for delivering

feedback and should judge the learner and the situation to determine the most effective manner

to deliver feedback. The feedback given at this stage is more formative and may be followed by

repeating several of the previous steps such as guiding practice and eliciting performance (Gagné

& Medsker, 1996).

It is also important to determine if the desired learning has occurred. An assessment or

test should used to determine if the content to be learned has been committed to long term

memory and is able to be retrieved (Gagné & Medsker, 1996; Gagné et al., 2005). The assessment should be similar to the guided practice and eliciting performance but should occur without assistance from the instructor. It is also important that the assessment corresponds with the original objective shared with the learner. The assessment may be formal or informal.

The final event of instruction according to Gagné is enhancing retention and transfer (1985). The new concept or skill has been learned and it is now necessary to prevent forgetting and enhance the learner's ability to recall and use the new information (Gagné et al., 2005). An effective method to achieve this step is to provide opportunities for application of the concept or skill. In addition to application, it is helpful if the learner can use the skill for problem solving or in a realistic situation.

Instruction Using the Interactive Whiteboard

The interactive whiteboard has the potential to improve classroom instruction by the basic nature of the board and the purpose for which it was created. Teaching with the interactive whiteboard is an improvement over teaching with only a computer and projector because it allows the teacher to manipulate the computer from the front of the room allowing for more attention to the class and less focus on the computer (Ball, 2003; Smith et al., 2001; Smith et al., 2005). Being able to load, play, pause, rewind or advance multimedia is easily accomplished from the front of the room without having to move back and forth to the teacher computer (Boyle, 2002; Thomas, 2002) and results in a more professional delivery of multimedia portions of the lesson (Smith et al., 2005; Thomas, 2002). The touch sensitive feature of the board also allows students to interact and have a more active role in the delivery of the lesson (Thompson & Flecknoe, 2003) leading to a less teacher-centered classroom (Bell, 2002; Smith et al., 2005; Thomas, 2002). The use of the board with students combines visual, audio and tactile content,

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which accommodates a variety of learning styles (Bell, 2002; Glover & Miller, 2001) and aids the teacher in selecting whichever resource best meets the needs of the learners (Bell, 2002; Glover & Miller, 2001; Smith et al., 2005).

According to Kennewell and Beauchamp (2003), another advantage of using interactive whiteboards for instruction is that teachers report spending more time preparing the lesson so when the students are present, everything is ready to go from the beginning of class. There are fewer pauses in the flow of the lesson because the teacher is not taking time to write information on the board and then erasing it so that more information can be written. Students and teachers report that lessons delivered using the interactive whiteboard are faster paced with fewer pauses, allowing time for more teacher attention to the students (Smith et al., 2005; Smith et al., 2006). According to a teacher in a study by Levy (2002), the interactive whiteboard "eliminates disruption associated with movement around the classroom, improves visibility for the students, reduces time spent in repeating explanations to individuals or writing out procedural instructions on a traditional board" (p. 7). These factors led teachers to report that students were more motivated to learn because the lessons were more interesting and it is was easier to maintain student attention (Smith et al., 2005).

Gaining Attention

According to Gagné (1985), the instructor must gain the attention of the learner and strive to maintain that attention throughout the process of instruction. The learner receives some type of sensory input to begin the process. Students are more engaged by lessons that use the interactive whiteboard because of the multimodal sensory nature of the presentations (Deaney, Chapman, & Hennessy, 2009; Hennessy, Deaney, Ruthven & Winterbottom, 2007). Torff and Tirotto (2010) reported that the level of engagement was higher for students who were taught

with an interactive whiteboard than for those students who were taught without one. Students are more engaged by the activity around the board which allows the teacher to lead the learners to think through guided interaction (Deaney et al., 2009). Kennewell (2006) found that the use of the board allows a student (or the teacher) to engage the other students through vicarious participation. Thompson and Flecknoe (2003) reported students were motivated and empowered when they were allowed to interact with the board as part of the lesson.

One of the key features of the interactive whiteboard that engaged students was the large, interactive display (Glover & Miller, 2001; Mechling, Gast, & Krupa, 2007; Smith et al., 2005). Some studies found that students were motivated by the larger display because it gave instruction and the overall classroom a contemporary feel (Glover & Miller, 2001; Smith et al., 2005). Smith et al. (2005) reported that the larger display served as a motivation for students to be involved with the classroom activities and allowed for more student participation to the group's lessons. This "communal engagement" is the most powerful characteristic of the interactive whiteboard (Betcher & Lee, 2009, p. 118). Mechling et al. (2007) reported that special needs students were more engaged by the larger, interactive display. In 2003, Thompson and Flecknoe's study indicated that when the interactive whiteboard was used for instruction, student behavior improved and students spent more time on task than instruction that did not use the interactive whiteboard. All of these attributes allow the teacher to gain the attention of the student to create initial conditions for learning.

Informing the Learner of Objectives

The registration of information may be achieved by explaining the learning objectives to the student (Gagné et al., 2005). This step in the instructional process is easily facilitated by the use of the board because of the nature of the large display. Because the screens are digital and

may be created ahead of time for easy access, not erased as with a regular board (Miller & Glover, 2002), the teacher may easily flip back to remind the learner of the objectives at any time.

There are not many studies on the use of interactive whiteboards being used to inform the students of the learning objectives. This lack of documentation may be because it is easy to accomplish this event in a quick manner that it is often left out of description of lessons or it may be because this step is omitted by the instructor. The researcher in this study anticipates clarification of why there is so little discussion of this particular step by collecting and analyzing the data from the classroom teachers.

Stimulating Recall of Prior Knowledge

According to Gagné et al. (2005) information is easier to retain when it has been connected to prior knowledge. This event of instruction is easily made possible by a unique feature of the interactive whiteboard software. Because the content is digital, it is possible to save the entire lesson and retrieve it at a later time. Not just the lesson as it was originally planned but more importantly the specific lesson that the students in the class created during their instructional time. If the class annotated over images or composed a story during class, the whole event, including audio from the teacher and students, from beginning to end may be recorded and archived for future use (Geer & Barnes, 2007; Glover et al., 2007; Haldane, 2007; Knight et al., 2005).

Recalling prior knowledge assists the learner in connecting new content with information that has already been encoded into long term memory (Gagné & Driscoll, 1988). Being able to save previous lessons and revisit them as an introduction to new material is a valuable characteristic of the interactive whiteboard. Overall unit lessons may be structured to scaffold

learning by accessing prior lessons and then building upon the content (Geer & Barnes, 2007; Haldane, 2007; Smith et al., 2005). Easy access to prior lessons provides the link for students to connect previous knowledge with new concepts (Geer & Barnes, 2007; Glover et al., 2007) and makes it easy to recall previous material spontaneously when necessary (Smith et al., 2005). The ability to easily review content is most beneficial to special needs students and lower ability groups (Knight et al., 2005; Smith et al., 2005).

Presenting the Stimuli

Gagné et al. stated, "the events of instruction do not have to be presented in this order, nor do all of the events need to be included in every lesson" (2005, p. 194).   The nine events are not a recipe to be followed exactly but more of a guide. When researching instruction using the interactive whiteboard, it is sometimes difficult to discuss each of these main events independently without a clear description of the entire lesson. The next three sections will describe various features of the interactive whiteboard software in addition to some descriptions of lessons using those features. Although the features or lessons have been categorized under a specific event of instruction, other events may also be included. When you get into the heart of a lesson it is sometimes difficult to state how each individual event was addressed within the lesson without also discussing other events of instruction that occurred during the lesson.

As discussed previously in this paper, there is a great deal more to the interactive whiteboard than just a large interactive display. The most important attribute of installing an interactive whiteboard in the classroom is the use of the instructional software that is included with the purchase of the board. The software capitalizes on the interaction between the computer and the board to provide the teacher with many powerful instructional tools. Some of these tools are the ability to highlight or annotate over content, control display of animations or video, use

sound effects for attention and emphasis, and edit content easily using drag and drop (Kennewell & Beauchamp, 2003).

Glover et al. (2007) reported that annotation was useful in building conceptual development by taking one concept but explaining it different ways all on the same screen. An example of this concept building was given in a study by Deaney, Chapman, and Hennessy (2009). A social studies teacher projected an image of Queen Elizabeth on the board and asked the students to annotate adjectives describing the image on top of the picture. These annotations that were written on top of the image were then copied and pasted to a blank screen and organized into social, economic, political or religious attributes. Using these categories the students developed their characterization of the Golden Age. In this one activity alone, the teacher was able to present the content while eliciting performance and providing guided learning.

According to Smith et al. (2005), foreign language and English Second Language teachers found many of the features of the board software to be particularly useful in learning a new language. The ability to highlight, annotate, drag/drop, and conceal/reveal was fundamental in guiding student learning and eliciting performance. Another excellent feature reported by these teachers was the ability to layer resources. The teacher or students would create presentations that had an image that also served as a hot button with a link to a sound file that provided the correct pronunciation. Below the image may be the text for that particular word that was also linked to a website with a definition or explanation in the native language. These dynamic presentations are a good example of presenting new content.

Morrison (as cited in Smith et al., 2005) details an account of a lesson on World War I taught in a social studies classroom. The students went to the battle location using Google Earth

and saw a 360° panoramic view of the site where fighting took place the way it looks today. A lesson had been created with indicators of where veterans were during that battle and linked this with the soldiers' audio accounts of the battle in the veteran's actual voices. The students were transported back in time to vicariously experience the sights, sounds and smells of the battle. This is an excellent example of an effective method of presenting new material.

Hennessy, Deaney, Ruthven and Winterbottom (2007) described a lesson that took place in a biology class on the gas exchange process. The teacher went through the process step by step with appropriate images. He annotated over the images and then reviewed the process. Following his detailed explanation, he used an animation of the whole process and had students describe what was happening as the animation played. The teacher or students could pause and restart the animation to allow for guided learning, feedback and reteaching. The science teacher reported, "that animation…maybe touched those pupils in a way, for their understanding, that wouldn't have happened otherwise" (p. 296). The multimodal learning that occurred in this lesson alone addressed many of Gagné's events, especially presentation of new content and guided learning.

