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Teachers' Perception of Handheld Response Systems as a Tool for Formative Assessment in High School Classrooms

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Abstract

While research supports that formative assessment can improve student learning, it is rarely used and difficult to implement. The purpose of this qualitative case study was to investigate the use of student handheld response systems (SRS) as a tool for formative assessment in high school classes as well as teachers' attitudes towards this emerging technology. Self-efficacy and motivation theories provide the theoretical framework for this study. To explore this phenomenon, data were collected via an online interview from high school teachers (n=11) and were analyzed using inductive coding. Three themes emerged from this analysis and served as a basis for a professional development plan that school districts may use to incorporate formative assessment via SRS into their curriculums. These themes included strong teacher and student satisfaction, improved formative assessment, and improved pace of instruction. This project study will contribute to the existing literature on formative assessment and student response systems. Additionally, it will also initiate social change by giving school districts a framework for how to implement the broader use of these devices in classrooms and may impact how these teachers use assessment. Shifting the focus of classroom assessment from simply measuring student learning to improving instruction can in turn increase student learning.

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Section 1: The Problem

Introduction

The pressure on teachers to better assess students has increased since the federal government's implementation of No Child Left Behind ([NCLB], 2001) Act (Chapman, 2007). NCLB requires states to assess their students in order to determine if the school has made adequate progress for a particular year (AYP). The passage of NCLB has made assessment a priority for schools across the United States (Chapman, 2007; Goertz, 2005). With the recent economic recessions, school districts are searching for answers for how to meet the standards the government has put in place without spending any more money and in some cases spending less with pending budget cuts (LaFee, 2009; Robelen, 2009). Out of this new focus on high stakes testing and cost efficiency, formative assessment has emerged as a tool educators can employ to improve student performance because of its ability to improve student learning and gaps in achievement (Black & Wiliam, 2009; Cotner, Fall, Wick, Walker, & Baepler, 2008; Dorn, 2010; Harris, 2007; McMahon, 2008). In addition to its influence on achievement, formative assessment is also depicted as a significant factor in motivating learning (Cotner et al., 2008; Eldridge, 2008; McMahon, 2008; Shute, 2008).

Schools have increasingly turned towards technology such as student handheld response systems (SRS) as the means of providing assessments that not only promote higher learning but also prepare students for the rigors of standardized testing (Cotner, et al., 2008; Kenwright, 2009; Koenig, 2010; Penuel, Boscardin, Masyn, & Crawford, 2007; Salemi, 2009). Formative assessment is central to the utility of this technology. The SRS

has shown to provide educators with a tool that improves student engagement, provides immediate feedback, and encourages higher levels of cognition (Blood & Nell, 2008; Cotner, et al., 2008; Diers, 2008). These devices are also referred to as "clickers" or "remotes."

This section will include a definition of the problem teachers face in developing effective formative assessment strategies. Evidence of the problem at the local level and from current literature will be presented. Important terms relating to this research will be defined, and the rationale for this research will be described. A literature review will be included to create a theoretical framework for this project study to justify the subject as a valuable scholarly venture. The implications of this research will be discussed and a summary will be given.

Definition of the Problem

High school teachers typically use an assortment of assessment tools to determine what the students have learned (Layton & Lock, 2007; McMahon, 2008; Stiggins & DuFour, 2009). Teachers use tests, quizzes, projects, and essays to assess student learning. However, these forms of assessment take time to grade, and there is typically a lag time between when the assessment is given and when the instructor provides the student feedback. Teachers also need additional time to reflect on assessment outcomes and modify instruction to meet student needs. In an attempt to use formative assessment, instructors employ advanced questioning techniques, group discussions feedback without grades, peer assessment, and self-assessment (Black & Wiliam, 2009; Stiggins & DuFour, 2009; Volante, Beckett, Reid, & Drake, 2010). However, it is the belief of some that none of these formative assessment strategies is efficient or engaging to the entire

class (Johnson & McLeod, 2005; Sato & Atkin, 2007). The ability for teachers to gauge how well their students understand what is being taught so they can move on to new material has grown more important particularly with the pressure placed on school to improve standardized test scores. Teachers are caught between attempting to prepare students for standardized tests by moving quickly through a large amount of material or taking extended time to use formative assessment tools to improve their instruction (Harris, 2007). Because of the positive impact formative assessment has shown on learning (Black, McCormick, James, & Pedder, 2006; Black & Wiliam, 2009), and the difficulty teachers have implementing formative assessment (Elwood, 2006; Harris, 2007), the effect SRS may have on a teacher's ability to use formative assessment will be the focus of this study.

The use of formative assessment is supported not only by instructional logic but also supported by research (e.g, Black & Wiliam, 2009; Chappuis & Chappuis, 2008; Cotner, et al., 2008; Davis & McGowen, 2007; Harris, 2007; Kenwright, 2009; Koenig, 2010; McMahon, 2008; Otero, 2006; Salemi, 2009). In recent years, school districts have gradually turned towards technology as the way of providing assessments that not only promote higher learning but also prepare students for the rigors of standardized testing (Irving, 2006; Jones, 2008; Koenig, 2010; McFarland, 2006; Salemi, 2009). Technologies such as interactive SMART boards and classroom response systems have emerged as potential leaders in this movement to employ technology as a tool of evaluation (Beuckman, Rebello, & Zollman, 2007; Conoley, Moore, Croom, & Flowers, 2006; Fies & Marshall, 2006; Fisher, 2006; Herreid, 2006; Patton, 2006; Ruggieri, 2005; Schut, 2007; Starkman, 2006). The SRS or clickers have been around been since the

1950s but their widespread use as a tool of formative assessment has been limited to the last 10 years and mostly relegated to large, postsecondary school lecture hall formats (MacGeorge, et al., 2008; Medina, et al., 2008). Little research has been conducted to develop the best practices for using student handheld response systems as a tool of formative assessment in secondary schools.

Rationale

Evidence of the Problem at the Local Level

In recent years, the United States has taken on the philosophy that in order to improve schools the government must require more demanding standardized tests (Berliner, 2009; Chapman, 2007; Petress, 2006). These large summative tests are typically given once a year and are not conducive to providing teachers with feedback that can help them improve instruction. Across the United States, districts have strained their resources to prepare students for standardized tests while neglecting teacher professional development relating to formative assessment (Petress, 2006; Volante, et al., 2010; Zellmer, Frontier, & Pheifer, 2006). Every year, leaders in education and politicians examine how their districts performed on these tests to determine if changes need to be made. The reality is that by the time the summative data is evaluated the ability to impact student learning has passed. The challenge for school districts is to try to balance the need to meet federal and state assessment requirements with the instructional benefits of formative assessment (Huebner, 2009). For example, the results for the New Jersey High School Proficiency exam that all students are required to take are not available until almost a year after the exam is completed. By that time, districts are forced to scramble to provide remediation for students who did not perform well. The

critical moment of learning for those students has passed because there is such a lag time between when the test is administered and when the results are available.

There are few researchers who have supported the idea that this intense focus on large summative tests actually improves student learning (Stiggins, 2007). Researchers have shown that there are achievement problems with many districts but the scores these tests offer do not help teachers improve pedagogy (). Summative assessments provide data that may assist in comparing and raking schools. These tests may also help find subject areas which students may be having difficulty. This summative data can assist district leaders plan for the future but they provide little assistance for improving classroom instruction (Stiggins, 2007).

In an attempt to improve student outcomes, the New Jersey Department of Education (NJDOE) developed Core Curriculum Content Standards (CCCS) in 1996 (Education, 2010). These standards provide New Jersey school districts with a framework for what a student should know and what skills they should possess when they graduate from high school. The New Jersey CCCS are revised every 5 years with the most recent revision completed in 2009 (Education, 2010).

The New Jersey CCCS (2011) emphasize instructors using a mixture of assessments to gauge student skills and knowledge. Despite this the New Jersey DOE relies solely on the summative standardized High School Proficiency Assessment (HSPA) which currently measures students' competencies in mathematics and language arts in a multiple choice format (Education, 2010). Teachers are left with the task of developing assessments that not only promote student learning but prepare students for

the rigors of the standardized tests they must pass to meet the state's graduation requirements.

The State of New Jersey has the following three categories for its assessment program: partially proficient, proficient, and advanced proficient (Education, 2010). Students are required to be proficient in mathematics and language arts in order to be eligible for graduation (Education, 2010). With these increased expectations on student learning outcomes, there is added emphasis on the school districts to do more than they are currently doing, or face possible sanctions and increased government involvement in their school districts. More and more students are being looked at by school districts as commodities that need to perform well on tests in order for a school to maintain its funding (Barrier-Ferreira, 2008).