Students are often assigned group or individual projects to meet learning objectives that are ultimately shared using the interactive whiteboard. Students were engaged by projects that related to real life issues or utilized actual student data. Creating the projects with the interactive whiteboard software, gathering the data, and sharing their work with the whole class using the board was found to be an effective instructional strategy (Becta, 2007; Bell 2002; Miller & Glover, 2002). In a study by Wood and Ashfield (2008) a teacher reported, "Opportunities were given for children to discuss in pairs and groups with some individuals modeling their ideas during whole-class discussions at IWB. The key focus was the children's active and creative engagement with their own learning" (pp. 92-93). An advantage of using the interactive

whiteboard software for student projects is the fact that students may post their work into shared intranet workspace to allow for collaboration (Haldane, 2007). Not only does saving the digital file in a shared workspace facilitate collaboration, projects may also be opened and edited by a representative student in front of the whole group at the board. This opportunity to work as a large group on content reinforces learning and extends the knowledge the students have acquired individually. Higgins (2010) discussed the sharing of student projects that have been collected in student digital portfolios. Researchers have found that student rehearsals, in preparation for sharing with the whole class, helped students develop self-assessment skills which are usually difficult to teach (Deaney et al., 2009; Higgins, 2010). Project based learning allows for presentation of new material without instruction being teacher-centered. This type of instruction also requires student performance and it is necessary for the instructor to guide the direction of the projects before the final project is submitted.

Providing Learner Guidance

As previously mentioned the interactive whiteboard creates a greater sense of being part of a group (Smith et al., 2005). Whole group instruction does not necessarily mean teacher led. The interactive whiteboard may be used for peer instruction, student guided practice, (Kay 2009) and whole class game playing or simulations (Smith et al., 2005). Students were valuable when directing lesson review because they could explain or illustrate what they had learned while in front of the class with teacher feedback or redirection, if necessary (Glover et al., 2007). A teacher in a study by Hennessy et al. (2007) explained that her students led the class from the board more than she did. The students created idea webs with annotations and links to more information. The idea webs were ever-changing as the knowledge of the class grew. The power

in these lessons is the corroboration of the students and the empowerment of the students to control their own learning.

In other studies students were able to use the interactive whiteboard to develop and share creative or narrative writing. Armstrong et al. (2005) highlighted a teacher who paired up students to contribute portions of a narrative. The students posted information on the board and used the tools to easily edit all of the portions into a class narrative. Editing as a whole class made the assignment a success and oddly resulted in fewer behavior problems during the process. Borsheim, Merritt, and Reed (2008) reported that many students used the interactive whiteboard to collaborate and revise throughout the entire writing process. The students would create a final product and then post the group's work on the Internet. The students felt a sense of pride and worked together better because their work was being displayed in front of the whole class and eventually shared with the world. These lessons allow the students to present new content in addition to performing with teacher guidance.

Eliciting Performance

Armstrong, Barnes, Sutherland, Curran, Mills, and Thompson (2005) described a language arts teacher who used the board to do whole class, small group, and individual text editing. The software features of drag and drop make text editing more enjoyable to the students. The students responded best when able to build ideas on the board and arrange the concepts as part of the pre-writing experience. The teacher and students would also model text editing (guided learning) in front of the class which was helpful for students to see, hear and participate in the editing. The teacher in this study commented that a particularly challenging student "not only produced a much longer and better-crafted piece of writing after using the IWB but was also able to articulate what he had learned and how this had happened" (p. 464). This lesson

combined providing learner guidance and eliciting performance to help students create, edit and compose. According to Gagné (1985), the ability to discuss what has been learned is helpful in enhancing retention.

Another valuable feature of the interactive whiteboard is the tool box containing math tools (Hodge & Anderson, 2007; Smith et al., 2005; Zevenbergen & Lerman, 2007). It is easy to open a graphic of a number line and have the students come count on it or demonstrate addition of signed numbers using the line tool with different colors selected for the pen (Smith et al., 2005). Students may also see a large calculator on the screen and follow the specific order of clicking of the buttons that is being modeled on the board (Zevenbergen & Lerman, 2007). Math teachers may also use digital tools such as rulers, protractors, and compasses to teach measurement of lines and angles in addition to modeling how to perform geometric constructions (Smith et al., 2005). Furthermore, it is easy to manipulate two and three-dimensional objects on a graph resulting in concrete visuals of transformations including translation, rotation and tessellations. Teaching fractions also makes more sense to learners by being able to model and easily edit true representation of the fraction or the operation containing fractions (Zevenbergen & Lerman, 2008). The teacher or students could use the fraction creator to easily create circles or rectangles that were equally divided into parts, even fifths and sevenths. This visual could not have been created and changed so quickly or easily without the fraction tool, allowing more examples for the students and less time wasted trying to free hand accurate sketches of fractions. Glover et al. (2007) found that eliciting performance through virtual manipulation was easier for the students and resulted in more effective understanding of concepts. The math tool features in the interactive whiteboard software may be used to present new content, provide learner guidance or elicit performance.

Students report going to the board in front of the whole class is also less intimidating because of the ease of editing and quickly erasing incorrect information (Glover et al., , 2007; Knight et al., 2005; Wood & Ashfield, 2008; Zevenbergen & Lerman, 2008). The perception of the student that a mistake is not permanent encourages student participation in front of the group (Glover et al., 2007; Knight et al., 2005). The students wanted to go to the board because when they needed to draw a line or create circle, they did not have to worry about being frustrated or embarrassed by an oddly shaped object (Knight et al., 2005). There was less time wasted simply trying to get a decent representation of the shape or object needed to teach. Even the youngest students find the use of the board helpful. Smith et al. (2005) discusses the use of the boards by young students to practice letter formation on the board using their gross motor skills before having to repeat the same letter formations on paper using fine motor skills. This practice allows the teacher to not only elicit performance but also allows students to help one another with guided practice.

The use of the interactive whiteboard for small group instruction is also a very effective instructional strategy (Kennewell et al., 2008; Mechling et al., 2007; Miller & Glover, 2002; Smith et al., 2005). In a study by Kennewell et al. (2008), a teacher modeled a math skill on the board and then split the class into small groups. While the teacher took time with each group providing guided practice, each group had turns at modeling the skill, addition and subtraction of integers, on a virtual thermometer game that would provide the students with audio and visual feedback for correct and incorrect answers. The students were able to manipulate a concrete example of the skill they were trying to learn while providing the teacher time to work with students who may need further instruction. A teacher in a study by Miller and Glover (2002) was able to divide her class into three groups to have them work on reading comprehension. She had

three screens that were created as she worked with each group. As she changed groups, she could simply "flip" to the screen that contained the work of that specific group. Because she was using the interactive whiteboard, she did not have to erase and rewrite for each group. Small group lessons were easily facilitated by the ability to flip back and forth to different screens (Miller & Glover, 2002; Smith et al., 2005). Small group instruction with the interactive whiteboard elicits student performance while also allowing for the teacher to guide practice. It is also a very effective means of delivering new content.

Providing Feedback

The ability to view student performance and provide immediate feedback is another positive attribute of the interactive whiteboard (Glover et al., 2007; Kay, 2009; Miller & Glover, 2002; Smith et al., 2005). When eliciting student performance, feedback from the teacher or the students was immediate when the student was at the board (Glover et al., 2007). The interactive whiteboard may also be used with pre-planned lessons that may include visuals and sound for reinforcement or shaping to lead students to correct conclusions (Miller & Glover, 2002; Smith et al., 2005). The immediacy of feedback may also help the teacher to identify misconceptions or weaknesses (Smith et al., 2005) and allow for the modification of instruction or guided practice to help the learner achieve the stated goals (Kay & LeSage, 2009).

As previously discussed, the typical pace of a lesson using the interactive whiteboard moves faster than a traditional lesson. The extra time allowed by the faster pace of the lesson gives the teacher more time for eliciting student performance and for providing corrective feedback (Glover et al., 2007; Higgins, 2010; Wood & Ashfield, 2008; Zevenbergen & Lerman, 2008). This increased attention to students led to deeper questioning and more thoughtful answers on the part of the student (Glover et al., 2007).   This extra time also allowed for more

student participation in the lesson (Zevenbergen & Lerman, 2008) and allowed the teacher to deliver more engaging and effective feedback (Higgins, 2010).

Assessing Performance

An additional feature of the interactive whiteboard software that may be purchased for an additional cost is the student response system (Dangel & Wang, 2008; Kay & LeSage, 2009). A student response system, also commonly called "clickers," is a set of handheld devices that are given to each student in the class. The students may respond with simple multiple choice or true/false answers. Some other sets of student response systems have a keyboard similar to a phone and may be used to text in complete sentences or paragraphs. The student responses are integrated into the interactive whiteboard software. The student responses may be anonymous leading to more accurate assessment of student learning (Kay & LeSage, 2009). Student response systems make it easy to elicit performance, and provide feedback in addition to increasing time on task by the students (Dangel & Wang, 2008; Kay & LeSage, 2009). The student response systems are most effective when the teachers structure questions so that student respond with reflective answers involving critical thinking (Dangel & Wang, 2008).

Enhancing Retention and Transfer

Teachers report that using real-world simulations and applications help the students retain what is being learned and transfer that knowledge outside of the classroom (Hennessy et al., 2007). The use of many different senses engaged during instruction also increases retention by reinforcing more than one learning style (Glover et al., 2007). The visual tools and interactive features of the interactive whiteboard help students develop complex ideas (Deaney et al., 2009) while student use of the board to explain reasoning and methodology facilitates the internalization of knowledge (Thompson & Flecknoe, 2003). Haldane (2007) reported that

teachers would print out the lessons with annotations created by the class so that the students could take the lessons with them. A teacher in the study stated, "I feel that they have better recall when they see pages where they added their own ideas…it's really a quick and effective way of recapping before we start a new lesson" (Haldane, 2007, p. 265).

Unintended Outcome

An unintended consequence of placing an interactive whiteboard in the classroom has been the increased technology skills of the students by the constant modeling of the use of the technology tool in the classroom (Becta, 2007; Smith et al., 2005). Some schools have even reported they no longer need to teach technology as a separate subject because computer skills are being modeled within the lessons of other content areas (Lee & Boyle, 2003; Smith et al., 2005). Teachers who use a variety of resources within the interactive whiteboard lessons are not only familiarizing students with the technology, they are preparing their students with the skills necessary in a 21st century society (Borsheim et al., 2008).

<center>**Professional Development**</center>

A key to any successful technology initiative is to support the teachers with the tools they need and the necessary training to use those tools. It is important that teachers have daily access to the interactive whiteboard (Armstrong et al., 2005; Smith et al., 2005; Zevenbergen & Lerman, 2008); having to share, schedule or move the board for use will affect the amount the board is used for instruction. Teachers with a board permanently installed in their classroom with daily access used more resources and features of the interactive whiteboard (Armstrong et al., 2005). The interactive whiteboard will also not be used as effectively without adequate and on-going teacher training (Armstrong et al., 2005; Smith et al., 2005). Teachers will use the basic features of the board without utilizing all of the available features when consistent training is not

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available (Armstrong et al., 2005). The cursory training provided by the vendor when a new board is installed is not enough training for the teachers (Glover & Miller, 2001; Smith et al., 2005). Sustained professional development helps the teacher not only gain new skills to use the board but also provides the teachers with a greater sense of confidence using the tool in the classroom because they are comfortable and not intimidated by all of the features offered by the interactive whiteboard (Zevenbergen & Lerman, 2007). Teachers who have not had enough training on the use of the interactive whiteboard were easily frustrated and were less likely to use the board for instruction (Smith et al.. 2005). An effective method for ongoing teacher professional development is to pair the proficient users of the technology with the reluctant users (Glover & Miller, 2001; Jewitt, Moss, & Cardini, 2007; Smith et al., 2005). Shenton and Pagett (2007) suggested that the best approach for training was to use classroom teachers to do the training and avoid the corporate training that focused on the technology and not the curricular integration. It was also found that teachers who used a common space on the intranet to share resources, tips and lesson ideas felt supported and less intimidated when expected to use the interactive whiteboard for instruction (Levy, 2002; Smith et al, 2005). Lastly, it is very important to not only train teachers in the use of the features and how to integrate the technology into content instruction but also to equip teachers with the basic knowledge for technical troubleshooting to avoid frustration when there are technical issues (Levy, 2002; Smith et al., 2005).

Content Areas

There is also limited research on which content areas use the interactive whiteboards for instruction but a few studies have indicated that Language Arts, Math and Science are typically

the subjects where instruction using the interactive whiteboard occurs (Beauchamp, 2004; Wall, Higgins & Smith, 2005).

Beauchamp (2004) observed seven teachers teaching with interactive whiteboards. The classes observed were from one primary school and represented a variety of age ranges and all curricular areas. The teachers used the interactive whiteboard for instruction more often for the core areas of math, language arts, and science. Student interaction with the board also occurred more often in the math, language arts, and science content areas.

Wall et al. (2005) studied student perception of the use of interactive whiteboards in the classroom as part of a larger government-sponsored evaluation of the use of interactive whiteboards in England's primary schools. The students made more positive comments about the specific subjects of math, language arts, and science when asked to comment on instruction using the interactive whiteboard. The researchers concluded this may be because those where the subject most often taught using the interactive whiteboard.

Summary

Interactive whiteboards have many features that assist teachers' creation of conditions for learning when viewed from the framework of Gagné's nine events of instruction. The interactive whiteboard creates an atmosphere of engagement and allows the teacher to facilitate instruction efficiently, allowing more teacher attention to students. The board may be used for whole group, small group or project based instruction.

The interactive whiteboard is a relatively new instructional tool in U.S. schools, therefore the research is limited. The majority of studies in this review of the literature are from the United Kingdom or Australia because that is where the majority of interactive whiteboard research has

been conducted. Very limited research has been conducted on the use of interactive whiteboards in the United States.

CHAPTER III:

METHODS

Introduction

Many teachers are using interactive whiteboards in their classrooms but little research has been conducted on how they are using them to create the conditions necessary for learning. This study will seek to find how teachers are using the interactive whiteboards for instruction using the framework of Gagné's nine events of instruction. An invitation to an online survey was sent to 37 fourth-, fifth-, and sixth-grade teachers who have an interactive whiteboard in their classrooms and the researcher conducted eight classroom observations of teachers using the interactive whiteboards for instruction. Follow-up interviews were also conducted with the same eight teachers who have been using interactive whiteboards in their classrooms and who volunteered for the classroom observation.

Setting

This study was conducted in a northern school system of a southeastern state, with teachers who have interactive whiteboards in their classrooms. The study school district is comprised of seven schools. There are four elementary schools that contain kindergarten through fourth-grade and one intermediate school that has a fifth- and a sixth-grade that is considered an elementary level school. The one middle school in the system contains seventh and eighth graders and the one high school houses grades nine through twelve. Because this study focused on grades four through six it involved all five elementary schools in the district.

There were approximately 3,115 students enrolled as of December 2011. In comparison to the state, this school district is in the median poverty category. There are three schools in the district that qualify for Title I funding. The school district is suburban with a total population of about 30,000 residents. There are also approximately 300 full time teachers employed by the district.

Researcher Positionality

I have been an educator for twenty-one years. I taught high school math for fifteen years and currently serve as the Instructional Technology Specialist for a school district. I have spent many years helping teachers, kindergarten through twelfth grade, integrate technology into the curriculum. I was involved in education long before interactive whiteboards were even invented so I have an educational foundation without the technology to make a comparison. I have taught many courses and training sessions using an interactive whiteboard. I have been involved in the district decisions concerning which particular products to purchase for our classrooms. It is also my responsibility to provide training for all of the teachers in my district on methods for using the interactive whiteboard for instruction. In addition to being responsible for training, I am also responsible for securing the funding for maintaining/replacing the hardware when it stops functioning properly.

I have strived to remain cognizant of the fact that I have been personally involved in the implementation of and training for a major deployment of interactive whiteboards to protect against bias. The school district has committed significant time and money to this initiative. To ensure the success of this project at this point it is vital to determine how the interactive white boards are being used and what types of professional development may be necessary to move forward with the initiative and improve the chances of successfully impacting student learning.

Participants

The participants in the survey portion of this study were a convenience sample of 37 teachers from a school district in a southeastern state. The teachers were selected to complete the survey because they are teachers in a fourth-, fifth-, or sixth-grade classroom responsible for teaching multiple subjects and not just a single content area. The participants also included a special education teacher and an English language learner teacher (formerly titled English as a Second Language). These two special area teachers also provided instruction in all content areas. The participants represented a wide range of ages and years of teaching experience.

All of the teachers were asked to participate in this study because they have a classroom equipped with an interactive whiteboard and have had the interactive whiteboard in their classroom for more than one year. The majority of these teachers have had the interactive whiteboard technology installed in their classrooms for approximately three to five years.

Instrumentation

A researcher-developed, open-ended interactive whiteboard survey, Appendix A, was developed to measure teacher opinions on the use of interactive whiteboards to facilitate learning. The survey asked participants to respond to questions about the use of interactive whiteboards in their classrooms using the framework of Gagné's nine events of instruction. There were also questions designed to gather more information about how the interactive whiteboard has changed instruction, the advantages/disadvantages of using the interactive whiteboards for instruction, and what type of interactive whiteboard professional development is recommended for the future.

In addition to the survey, the researcher conducted classroom observations focused on the use of interactive whiteboards for instruction. Each of the eight volunteers was observed once.

The observations were conducted for an entire instructional period as defined by the teacher. The researcher contacted the teacher to determine what time of day was best for the observation. Allowing the teacher to select the time of day for the observation to take place was to assure that the researcher was observing actual instruction and not other classroom tasks. The classroom teacher was given 24 hours notice prior to the actual day of the observation. Providing short notice for the date of the actual observation increased the likelihood that the observed instruction was typically the type of instruction delivered when the teacher is not being observed. Classroom instruction was observed on how the teacher addressed each of the nine events of instruction using the board. The classroom observation was documented using the Instructional Observation Form, Appendix B.

A semi-structured interview, Appendix C, was conducted following the administration of the survey and the classroom observations. The teachers who participated in the classroom observations were the same eight teachers interviewed. During the semi-structured interview, the researcher asked questions about how the teachers prepare for instruction and whether or not they share created lessons with other teachers. These teachers were also asked to describe a typical lesson using the interactive whiteboard. The answers were more in depth because the situation allowed the teachers to talk about the lessons instead of typing a simple reply to a survey. The interview participants were also asked what professional development is needed to train teachers on the use of interactive whiteboards to facilitate instruction. The interviews were conducted last to allow for any follow up questions that resulted from the survey findings or from classroom observations.

Data Collection

The researcher contacted the district superintendent for permission to conduct the study. Once permission was granted, the survey participants were contacted via email by the researcher. The email contained information about the study including information on informed consent by participants. After reading the information about the study, the participants were asked to follow a link to the online survey (see Appendix A). The first part of the survey again contained information about the study and informed consent. The participants agreed to the information outlined in the informed consent statement by completing and submitting the online survey. The last question on the survey asked the participants to include their name if they were willing to volunteer for a classroom observation and a follow up interview. If a survey participant did not volunteer, his or her responses were anonymous. Including the name on the survey for the classroom observation and interview volunteers allowed for triangulation of data. Of the 37 potential participants, 25 responded to the survey (68% response rate).

There were eight teachers who volunteered for the classroom observation and interview. Three of the teachers were fourth-grade teachers. One was a fifth-grade classroom teacher. Two were sixth-grade teachers. There were two resource teachers who serve students in small groups. Of the resource teachers, one was a fifth- and sixth-grade special education teacher and the other was a fifth- and sixth-grade English Language Learner (ELL) teacher.

These eight teachers were observed one time while they were delivering instruction to their students. Although these teachers consented to the observations in advance, the actual observations were conducted with little notice to the cooperating teacher in an attempt to avoid the teacher planning and delivering a special lesson just for this study. This lack of notice before

an observation increased the likelihood that the observed instruction was typical of what occurs daily in the classroom.

These same eight teachers participated in a one-on-one interview with the researcher that occurred after the classroom observation. Upon the conclusion of the classroom observation, the time of the follow up interview was scheduled. The teachers were allowed to establish the time and place of the interview. The teachers were once again provided with the details of the study along with the information necessary to gain consent. After the teachers signed the informed consent letter, each was interviewed independently by the researcher. The interviews were audio recorded.

Data Analysis

Multiple methods of data analysis were utilized in this study. The data obtained on the frequency of the use of the white board to teach certain subject areas were analyzed using a frequency count and the averaging measure of central tendency. Data from all three forms of data collection were analyzed using content analysis to identify the presence of Gagne's nine events. The same data were analyzed again using open coding for repeated or related themes. Lastly, triangulation of all data was utilized to validate the findings of the study.