In order to simplify the process by which the NJDOE monitors school compliance to the CCCS and other state statutes the New Jersey Quality Single Accountability Continuum ([NJQSAC], 2007) was created. According to NJQSAC, school districts are required to use multiple assessment tools to evaluate and improve instruction. Districts are also required to gather and evaluate assessments for the purpose of measuring student achievement (NJDOE, 2007). School districts have to report every 3 years on the progress that has been made in complying with the performance indicators put in place by NJQSAC.

The school district in which the study was conducted is located in Bergen County, New Jersey. Bergen County borders New York and Pennsylvania. The school has taken measures to meet the student assessment performance indicators created by NJQSAC. All teachers are required to give common midterm and final course assessments.

Teachers must submit documentation that all components of their assessments are aligned to the CCCS. Once these exams are graded, they are then turned in to the curriculum department and entered into a web-based performance tracker program. The performance tracker allows the district to measure student outcomes and documents the results for the state. Teachers can also perform item analysis to assess the value of their assessments.

The performance tracker used by Bergen Tech is needed to comply with QUSAC and has its benefits but has little connection to improving classroom instruction. The tracker program analyzes summative standardized tests and takes weeks for the data to be available for teachers to analyze. The lag time between when the assessment is given and when the feedback is available is a result of lack of resources and funding within the central administration. Even if feedback for these assessments could be provided in a more timely fashion, the nature of these tests does not provide teachers with data that can help them improve how they teach. Recently, the district has sought out tools teachers can use for formative assessment to improve instruction. The most prominent tool that has emerged from this change has been the student handheld response system.

Evidence of the Problem from the Professional Literature

The prominence placed on teachers using formative assessment has grown since the research of Black and Wiliam (1998); however, widespread implementation of formative assessment has remained a difficult task (Harris, 2007; Popham, 2008). Although Black and William (1998) revealed messages about what was needed, they provide little or no explanation of the strategies teachers should use to employ formative assessment in their classrooms. Black and William indicated that formative assessment improves student learning and has been followed up by many researchers (e.g, Eldridge,

2008; McMahon, 2008; Stiggins & DuFour, 2009; Wolf, 2007). Improving formative assessment practices in the classroom and incorporating them into curriculum has proved to be challenging (Ayala, et al., 2008; Bennett & Cunningham, 2009). Integrating formative assessment practices into the daily rituals of classroom instruction is a departure from the traditional practice and can take time and extensive professional development (I. D. Beatty, et al., 2008; S. Brookhart, Moss, & Long, 2008; Wylie, Lyon, Goe, & Educational Testing, 2009). There is also political pressures put on districts to not overemphasize formative assessment because it may create a perception that they are not focusing on preparation for larger state mandated summative evaluations (Dorn, 2010).

Teachers face many obstacles when developing and implementing quality formative assessment. A practical issue that arises is time management. The teacher has to engage the entire class without spending too much time with particular students. Teachers must use advanced questioning techniques, provide students with direct feedback, redirect learning based on their feedback, facilitate peer assessment, and provide assistance to students who need additional help (Black & Wiliam, 2009; Harris, 2007). Without the aid of technology ,this entire process is difficult to manage even for the most skilled of teachers (Stowell, Oldham, & Bennett, 2010).

Class discussions are a typical method of formative assessment that is supported by a wealth of literature (e.g., Baroudi, 2007; Black & Wiliam, 2009; Chappuis & Chappuis, 2008; Leahy, Lyon, Thompson, & Wiliam, 2005; Popham, 2009). While whole class discussion allows teachers to probe for student knowledge, they are not 100% inclusive. Often during a discussion, some students will prefer to be bystanders while

others will be more active participants (Graham, Tripp, Seawright, & Joeckel, 2007; Stowell, et al., 2010). These discussions do not foster students to acquire new knowledge but typically simply reinforce what has already been learned (Graham, et al., 2007). In most cases, teachers leading discussions are looking for the right answers instead of listening to what can be learned from how the students are thinking (Leahy, et al., 2005). Teachers attempt to provoke higher levels of critical thinking by developing questions that call for the students to think or allow the teacher to change instruction (Ribbens, 2007; Stowell, et al., 2010; Sullivan, 2009). These questions are not only difficult to develop but also require a large amount of planning time (Shepard, 2009; Sullivan, 2009).