Triangulation of the data occurred by analyzing the survey responses, the data from the classroom observations, and the interview responses. According to Creswell (2007), triangulation "involves corroborating evidence from different sources to shed light on a theme or prospective" (p. 208). Triangulating the various sources of information gathered from the survey, classroom observations, and interviews assisted in the validation of the study. The survey information was recorded using Qualtrics software. Classroom observations were recorded in detail on the Instructional Observation form (see Appendix B). Teacher interviews

were recorded using the Audacity program on a laptop and then transcribed. The data analyses were ongoing throughout the study and are described in detail in the following sections.

Deductive Content Analysis

An initial method of analysis utilized the deductive approach because the researcher wanted to analyze the methods of instruction (both teacher reported and researcher observed) to identify the occurrence of Gagne's nine events of instruction. A deductive approach is often used when research is based upon an existing theory or model (Elo & Kyngas, 2008). The categories in deductive content analysis are generally based on earlier theories (Elo & Kyngas, 2008; Sandelowski, 1995). The deductive content analysis portion of this study consisted of coding all data from the surveys, classroom observations, and the interviews using Gange's nine events as the categories. Examples of how the interactive whiteboard was used for each of Gagne's nine events are described in the section labeled "Instruction Using the Interactive Whiteboard" in Chapter IV.

Inductive Grounded Theory Analysis

The second data analysis began by taking the raw data and using a method called open coding. Open coding consists of identifying categories into which the phenomena observed were grouped (Hoepfl, 1997). This is the process of reducing the data "to a small set of themes or categories that characterize the process or action being explored in the grounded theory study" (Creswell, 2007, p. 160). Some examples of the codes used in this initial phase of data analysis were good audio/visual use, use of interactive game, sharing lesson on network, and began lesson planning by searching Internet portal. Throughout this process the researcher used the constant comparative approach. According to Creswell (2007), the researcher constantly

compares the data elements to "saturate" the categories until no further themes arise and no new information is being obtained from the data.

As the data were coded during the analysis process, several themes began to emerge. The general codes derived from the open coding process were then further categorized into the four themes that emerged from the first stage of the grounded theory analysis. Re-examining the data and the initial categories to determine how they are linked to the emerging themes is called axial or analytical coding (Creswell, 2007; Hoepfl, 1997; Merriam, 2009). The four themes used for axial coding include multisensory quality of lessons, ease of access to digital resources during instruction, ease of sharing digital resources, and increased teacher motivation.

The final step in the analysis was to correlate how the four themes that emerged from the analysis assist in the creating conditions for learning as defined by Gagne's nine events of instruction. "Generating statements that interrelate the categories in the coding paradigm" is called selective coding (Creswell, 2007, p. 161). The findings will discuss how each of the four themes or characteristics of the interactive whiteboard facilitates Gagne's nine events of instruction and how this instructional tool is used to meet the needs of the students and teachers when striving to create conditions for learning.

CHAPTER IV:

RESULTS

The purpose of this study was to examine how the interactive whiteboard is being used in the classroom for instruction using the framework of Gagné's nine events of instruction. In addition, the researcher wanted to determine if the use of the interactive whiteboard changed the way the teachers plan and deliver instruction, and also, if the use of the interactive whiteboard was more prevalent in certain subject areas than others.

The results section of this study will first discuss how the teachers plan for instruction using the interactive whiteboard. A large portion of the results section will be devoted to how Gagné's nine events of instruction are facilitated by the use of the interactive whiteboard to establish conditions for learning. After reporting the findings of how instruction has changed since teachers began using the interactive whiteboards, each of the nine events will be addressed with information gathered from the survey, classroom observations and teacher interviews. The description of each of the themes that emerged from the analysis of the data will be provided followed by an explanation of how each of these themes or characteristics correlates to creating the conditions for learning as defined by Gagne's nine events of instruction. The last portion of the results chapter will report findings on in which content areas the interactive whiteboard is being used the most and teacher suggestions for future professional development.

Planning for Instruction

The survey results show that teachers planned for instruction using the interactive whiteboard in many different ways. Although two of the teachers reported that they only use the

digital whiteboard the same way as a traditional whiteboard, all of the other respondents used a variety of resources to capitalize on the features that the interactive whiteboard offers. Some of the teachers reported using multiple sources to create their lessons. Table 1 provides a breakdown of the various responses of the 25 teachers who responded to the survey.

Table 1

Source for Interactive Whiteboard Lesson Plans

Source for Lesson/Activity	Responses
Online lesson portal (Promethean Planet, ALEX, etc.)	16
Shared on local network	10
Create their own lessons	7
Online interactive sites	5
Lessons downloaded from Internet then edited	4
Resources from curriculum resources (Textbook, Reading Series, etc.)	3
District instructional software (Voyager Math, Compass Odyssey, etc.)	2

Most of the teachers interviewed recounted a similar process for developing lessons for their classes. They begin by determining the lesson objective and then they go to an online portal that contains a repository of many lessons created by other teachers (Promethean Planet, ALEX, etc.). They search for lessons that have already been created with the same lesson objective and download the appropriate flipcharts or PowerPoint activities.

All of the teachers interviewed also talked about working with other teachers on their campus to divide the lesson development responsibilities among themselves and then share the

lessons created. One fourth-grade teacher said that she created all of the math lessons while the other three teachers each created the language arts, science, and social studies lessons. They placed all of their work on a shared network folder with specific instructions for the lesson. All of the teachers interviewed reported the sharing of interactive whiteboard lessons on their own campus but did not report sharing lessons with other teachers outside of their school.

Advantage, Disadvantages, Barriers and Teaching Methods

The survey results indicate that teachers see advantages and disadvantages when using the interactive whiteboard for instruction. There are many advantages and most of the teachers named more than one in their response. Teacher responses when asked about the advantages of using the interactive whiteboard for instruction include increased student engagement/attention, easy access to digital audio/visual resources, excellent visual tool, efficient pacing of lessons, ease of providing feedback, modeling the use of technology, and accessing previously saved lessons.

Teachers also listed some disadvantages of using the interactive whiteboard for instruction. By far the main disadvantage reported was having technical problems with the board, the projector or the computer. Other disadvantages reported include that lessons are very time consuming to plan, expense of equipment, only allowing for one or two students to interact with the board at one time, and not enough training on the software.

In addition to disadvantages, teachers were asked what they see as barriers to using the interactive whiteboard. The teachers responded with basically the same responses listed in the disadvantages. The main barrier is technical problems such as pens not working or having to reboot the computer. Other barriers reported were lack of training of newly-hired teachers, the

amount of time it takes to create lessons and the desire to have more than two people write on the board at the same time.

When asked if the use of the interactive whiteboard changed the way they teach, three teachers responded that it had not changed their methods and 22 responded that it had improved the way they teach. The teachers reported that the interactive whiteboard allowed them to use digital resources that they have never been able to use before. The most valuable digital resources were the ones that engaged the students by allowing them to interact with images and text in front of the class. Some of the teachers stated that they enjoyed teaching more when the students were involved and engaged in the lessons. Another teacher stated that the use of the interactive whiteboard had pushed her to become more creative and use a wider variety of learning modalities. One teacher replied, "I'm lost without it." When discussing lesson planning, one teacher stated that the first thing she always does is to go to the Internet to see if a lesson has already been created.

The teachers reported and the researcher observed features that the use of the interactive whiteboard provides that are not available with the traditional classroom set utilizing a computer and projector. The value of the board as an input device is the greatest difference. The interactive whiteboard allows the teacher and students to start, stop, pause, and review audio/video clips from the front of the classroom without having to constantly walk back and forth to the computer mouse and keyboard. Teacher and students may also manipulate objects or words by just touching and dragging leading to more interactive lessons. Using the software included with the interactive whiteboard allows the class to highlight, annotate over, spotlight, or reveal images and text in a way that is not available with just a computer and a projector. The students in a fifth-grade science class were able to move the pen over a picture of the eye while the software

was in the "magic reveal" mode. As the magnifying glass moved over the image of an eye, the interior structures of the eye were revealed and the students discussed the name and function of that particular structure. Also, quick access to the undo feature is helpful in resetting the lesson. One teacher reported just resetting the flipchart allowed her additional time when working with small groups. Instead of having to erase the board and start over, she just saved the previous group's work and reset the page to the original activity. The use of math tools was also very helpful for the teachers. Instead of trying to use a clear ruler on a traditional overhead/transparency to model measurement, the teacher clicks a button and the ruler (protractor, fraction bar, compass, etc.) appears.

Use of the Interactive Whiteboard to Address Gagne's Nine Events

The following sections present the information gained from this study on how each of the nine events of instruction are being met using the interactive whiteboard. The information presented for each of the nine events was gathered through surveys, classroom observations, and teacher interviews. Each section will describe ways in which the interactive whiteboard was used as a step to create conditions for learning.

Gaining Attention

Teachers reported on the survey that they used the board to gain student attention by displaying interactive lessons that required the students to come to the board to manipulate objects. They also reported that student attention is gained by beginning lessons with a video or images that build background knowledge. Videos embedded within the lesson break up the activities and gain student attention. Also there are numerous games and interactive competitions that gain and retain the attention of the students. One teacher stated that anything that gets them out of their seat and working at the board gets the students excited and engaged.

The classroom observations yielded more examples of using the interactive whiteboard to gain student attention. A fourth-grade class began a math lesson on fractions by playing an informational cartoon from the BrainPop website. All of the students were engaged in the video and often referred to information presented in the video to support their answers throughout the lesson. A fifth-grade class of English language learners shouted with excitement when the teacher opened the internet game, Word-O-Rama, to review their vocabulary words for the week. A sixth-grade teacher opened a reading lesson by having the students read a passage in their textbook and use the ActiVotes (classroom response system) to answer questions designed to measure their understanding of the initial passage. All of the students were reading purposively and trying to determine the answers to the questions so that they could place their vote. The teacher in a fifth-grade special education class projected pictures on the whiteboard of different shipwrecks and posed the question, "What are some reasons that ships wreck?" The teacher then drew a word web on the board with the students' responses. The teacher was building background knowledge and peaking the interest of the students leading up to the story they were about to read.