A critical element of successful formative assessment is the feedback that is provided to the students in real time. This feedback needs to be timely and should cause the students to think (Black & Wiliam, 2009; Chappuis & Chappuis, 2008; Leahy, et al., 2005; Shepard, 2005). Teachers should make comments that inform the students how they can improve. This type of feedback has been found to be much more successful than a grade at encouraging additional learning (Wiliam, 2007). Researchers have indicated that when students received an assignment back with a grade and a comment that more often than not, students ignored the comment and focused on the grade, and feedback without grades is crucial for formative assessment to be effective (Leahy, et al., 2005; Volante, et al., 2010). In many instances, students will check to see what other student's grades were instead of reading the comment written by the instructor (Leahy, et al., 2005). The teacher's ability to provide students with effective feedback that helps them learn is second only to having a strong curriculum in influencing student achievement at the school level (Ferriter, 2009).

Real time feedback is a crucial element of effective formative assessment. Self and peer assessments are two feedback tools supported by researchers (Chappuis & Chappuis, 2008; Cotner, et al., 2008; Popham, 2008; Stiggins & DuFour, 2009; Volante, et al., 2010; Wiliam, 2007) as an effective tool for students to acquire the feedback that is essential for learning. Self-assessments allow students to take personal ownership in their own work and are generally accurate (Leahy, et al., 2005). By performing self-assessments, students can internalize the standards by which they will be judged. Self-assessments encourage a more collaborative relationship between students and teachers (Cotner, et al., 2008; Shepard, 2005). Self-assessment requires a level of maturity and understanding of rubric application that many students do not possess (Leahy, et al., 2005). Peer evaluation allows the students to use each other for feedback to improve understanding and check the quality work of their own work. In many cases, students can communicate better with each other than with the teacher (Chappuis & Chappuis, 2008; Cotner, et al., 2008; Stiggins & DuFour, 2009). Peer and self-assessment gives the teacher more time to work with students who may be struggling more than others may.

Many school districts have failed to provide teachers with the professional development or tools required to incorporate formative assessment in into their pedagogy (I. D. Beatty, et al., 2008; Cotner, et al., 2008; Wiliam, 2007; Wylie, et al., 2009). Typical teacher professional development programs place an emphasis on knowledge, while in many cases ignoring skill development (I. D. Beatty, et al., 2008; Wiliam, 2007; Wylie, et al., 2009). School districts assemble teachers in a room and explain to them what needs to change. In this model of professional development, teachers are informed about the formative assessment that they will in turn incorporate into their lessons.

Researchers have indicated that changing the way teachers think does not necessarily impact how they teach (Wiliam, 2007; Wylie, et al., 2009). Understanding that formative assessment is a valuable tool is the first step; implementing it well in the classroom is much harder. There is a void in professional development related to formative assessment, confusion as to what formative assessment is, and how it is best employed (I. D. Beatty, et al., 2008; Black & Wiliam, 2009; S. Brookhart, et al., 2008; Chappuis & Chappuis, 2008; Cotner, et al., 2008; Wylie, et al., 2009)

Definitions

Handheld response systems or student Response Systems (SRS): Commonly known as "clickers," handheld response systems are typically the size of a television remote control {Bush, 2007 #183}. The handheld response systems transmit singles to a computer which can provide immediate feedback to instructors usually displayed on an interactive whiteboard (Kollie, 2008).

Formative assessment: Assessment that provides the instructor with information needed to differentiate instruction and learning while they are happening (Black & Wiliam, 2009).

Summative assessment: Assessments that are given at a period in time to determine what students have learned {Taras, 2008 #158}. Generally, summative assessments are utilized by teachers as a part of the grading process {Taras, 2008 #158}. Summative assessments are typically given once instruction has ceased (Taras, 2008).

Significance

In order to meet the increased standards placed on districts by legislation like NCLB (2001) school districts in greater numbers are turning to formative assessment as a

path towards improving instruction (Chapman, 2007; Zellmer et al., 2006). NCLB has placed an emphasis on accountability through standardized tests and little on improving classroom instruction (Chapman, 2007). The state has provided improved standards but no method for teachers to improve instruction (Berliner, 2009). School districts like formative assessment because it has shown positive results improving student outcomes and are relatively inexpensive (Black & Wiliam, 2009; Dorn, 2010).

The use of formative assessment has been demonstrated to improve teaching and student outcomes on standardized tests (Black & Wiliam, 2009; S. Brookhart, et al., 2008; Chappuis & Chappuis, 2008; McMahon, 2008; Yue, et al., 2008). However, more work is needed to assist teachers in the implementation of it into the classroom (Black & Wiliam, 2009; Volante, et al., 2010). There is potential to develop more sophisticated techniques for teachers to use to interpret the feedback they obtain from their students (Black & Wiliam, 2009). In many cases, teachers have limited time and lack the resources to plan and put into action assessment activities that will help them improve instruction. Traditional teaching strategies for formative assessment lack the organization and visual stimulus that handheld response systems provide. The use of handheld response systems makes student thinking visual and allows teachers to alter instruction based on the feedback they receive instantly (Campbell, 2007; Cotner, et al., 2008; Kenwright, 2009). Providing teachers with tools and professional development that could make the implementation of formative assessment easier could make a significant impact on improving classroom instruction. The handheld response system allows teachers to employ ongoing assessment that is genuine and can help student understanding by altering instruction.

Guiding/Research Questions

The use of SRS has shown to be a powerful tool of formative assessment (Brewer, November 2004; Caldwell, 2007; Cotner, et al., 2008; Diers, 2008; Graham, et al., 2007; Kenwright, 2009; Kollie, 2008; McGuire, 2005; Ribbens, 2007; Salemi, 2009; Salend, 2009; Stowell & Nelson, 2007; Trees & Jackson, 2007). This technology has become prevalent in a number of large-scale universities that use the clickers in large lecture hall settings (Banks, 2006; Blood & Nell, 2008; Herreid, 2006; Li, 2007). Extensive research as to the implementation of clickers in high school classrooms appears to be lacking (Caldwell, 2007; Herreid, 2006; Woelk, 2008). I will use current research on formative assessment, SRS, and data collected from high school teachers who use SRS on a daily basis to answer the following research questions.

1. What are the best practices for utilizing student handheld response systems as a tool for formative assessment?

To answer this overarching research question, the following sub questions will be explored:

1. What are the teachers' self-reported attitudes and beliefs towards the role of formative assessment in their classroom?

2. What are the teachers' self-reported attitudes and beliefs towards the use of SRS in their classroom?

3. What are the teachers' self-reported attitudes and beliefs regarding student learning and utilization of response systems?

Review of Literature

Theoretical Framework for Formative Assessment

Historically, teachers have looked at assessment as a means to determine how much students have learned. However, towards the end of the 20th century researchers began to look at the role assessment could have on improving student understanding instead of simply measuring it. The distinction between assessment for learning and assessment of learning began to arise from this ground breaking research (Black & Wiliam, 1998; S. M. Brookhart, 1997; Crooks, 1988; Kluger & DeNisi, 1996; Natriello, 1987). These researchers laid the groundwork for future inquiries regarding the implementation of formative assessment in the classroom (Baroudi, 2007; S. Brookhart, et al., 2008; Chappuis & Chappuis, 2008; Crumrine & Demers, 2007; Dunn & Mulvenon, 2009; Gallagher & Worth, 2008; Popham, 2008; Stiggins & DuFour, 2009).

(Crooks, 1988; Natriello, 1987) indicated that there could be a positive impact to teachers using assessment as a tool for teaching on student achievement. Crooks' findings were significant because they were based on extensive reviews of educational literature that included motivational psychology, learning theory, and research on teaching. Crooks found that students learn better when the assessments they are given focus on higher levels of critical thinking, opposed to those that stress memorization. Crooks also pointed out the importance of feedback in improving student motivation. Crooks suggested teachers use cooperative learning techniques to promote student engagement and help students develop peer and self-assessment skill. Natriell also conducted an extensive review of research conducted on classroom assessment, and found that students who were given more immediate feedback from their instructors

showed better overall performance in those classes, opposed to classes in which teachers gave little to no feedback.

Black and William's (1998) meta-analysis of 250 studies addressed various aspects of formative assessment. Black and Willaim found that by improving formative assessment, schools could improve student outcomes. Effect sizes ranged between 0.4 and 0.7, with formative assessment helping low achieving students more than those who were considered high functioning (Black & Wiliam, 1998). The reason for this is unclear but one could suggest that formative assessment helps lower functioning students develop critical thinking skills that high functioning students already possess. Formative assessment also provides immediate feedback and gratification for struggling students, which may help in keeping them motivated. Wiliam (2006) reported that students in classes where formative assessment was regularly practiced performed better on standardized summative tests. Wiliam also found that teachers employing formative assessment in their classrooms were able close achievement gaps much quicker than those who did not use it.

Current Literature

Based on an review of the literature on formative assessment, Black and Wiliam (2009) have identified five teaching strategies that are prevalent in effective formative assessment: (a) clear learning objectives must be present: Students must be made aware of the criteria required for them to be successful, helping students understand learning outcomes is very important; (b) timely feedback that allows the learners to move forward; (c) classroom discussions and other leaning tasks must allow teachers to gain feedback into student understanding. Feedback that is obtained by the instructor must be used in a

timely fashion so instructional modification can be made as the students learn; (d) collaborative learning: Peer evaluation and collaborative learning exercises must be a vital component of instruction; and (e) self-regulated learning: Students need to have more control over the pace at which they learn.