During the teacher interviews the teachers were asked to describe their favorite lessons. Two of the lessons described had perfect examples of how the interactive whiteboard is used to gain and maintain student attention. First, a teacher described that in her classroom any time they did an activity that allowed the students to come to the board and interact with the lesson she instantly had all of her students' attention. She said that she strives to include student interaction in all of her lessons because she knows that is the best way to keep the attention of the students who often have trouble focusing on the content she is teaching. Secondly, a sixth-grade teacher described a large flipchart lesson that corresponds with a unit lesson on biomes. The students

have been using the same flipchart to guide their lessons for weeks. The flipchart has embedded videos that play as a result of student interaction such as click on the camel for information about the fauna that have adapted to the desert biome or click on the cactus for the characteristics of the flora associated with a desert biome.

Informing the Learner of Objectives

Only seven of the survey respondents stated that they used the interactive whiteboard to display the objective of the lesson. These teachers indicated that the lesson objective was usually at the very beginning of the flipchart. If the flipchart is used over multiple class sessions, the teacher will refer back to the saved slide from the previous day to reengage the students and continue with the lesson from the previous class. Two other teachers said they write the lesson objective on the regular whiteboard beside the interactive whiteboard so that students have access to view the objective throughout the lesson.

The data collected from the classroom observations and interviews indicate that a small percentage (25%) of the teachers in this study use the interactive whiteboard to inform the learner of the lesson objective. The researcher observed two instances out of eight classroom observations where the teacher used the interactive whiteboard to state the learning objective. One of the teachers had written the lesson objective on the dry erase board to the side of the digital whiteboard. Four of the teachers stated verbally the topic and expected outcomes for that day's lesson. When asked to describe a typical lesson using the interactive whiteboard, two of the eight teachers interviewed said that they always include the learning objective on a slide at the beginning of the lesson.

Stimulating Recall of Prior Knowledge

Teachers were asked on the survey, "How do you use the IWB to help your students recall prior knowledge?" There were four main answers. Sixteen teachers stated that they used the board to review previously taught materials in preparation for introduction of new content. Of these sixteen, three stated that they often reopen previously used flipcharts to review prior content. Three teachers reported using the ActiVotes response system to refresh recall of prior knowledge. Six teachers indicated that they used graphic organizers such as KWL charts, word webs and Venn diagrams to increase recall of prior knowledge or as a pre-reading strategy.

During a classroom observation, a sixth-grade special education class was getting ready to read a story about shipwrecks. The teacher projected some images of wrecked ships and asked the students to, "tell me some things that may cause a ship to wreck." As the students took turns sharing their thoughts, the teacher was writing their answers on the board.

A sixth-grade science teacher reopened a flipchart she had been using to teach biomes. She went to the slide with a map of the world with each of the biomes color coded. She touched certain regions and a question appeared about that particular biome. Reviewing characteristics of previously taught biomes was used to prepare students to learn about the new biome presented in class that day.

Presenting the Stimuli

The majority of the survey responses indicated that they use flipcharts or PowerPoint presentations to present new content. In addition many of these same teachers said they also use a wide variety of media such as videos, educational websites, and purchased instructional software. A couple of teachers indicated that they use the math tools (number cubes, spinner,

graph maker) built within the software to teach new concepts. One teacher mentioned using online maps for social science to introduce new material.

Two of the classroom observations provided wonderful examples of how the interactive whiteboard is used to present new material to the students. A fifth-grade science class was learning about the anatomy of the eye. The teacher used a flipchart with a cross-sectioned image of the eye. As the teacher touched different parts of the eye, the name of that part appeared in addition to the part's primary function. The visual aid with the interactive information served as a valuable centerpiece for the classroom discussion. In a sixth-grade science class, the teacher was using a flipchart to introduce the class to the boreal forest biome. The teacher had a map of the world indicating the locations of the boreal forests. From that slide there was a link to a five-minute video about the characteristics, flora, and fauna of the boreal forest.

During the teacher interviews, the teachers discussed some of the ways they present new content using the interactive whiteboard. A fifth-grade teacher said she often uses the board to display pictures that reflect the vocabulary words for the week. The students brainstorm about what they see in the picture leading up to the point where the teacher reveals the vocabulary word and the definition. A fourth-grade math teacher stated she likes to explain and model a math skill on the board while the students work the same problem on their own paper. A sixth-grade teacher said she always attempts to present new content in a flipchart requiring student interaction. This teacher said that in her opinion her students behave better and pay more attention to the lesson when they are able to interact with the content.

Providing Learner Guidance

The results of the teacher survey indicate that the interactive whiteboard is used numerous ways to provide guided practice for students. Ten of the responding teachers answered

very generally stating that the board was used every day for guided practice in all subjects. Three of the teachers said they did not use the interactive whiteboard for guided practice. Some of the teachers responded with specific answers. Two of the teachers stated that they use activities from the instructional software, Odyssey. Two teachers said they use the interactive whiteboard to demonstrate science experiments before the students conduct them. Two teachers reported using the board to model the writing process and the daily oral language activities. Four teachers reported using the board to model math problems. Of these four, two of the teachers said they often let the students model the math problems on the board, allowing the other students to provide assistance as necessary.

The classroom observations provided many examples of how the interactive whiteboards are used for guided practice. Students in a fourth-grade class took turns going to the board to model subtraction of numbers with decimals in them. The teacher modeled the first example then students followed. Other students provided verbal guidance if the student at the board became confused. The teacher also provided verbal guidance for the student at the board. Another fourth-grade math teacher used a website that modeled "fraction bars" while the students each had their baggie of paper fractions bars. The teacher would put the problem representing equivalent fractions on the board then model the problem with fraction bars on the web site while the students modeled the same problem with the fraction bars at their desk.

Students in the sixth-grade class studying biomes were allowed to come to the board to drag and drop photos of particular animals into the correct biomes, also photos. Many of the students participated at the board. The whole class participated in the discussion about how the animals had adapted over time to coexist with the climate conditions of that particular biome. Following this exercise the students did the same activity using plants instead of animals. The

teacher ended this lesson by drawing the biome on the board while the students drew it on their paper using colored pencils. The teacher had done this for every biome covered in class and had a flipchart of biome illustrations to match the students' book of biomes.

The interviews provided information about the extent of the use of the interactive whiteboard for guided practice during instruction. Seven of the eight teachers interviewed expressed the value of using the board daily to model math problems and the writing process. Five of the seven interviewed stated that the ability to move, edit, erase and save work make the interactive whiteboard an invaluable tool for instruction.

Eliciting Performance

The teachers reported several ways that the interactive whiteboard helps to elicit student performance. Fourteen teachers reported that anytime the students get to interact with the board, motivation to perform is much higher than if they are just doing work at their desk. Three teachers reported that the best activity to get the students thinking and working is to play games such as Jeopardy or Millionaire using the board. Three teachers indicated that student performance was greatly increased by the use of the ActiVotes that work within the whiteboard software. One teacher listed the use of student created writing prompts as a great way to elicit performance. Three teachers stated they did not use the interactive whiteboard in this manner.

The classroom observations produced three good examples of how the board may be used to elicit student performance. A fourth-grade math lesson involved students coming to the board and shading fractions of various objects by using the bucket fill feature on the whiteboard. A student may color three circles in a caterpillar body containing five circles to represent three fifths. Students took turns at filling fractions of various objects and all students remained engaged in the lesson. Students in a fifth-grade English language learning class participating in

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an online exercise stood at the board and shared their thoughts as they had to make decisions about how to answer the question. There were only five students in this class so they were all able to participate in the "think aloud" exercise at the board. In addition, a sixth-grade science teacher had created a flipchart with an interactive exercise. The students pulled the words hidden behind an eye chart and properly labeled the parts of the eye (see Figure 1).
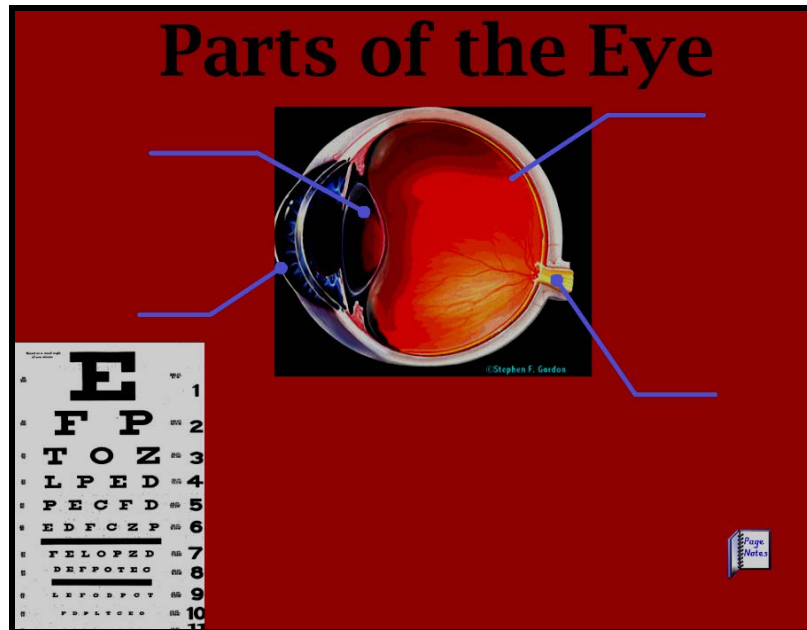
Figure 1. Parts of the Eye

All of the teachers interviewed talked about the value of the students getting to interact with the board and how much student performance is enhanced by the board. A fourth-grade teacher talked about how difficult it had been in the past to get the students to practice multiplication tables. She tried flash cards and many other tactics but the activity that seemed to get the students performing was to use the number cube tool built into the software. The activity is a digital simulation like rolling dice. The number cubes are clicked and the values that show up are the two numbers to be multiplied. She said her students loved that activity because it seemed to remove the boredom from the task.

Providing Feedback

      The survey responses about the use of the interactive whiteboard to provide feedback were quite varied. Four teachers responded that they often use ActiVote polling results to provide students with immediate feedback. Four teachers stated that they often built flipcharts with reward sounds for correct answers or hidden answers placed where they could be revealed after student performance to check their work. Three teachers said that games played using the interactive whiteboard provide immediate feedback for the students and often include reward images or sounds. Three teachers stated that feedback was received from the teacher or from the class as a student is at the board modeling skills in front of the whole class. Three teachers stated that an electronic form of the worksheet was projected on the board and the teacher used the annotate feature to fill in the answer key. Three teachers reported that they did not use the board to provide feedback.

      The information provided in the survey was also observed directly in the classroom lessons. Fourth-grade students working problems at the board could move a circle to reveal the correct answer. If they answered incorrectly, the teacher would provide guiding questions to help the student correct his or her work. Fifth-grade students playing a vocabulary game would dance around while the reward jingle played as a result of them selecting the correct answer. The game varied by sometimes asking for the correct word when providing a definition, a fill in the blank sentence, or it may ask for a synonym or an antonym. Students in a sixth-grade science class voted using the ActiVotes to answer review questions. After all students had voted, the results were projected using a graph. The class discussed the options and decided together which choice was actually the correct answer. All students had to answer with "I chose ____ because_____." The students had to rationalize all answers given during the discussion.

Assessing Performance

All of the survey responses concerning assessing performance fell into three categories. Teachers either reported using ActiVotes for assessing performance (20%), using activity at the board as an informal assessment (48%) or did not use the board at all for assessment (32%).

Other than formative evaluations, only one teacher assessed the performance of her students during the classroom observation. The sixth-grade students were taking a quiz on how to format a research paper. The twenty-question quiz was displayed in a flipchart with one question per slide. As soon as all of the students entered their responses via the ActiVotes, the correct answer was displayed providing the students with immediate feedback. When this teacher was interviewed she stated that the quiz results were exported into an Excel file for the teacher to enter the grades into her grade book.

Enhancing Retention and Transfer

Teachers reported on the survey that repetition and review is the best way to enhance retention of material taught. Ten teachers reported that the interactive whiteboard makes this easy because they can open previously saved flipcharts to review material. The teachers also create flipcharts that repeat instruction and skill practice. Nine of the teachers responding to the interview stated that the most valuable use of the interactive whiteboard is the ability for students to view and manipulate images. One teacher responded that "visuals, visuals, visuals" are the true secret to enhancing retention and transfer. Two teachers responded that the best way to increase retention is through engagement and the playing of games. One teacher responded, "engagement equals retention." Four of the survey respondents said they did not use the interactive whiteboard to enhance retention of information.

It was obvious from the classroom observations that the students were accustomed to using the interactive whiteboard in class. From the cheers when a game title screen is displayed to the hands that shoot up to volunteer to write on the board, it is evident that the use of the interactive whiteboard increases student engagement in the learning process. An excellent example of transfer of knowledge was observed in a fifth-grade science class studying the function of the eye. The teacher projected an interactive website that showed a cross section of the human eye with a graphic showing how a visual is supposed to converge on the retina at the optic nerve.   The students could go to an eye where the image was in front of the retina or behind the retina modeling what happens when a person has vision problems. The students could move a slider at the bottom of the screen to correct the vision problems with differing levels of a convex or concave lens. The goal was to select the appropriate lens to make the image appear on the retina. The students loved this activity.

Five of the eight teachers interviewed were very positive about the use of games as an excellent method of engaging the students and increasing retention. Three of the teachers stated that the students always get excited when reviews are conducted using the interactive whiteboards. Two teachers stated that the use of videos and interactive images is a powerful method to improve transfer of knowledge and increase student retention of material.

Interactive Whiteboard as Valuable Instructional Tool

As the study progressed several themes became apparent. The use of the interactive whiteboard is a valuable instructional tool because it is multisensory. The teachers also report that having all of the resources at their fingertips helps them pace the lesson and reduces the time needed to transition from one activity to another. The ability to create, share, and easily edit digital lessons was also a recurring theme in the data. One of the most encouraging themes that

emerged from the data was that teachers as well as students were more motivated by the interactive features offered by the interactive whiteboard. These characteristics of instructional use of interactive whiteboards make them one of the most valuable instructional tools widely available to today's classroom teachers.

Multisensory Lessons

The lessons using the interactive whiteboard are more engaging to students because they are multisensory. The instructional tool provides a variety of features that help create lessons that appeal to all types of learners – visual, auditory, and kinesthetic. Teachers report the use of digital audio and visual resources are often the best method of demonstrating a concept.

One teacher posted a photo of a kitten looking into a mirror and seeing the image of a lion. The vocabulary word represented in the picture was "esteem." The discussion of the visual and the students' interpretation of what they were viewing allowed the teacher to take a word that has traditionally been hard to describe using words alone and presented it to the students in a manner that helped them to understand the meaning of the word.

The researcher also observed students dance around while they were playing a vocabulary game. The students would match the word to a picture representing the word. If the students made the correct connection then a reward jingle would play. Also, if the student clicked on the work, they would hear the correct pronunciation. This was especially important for these students because English is not their home language. This one simple lesson utilized audio, visual and kinesthetic qualities.

A final example of the multisensory capabilities of the interactive whiteboard took place in a fourth-grade math class. Students were studying place value by playing a racing game. Two students were at the board and were racing to work place value problems. Students competed in

pairs to finish the place value problem that allowed them to move their race car forward. Although only two students were playing at a time the whole class remained engaged and provided feedback to the students at the board.

Ease of Access to Digital Resources during Instruction

Traditional lessons using a computer and a projector would allow the teacher to play a video from her computer but the teacher had to be at the computer, use a wireless mouse (very limited range) or have a student sit at the computer to stop and start the video. Audio files were played in a similar fashion. To provide audio feedback or reward sounds, the teacher would have to locate the audio file and click on it when it was time to hear the sound play. By using the interactive whiteboard, audio or video files can simply be embedded in an object and the only thing necessary to play the file is to click the object. The teachers love not having to run back and forth to play audio and video files. Teachers also report that in the past the students couldn't play games in front of the class and had to play individually with headphones on in the back of the class. With the use of the interactive whiteboard, games have become more fun because the whole class may participate and provide feedback.

One fourth-grade teacher discussed the many virtual websites available to use when studying about Alabama. In the past she had to rely on a student sitting at the computer to maneuver through the site. She said that now she uses the interactive whiteboard to explore these virtual places controlling the movement from the front of the classroom. She said that she liked to let the students take turns clicking on the places they wanted to visit and navigate through the virtual tour.

Many of the teachers discussed how they build their flipcharts so that all of the resources are linked within the lesson and are available at their "fingertips." Not only could they structure

the pace of their lesson but they could also retrieve previous lessons easily to scaffold concepts. One teacher stated that in the past, once she erased the dry erase board the visual of that lesson was gone forever. She stated that pulling up the specific lesson with that class's annotations and their own work was very valuable especially for the her lower ability level students.

Easy access to software features also makes teaching more engaging and interactive. It was obvious how much the students enjoyed the creative freedom allowed to them by using the interactive whiteboard to represent fractions. The students were given a fraction and had to illustrate that fraction using images of their choice. Most of the students drew or accessed one "whole" image and then colored a fractional portion of that image. For example they drew a pizza with six pieces and colored five pieces to represent five-sixths. One creative student found an image of a popcorn kernel and used the "stamp" software feature to display five equal kernels of popcorn. Then she colored two of them black and stated that two-fifths of her popcorn was burnt.

Ease of Sharing Digital Lessons

Teachers reported that sharing lessons plans in the past consisted of looking through another teacher's text descriptions of the steps involved in the lesson. Teachers could share ideas but it was more difficult to actually share the materials used. Traditionally the only attachments to these lessons were printable worksheets. Using the interactive whiteboard allows teachers to easily share the whole lesson and all of the audio/visual content in addition to any interactive exercises. The ease of sharing digital lessons was a common theme that emerged from the study.

One teacher noted that many of the new math textbooks that were being considered for adoption had supplementary material including digital lessons for use with the interactive

whiteboard. These lessons were not platform specific (Promethean, Smart, etc.) but could be used on any type of interactive whiteboard.

Accessing searchable online portals of digital lessons was most often reported as the first step in beginning to plan specific lessons. In addition to accessing these lessons, the teachers reported it was easy to share these same lessons created by the teacher with other teachers using email or shared network space. Although teachers reported that it takes too much time to create digital lessons from scratch, they often start by locating a premade lesson and editing it to make it their own. One of the biggest concerns of the teachers was not that there were not enough digital lessons already available but that there were so many available that it was hard to find the time to evaluate which ones were the best.

Increased Teacher Motivation

The teachers reported that students were more engaged and motivated to learn when instruction involved the interactive whiteboard. It also became apparent that teachers were more motivated to teach using a variety of resources afforded by the interactive whiteboard. One teacher stated that she could never go back to teaching without the interactive whiteboard while another teacher expressed how much she enjoyed creating digital lessons and being able to share with her fellow teachers. This teacher had made interactive flipcharts for every story in the fifth- and sixth-grade reading series in addition to creating flipcharts for each week's spelling and vocabulary words. She created a Moodle site (content management software) and allowed all of the teachers and students on her campus access. These flipcharts were used by the most of the teachers at that school.

One teacher stated that she enjoyed creating the lessons as much as she enjoyed delivering the lessons. She said that her instructional practices have been greatly enhanced with

ideas and methods she had learned from teachers who had posted to Promethean Planet. She

stated that before the installation of the interactive whiteboard on their campus teachers vary

rarely shared lessons and she felt as if she were isolated from the lack of collaboration. Now she

says that sharing of lessons on her campus has become standard practice and that was one of the

best moral boosters she had experienced since working at that school.

A fourth-grade teacher expressed how excited she always gets on Thursdays because the

"gifted" students go to a resource class and she has 12 students who remain in class for two

hours. She stated that she ALWAYS used the board with this small group. She looked forward to

this time every week because the students were engaged and enjoying the instruction. This

motivates her to spend more time creating interactive lessons with that particular group of

students in mind.

The teachers also reported the need for time to prepare lessons. One teacher stated that

she was determined to make her lessons the same quality as those she finds in Promethean

Planet. She stated her goal was to have one of her lessons meet the standards required to upload

to Promethean Planet. She was so excited talking about how much she would love to see if other

teachers throughout the world would download her lesson.

Characteristics of the Interactive Whiteboard Used to Create Conditions for Learning

The multisensory quality of using an interactive whiteboard to deliver instruction is one

of the most powerful features in helping a teacher create conditions for learning. Teachers report

the ease of gaining the attention of the students simply by presenting a lesson that included

multiple senses. Accessing prior knowledge is also easily accomplished by recording previous

lessons or saving content created by the students regardless of the medium of the content being

either audio, video or interactive. Multimodal methods may also be used by the teacher to

present the stimuli, provide learner guidance, elicit performance and provide feedback. Because instruction using the interactive whiteboard may include audio, visual and kinesthetic properties, the likelihood of student retention increases.

Having easy access to all of the digital resources during instruction also facilitates the teacher to create conditions for learning. One teacher reported that simply clicking on a video to begin a lesson was a great way of gaining the attention of the students. The ability to stop and start the video at precise moments with very little distraction was also reported as a valuable tool for presenting new content or providing learner guidance. The use of the ActiVotes by students and the fact that their answers may be presented immediately in a graph was reported to be a valuable method of eliciting performance in addition to instantly providing feedback. The ability to easily revisit prior content and review previously presented lessons is also a valuable characteristic when the teacher is attempting to build prior knowledge or enhance retention/transfer of knowledge.

Teachers repeatedly discussed the need for time to create digital lessons that effectively utilized the capabilities of the interactive whiteboard. Therefore, while the ease of sharing digital lessons may not seem to be directly related to creating conditions for learning, it may be one of the most important since easily sharing lessons saves time and creates an atmosphere to share best practices. Teachers may not always have the time to create a dynamic lesson from scratch but when the teacher has easy access to a wealth of lessons already created, the amount of time necessary to develop a lesson decreases significantly. Teachers reported that the majority of the lessons found online at Promethean Planet were high quality and very well constructed. Many of the teachers reported that the lessons available for download on the Internet already had the

necessary components to create conditions for learning and only needed to be "tweaked" a little before use.

The teachers observed and interviewed in this study were clearly motivated by the use of the interactive whiteboard for instruction. The motivation to create lessons that gain attention, allow the students to interact with the lesson, and provide multisensory instruction is vital for creating conditions for learning. One teacher commented how the use of the interactive whiteboard has inspired her to create lessons with multiple strategies for teaching concepts. She shared that she no longer feels like "Charlie Brown's teacher" by standing in front of the class lecturing about concepts presented in the textbook. Another teacher reported that now that she uses the interactive whiteboard for instruction she is constantly looking for interactive websites that represent concepts that are often difficult to explain or understand. The teachers also report how motivated they are to identify and/or create games because the students are always engaged when digital games are utilized. Teacher reported that the use of games not only gained the attention of the students but also provided an easy way to elicit performance, provide feedback, and increase retention of targeted content.

Content Areas

The survey revealed that on average, teachers in this study use the interactive whiteboard to teach language arts (40%) most frequently followed by math (21%), science (20%), social science (11%) and other (8%). It was determined from the follow up interview that the "other" category is mainly referring to state mandated character education. The interview responses also indicated that teachers use the interactive whiteboard the most for language arts instruction with math and science mentioned about the same number of times. Only two teachers interviewed mentioned teaching social science using the interactive whiteboard.

Professional Development

There were several suggestions for future professional development pertaining to the use of the interactive whiteboard for instruction. The overwhelming request was for TIME. Teachers stated they needed time to explore, play and share all of the features that the interactive whiteboard has to offer. A couple of teachers who had been hired after the initial training that occurred with the installation of the interactive whiteboard suggested that there be some type of formal training in place for new hires. They stated most of what they have learned was from other teachers and they would like to officially be trained. All of the teachers suggested having time set aside to share best practices with other teachers who use the interactive whiteboard. One teacher suggested that all further training be differentiated instead of having all skill levels placed into the same session.

Summary

Teachers who are teaching using the interactive whiteboard have found it to be an invaluable tool for creating the conditions for learning. The interactive whiteboard is a valuable instructional tool because it provides easy access to digital resources during instruction as well as making it easy for teachers to share digital lessons. It also facilitates the implementation of multisensory instruction and increases teacher motivation.

CHAPTER V:

DISCUSSION AND CONCLUSIONS

Although not all of the teachers participating in this study use the interactive whiteboard to create conditions for learning, most of the teachers studied are effectively using the instructional tool to address Gagne's events of instruction in their classroom. Planning for instruction using the interactive whiteboard may take more time but is offset by the ability to easily share created lessons. There are many advantages to using the interactive whiteboard for instruction but there are also some concerns that arise with the use of the digital tool.

Planning for Instruction

Planning for instruction using the interactive whiteboard takes time but also provides an opportunity to make sure instruction is varied to meet the needs of a classroom full of students who learn in different ways. Previous research reported that planning for lessons using the interactive whiteboard takes longer than planning a traditional lesson (Glover et al., 2007; Haldane, 2007; Higgins, 2010; Lee & Boyle, 2003; Smith et al., 2005). In the interviews, the teachers discussed how little time they were given for planning in relation to how much time it took to plan a lesson. Much of the time needed to develop quality lessons is necessary because the teacher is trying to identify quality visuals or videos as well as plan for student interaction within the content of the lesson. Although the teachers said that it takes time to prepare a quality lesson, using a lesson with a variety of text, images, and sounds was well worth the effort because the students remained engaged in the lesson and in all probability retain more because of the use of digital resources. Furthermore, as found in previous studies, the teachers reported that

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over time they are able to build an extensive set of lessons that may be easily updated and reused, reducing time needed for preparation (Kennewell et al., 2008; Zevenbergen & Lerman, 2008).

We are entering an era where the sharing of information is easier than ever. The ease of sharing digital materials via networks or the Internet reduces the stress involved in planning for lessons to use with the interactive whiteboard (Glover et al., 2007; Haldane, 2007; Lee & Boyle, 2003; Nevin et al., 2009; Smith et al., 2005). The teachers in this study are capitalizing on the ease of sharing digital lessons by going to the Internet to find already made lessons that address the learning goals set of their curriculum. The majority of the teachers stated that the first thing they do is go to a site such as Promethean Planet to see if a flipchart has already been created. Some of the teachers reported downloading these flipcharts and then editing them to make the newly created lesson meet the needs of their students. These findings concur with the study of Lefoe et al. (2009), which reported that rarely were lessons downloaded from the Internet used without teacher modification. The teachers also reported sharing lessons on the network so that other teachers on campus have access and may use these lessons also. This sharing of workload is more simple because the lessons are digital. The use of online portals for lesson plans is nothing new, but in the past these portals have contained mainly text documents with attached worksheets. The digital lessons that are available now make it easier than ever to compile and share digital resources that meet curriculum objectives and maintain the interest of the students. The fact that the teachers reported using networks to develop lessons supports the findings of previous researchers that online sharing allows teachers to build upon each other's strengths, learn new pedagogical skills, and improve on their own instructional practice (Nevin et al., 2009; Recker et al., 2005).

Framework for Instruction

There are many advantages to using the interactive whiteboard for instruction. From this study it is evident that the use of the board facilitates each of the events that create conditions for learning. One of the first events of instruction according to Gagne is to gain the attention of the learner. The teachers reported and the researcher observed that overall students stay engaged in the lesson when the teachers (or students) are using the interactive whiteboard. Not only does this teaching tool gain their attention but because many of the lessons are interactive, it maintains their attention throughout the class. Students are more motivated to learn because it is easier to maintain their attention (Smith et al., 2005). It was apparent that getting to come to the board was a positive experience because most of the teachers had worked out a system to use when calling on the students to interact with the board.

One of the reasons that teachers enjoy teaching with the board is that it allows them to pace instruction (Kennewell & Beauchamp, 2003; Knight et al., 2005; Schuck & Kearney, 2007; Smith et al., 2005; Smith et al., 2006; Wood & Ashfield, 2008; Zevenbergen & Lerman, 2008) and easily place all of the resources such as videos, images, or interactive web sites in one location with links for easy access. The previously created lesson allows for a smooth transition from one activity to the next while still allowing for a new slide to be inserted or a web site to be accessed for that "teachable moment" that was not planned. There are so many digital resources available for instructional purposes that it is helpful for teachers to be able to have links to these resources "at their fingertips."

According to Gagne, new information is easier to retain when connected with prior knowledge (Gagne et al., 2005). A great feature of the interactive whiteboard is the ability to save previous lessons to open and refer to when building background for a new lesson (Knight et

al., 2005; Schuck & Kearney, 2007; Wood & Ashfield, 2008). There were many examples of this practice throughout the study. Teachers often reopened previously saved graphic organizers completed in earlier lessons. One type of graphic organizer used is a KWL chart. The name comes from the exercise – what do you <u>K</u>now, what do you <u>W</u>ant to know, and what did you <u>L</u>earn. The KWL chart may be used for a week as students explore a new concept. In the past the teacher would have to leave the chart on the dry erase board for a week while the lesson progressed or use an overhead projector and write on a transparency. The teacher or the students write on the template on the interactive whiteboard and then save it for upcoming lessons. Recalling a previous lesson was used in several of the classrooms during the observations by accessing prior lessons and reviewing before moving into the new content using the interactive whiteboard.

The distinction between presenting new content, providing learner guidance, eliciting performance, and providing feedback was sometimes difficult to determine because the teachers made the entire process flow seamlessly. Lessons using the interactive whiteboard are typically more streamlined because of software allows for smoother transition between activities within the lesson (Kennewell & Beauchamp, 2003; Smith et al., 2005; Zevenbergen & Lerman, 2008). The lessons were so well planned that often by providing feedback the teacher was also eliciting a response. The students were very comfortable in the classroom and did not hesitate to perform work at the board in front of the class. Teachers stated that the students were less hesitant to make a mistake on the interactive whiteboard because they could simply hit the undo button and try again. Glover et al. (2007) and Knight et al. (2005) suggested that students are not intimidated to work on the board in front of the class because mistakes are not perceived as being permanent. Also, the students were just as helpful as the teacher in providing feedback for the

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student working at the board. It was obvious that the students were comfortable using the board to practice new skills with the whole class helping out.

Teachers and students were familiar with the tools built into the interactive whiteboard software. The researcher observed both teachers and students using the highlight feature to identify passages, words or parts of words during language arts lessons. A special education teacher projected a reading passage and the students came to the board to highlight the words unfamiliar to them. Another class highlighted all of the suffixes and prefixes of their vocabulary words to help them identify and begin discussion about the meaning of the root word. Students used the color fill tool to shade fractional parts of objects or moved a picture of an animal into the correct biome. According to Glover et al., (2007) virtual manipulation of learning objects results in more effective understanding of concepts. Other students worked math problems then moved a specific shape to reveal the correct answer, providing instant feedback. The immediacy of feedback is another advantage of teaching using the interactive whiteboard (Glover et al., 2007).

The interactive features of the board allowed teachers to model or simulate complex ideas in a way in which the typical textbook could never accomplish (Kennewell & Beauchamp, 2003). Watching students line up two representations of equivalent fractions and actually seeing that the objects were equal was a powerful visual to help students with an often hard to understand concept that until now was just an exercise in a textbook. It would take pages of text to explain the concept of how corrective lenses work to make vision more accurate when a simple interactive graphic was all that students needed. The class could tell you why you needed a convex or concave lens depending on the location of the image in relation to the retina and the optic nerve. Deaney et al. (2009) attributes the interactive whiteboard's ability to help students

develop complex ideas to the visual and interactive nature of the software. Also, watching a video of animals in their native habitat was valuable when the teacher could pause the video at each animal to discuss the body characteristics and how those characteristics allow the animal to thrive in that particular climate.

Real world simulations and concept application help the students retain what is being learned and allow students to transfer newly obtained knowledge to situations outside of the classroom (Hennessy et al., 2007). It became evident that the students loved the interactive games that have been designed for use with the interactive whiteboards. Almost every teacher interviewed discussed how wonderful the games were at eliciting performance, providing feedback and improving retention for many of the concepts that had previously been difficult to review. The teachers discussed the educational value of the games and how the students were learning but it was fun so they were engaged and responsive, unlike student behavior during traditional reviews before using the interactive whiteboard.

The ability to review content is most beneficial to special needs students and lower ability groups (Knight et al., 2005; Smith et al., 2005). During the classroom observations it became apparent that students in the smaller classes had more opportunities to interact with the board. Both the special education teacher and the ELL teacher discussed how valuable it was to have small groups of students come to their classroom for additional instruction and review. These same teachers discussed how the students often became frustrated or bored with the constant repetition of content. The use of the interactive whiteboard and educational games now allow the teacher to "mix things up" in a fun way that students enjoy reviewing while still meeting their educational goals.

Although Gagne's framework is valuable in providing guidance for instruction, the use of the interactive whiteboard does not change a couple of the events. While I agree with Gagne that it is important to inform the learner of the lesson objective, I do not believe it matters how the objective is displayed. Most of the teachers stated the objective verbally with only a little more than half actually displaying the objective in writing. I do not believe that displaying the objective on the interactive whiteboard is any more effective than simply writing it on the traditional board. Many teachers prefer to write it on the traditional board so that the goal is displayed throughout the lesson. If the teacher never previously displayed the learning objective but began displaying the objective with the use of the interactive whiteboard then an improvement in instruction occurred as a result of the use of the board.

During the classroom observations it became apparent that the interactive nature of the board was not enough in and of itself to hold the attention of classes with a large number of students. The smaller classes were more engaged because the likelihood of each student getting to interact with the board was higher. The students in large classes were more engaged when they were working along at their desks. The math teacher teaching equivalent fractions seemed to understand the need to have students working at their desks because in addition to modeling the fractions on the board, the students had their own set of fraction bars at their desk. The students were to model at their desk what they were seeing on the board. The need to keep students engaged at their desk was also observed in a lively sixth-grade class with 28 students. It was very difficult for all of the students to interact with the board so after delivering the content the teacher reinforced student learning by drawing the biome on the board while the students used colored pencils to draw the biome at their desk.

Formal assessment was not observed except for two classes. It seemed to the researcher that the interactive whiteboard was not used often for formal assessment (graded work) unless the teacher had easy access to the classroom response system, ActiVotes. Unless the number of classroom response systems increases, I do not believe that teacher will begin using the board for graded work because it is no more effective or efficient than traditional methods of assessment. It was also observed that the assessments that did occur with the ActiVotes amounted to the same as a true/false or multiple choice test. The questions were less effective because they were not structured, requiring students to answer with reflective or critical thinking (Dangel & Wang, 2008).

Content Area Use

Beauchamp (2004) observed teachers during classroom instruction and found that language arts, math and science were the content areas taught most often using the interactive whiteboard. Beauchamp's findings were reinforced by the teachers in this study. Teachers reported using the interactive whiteboard most often in language arts. This was not surprising, but what was surprising was the way they used it. It seemed as if all of the teachers used the interactive whiteboards for the interactive web sites; Spelling City, Quizlet, and Harcourt's Story town. I learned that this school system has adopted a reading series that must be "taught with fidelity," which means all of the teachers must follow the steps of the program so there is no risk of the program losing the integrity of design.

It was encouraging to observe the many different features of the interactive whiteboard utilized to provide math or science instruction. All teachers do not teach the same way and the interactive whiteboard may be used in so many different ways it allows for the instructional nuances of the individual teacher and their class.

Implications

The interactive whiteboard allows the teacher to enhance the traditional curriculum by easily adding audio, video and student interaction that is at the front of the room. Also, lessons may be structured to encourage student participation. The increased student engagement related to multisensory characteristics of interactive whiteboard lessons means that the board is a powerful instructional tool. Increased student interaction and the ability to provide immediate feedback within the program leads to the decentralization of the role of the teacher making instruction more student focused. The use of the interactive whiteboard also facilitates teacher collaboration on lesson planning because it is so easy to share and edit digital lessons. School administrators should be aware of positive aspects of using the interactive whiteboard for instruction and strive to support teachers who are using it to deliver instruction by providing the time and training necessary for effective use.

Conclusions

This study indicated that the use of the interactive whiteboard is a valuable tool for creating Gagne's conditions for learning. Many of the teachers in this study said that it would be impossible to go back to the "old way" of teaching before they began using the board. These teachers have recognized that the interactive whiteboard provides flexibility in the presentation of lessons and the promise of increased student engagement.

Concerning professional development, the participants in this study stressed the need for time to explore the available features, plan for instruction and share best practices. The majority of the teachers did not ask for more training on the software, instead they requested time to learn from other teachers on the instructional use of the interactive whiteboard. Shenton and Pagett

(2007) stressed the need for professional development focused on curriculum integration instead of software features and the teachers in this study validated that idea.

This study also indicated that there may be certain content areas which are better suited to the use of interactive whiteboards. Language arts, math, and science seem to be the subjects that are taught most using of the interactive whiteboard.

Suggestions for Further Study

A study to examine whether teaching with the interactive whiteboard leads to increased student learning would be of benefit. With the number of whiteboards in classrooms increasing, it would be beneficial to know whether they can increase learning. From teacher anecdotes in this study, it is believed that student learning is improved but it would be helpful to find out if this is actually true in an experimental study.

A qualitative study that examines why there are teachers who have access to interactive whiteboards but choose not to use them would be of interest. If instruction using the interactive whiteboard does improve student learning then an understanding of why teachers do not use the technology would be helpful. The results of this study could be used to develop a plan to increase teacher use of interactive whiteboards for effective instruction.

Studies replicating the methodology of this study but varying the location or the grade level of participants would be a good idea. The current study is also limited to one school system with a relatively small number of teachers. A replication of this study in another, possibly larger, school district would be helpful. Another idea would be to replicate this study but focus on different grade levels. The results found in an elementary setting may different when conducting the same study in a secondary setting.

A longitudinal study of instructional changes before and after the installation of the interactive whiteboard would be a beneficial study. A study of this nature would be helpful in actually documenting the differences in instruction. This information may also be used to improve teacher training when the board is installed in a teacher's classroom.

The current study revealed that instruction for very large groups was different than that of classes with a small number of students when using the interactive whiteboard for instruction. It would be useful to conduct a study focused on effectively designing lessons using the interactive whiteboard for instruction based on the number of students in the classroom.

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APPENDIX A

Online questionnaire using Qualtrics

- Discuss how you develop lessons that use the interactive white board (IWB) in your classroom. Please include if you ever share flipcharts with fellow teachers or use flipcharts downloaded from the Internet. (open ended)
- How do you use the IWB to gain your students' attention?
- How do you use the IWB to help your students recall prior knowledge?
- How do you use the IWB to introduce lesson objectives to your students?
- How do you use the IWB to present new material to your students?
- How do you use the IWB to provide guidance for your students?
- How do you use the IWB to encourage student performance?
- How do you use the IWB to provide feedback to your students?
- How do you use the IWB to assess your students' performance?
- How do you use the IWB to enhance your students' retention of the material learned?
- What do you see as barriers to using the IWB?
- What are the advantages of using the IWB?
- What are the disadvantages of using the IWB?
- How has the IWB changed the way you plan or teach?
- When using the interactive whiteboard for instruction, what percentage of time is used in the following content areas:

Content Area	Percent
Math	
Language Arts	
Science	
Social Studies	
Other	
Total (please make sure percentages add up to 100)	**100%**

- What are your recommendations for future interactive whiteboard professional development?

- If you are willing to participate in a follow –up interview and classroom observation, please enter your name. _____

INSTRUCTIONAL OBSERVATION (INTERACTIVE WHITEBOARD)

Grade: Subject:		Lesson topic:
Start time:	End Time:	Date:

GAIN ATTENTION

INFORM LEARNER OF THE OBJECTIVES

STIMULATE RECALL OF PRIOR LEARNING

PRESENT THE CONTENT

PROVIDE LEARNING GUIDANCE

ELICIT PERFORMANCE

INSTRUCTIONAL OBSERVATION (INTERACTIVE WHITEBOARD)

Teacher:	Date:

PROVIDE FEEDBACK

ASSESS PERFORMANCE

ENHANCE RETENTION AND TRANSFER

OBSERVER COMMENTS

APPENDIX C

Interview Protocol

- Introduce myself (if necessary)
- Describe project and goals
- Describe eventual product: a report discussing how interactive whiteboards are being used or instruction in the 4th – 6th grade classroom
- Describe eventual benefits: Improved knowledge base on the use of interactive whiteboards, targeted professional development
- Explain consent form and have them sign.
- Inform them that the interview will be audio-taped.

Interviews will be semi-structured. The questions listed below are the ones that will be asked, but other clarifying questions may be asked during the course of the interview.

✓ Discuss how you develop lessons that use the interactive white board (IWB) in your classroom. Please include if you ever share flipcharts with fellow teachers or use flipcharts downloaded from the Internet.

✓ Describe, in detail, a typical lesson utilizing the interactive whiteboard.

✓ Describe, in detail, your favorite lesson that utilizes the interactive whiteboard.

✓ Do you use the IWB to teach all subjects equally or do you find yourself using the board to teach one or two subjects more often than others? Discuss which subjects you teach using the IWB.

✓ What are your recommendations for future interactive whiteboard professional development?