Student Motivation and Self-Efficacy Theory

The aspects of formative assessment that enable it to improve learning can be found upon examination of research on student motivation. Cognitive researchers stated that students who are self-aware and monitor their own learning show higher levels of achievement (Usher & Pajares, 2008). Since the work of Bandura (1977), a number of researchers in education have used self-efficacy to explain how students learn (e.g, Artino, 2006; Britner & Pajares, 2006; Usher & Pajares, 2008). The literature on formative assessment supports this cognitive research. Students who are able to self-assess and internalize their findings can improve their overall achievement (Black & Wiliam, 2009; Chappuis & Chappuis, 2008; Leahy, et al., 2005).

Morling, McAuliffe, Cohen, and DiLorenzo (2008) conducted a study to determine the impact of self-efficacy on student performance using clickers. Morling et al. examined two sections of an introductory level psychology course that used clickers to give quizzes and provide some feedback for students. Two other sections did not use the devices at all. The researchers found there to be no significance difference between the groups on their final exams but suggested that the results could have been different had the clicker questions been implemented into the lectures and other strategies been employed such as cooperative learning activities (Morling, McAuliffe, Cohen, &

DiLorenzo, 2008). Technology alone is not the answer, but the correct implementation is the key to improved student engagement and learning outcomes.

Formative Assessment and Student Achievement

Well-implented Formative assessment in the classroom has shown to improve student achievement (Ayala, et al., 2008; Black & Wiliam, 2009; Leahy, et al., 2005; McMahon, 2008). For example, McMahon (2008) conducted a research study to determine if formative assessment improves the depth of understanding in a high school history class. During the study, formative assessments were used twice a week in one class and not at all in another. A summative assessment was taken by the students when the research period had concluded. The treatment group that was exposed to formative assessment demonstrated higher levels of achievement on a regular basis than students who were not in the class using formative assessment.

Assessments that are small and give quick feedback, for teachers and students, has shown to have positive impact on students' learning (e.g, Black & Wiliam, 2009; S. Brookhart, et al., 2008; Chappuis & Chappuis, 2008). Teachers should be encouraged to use numerous occurrences of formative assessment in their classes, but if the planning and implementation of these assessments become too difficult to develop and implement, teachers will stop using them. School districts can help teachers by providing them with assessment tools that are effective and easy to incorporate into their lessons. One of the most popular tools of formative assessment that has emerged is the handheld response system or clicker.

Handheld Responses Systems for Formative Assessment

The potential of formative assessment to improve student outcomes has led to a variety of products and services being sold to schools as tools of formative assessment, with few living up to the principles of formative assessment established by various researchers such as Black and Wiliam (2009), Morning et al. (2008), and Popham (2006). The SRS meet all the necessary requirements of effective formative assessment. They provide teachers with a tool that harnesses immediate feedback from students (Addison, Wright, & Milner, 2009; Cotner, et al., 2008; Kenwright, 2009). The speed in which the feedback is obtained allows teachers to make critical interventions to aid student learning and promote higher levels of critical thinking (DeBourgh, 2008).

Students are each assigned a particular clicker when they enter the classroom. The teacher can interject questions into the day's lesson that are displayed on an interactive white board. The students are then asked to enter in the answer to the question into their handheld devices. All of their answers are anonymous. The response system instantaneously gathers and organizes every student's response. The interactive white board creates a visual presentation of the student's responses in many instances in the form of a graph. From the graph, the teacher and students can observer if there were a large number of students who did not understand the concept (Caldwell, 2007; Kenwright, 2009; SMART, 2010). This would allow the teacher to reteach or have students who got the question right work with those who did not (I. D. Beatty, et al., 2008; Ferriter, 2009; Patry, 2009; Trees & Jackson, 2007).

While technology is simple, researchers have indicated that it can be a powerful tool (Bennett & Cunningham, 2009; Diers, 2008; Gauci, Dantas, Williams, & Kemm, 2009; Kollie, 2008; Patry, 2009; Ribbens, 2007). Researchers have found the technology

to improve student engagement learning (Addison, et al., 2009; Cotner, et al., 2008; Stowell & Nelson, 2007; Yourstone, Kraye, & Albaum, 2008). The instant feedback students receive in classes using handheld response systems is far greater than they would receive in a traditional classroom. When using handheld response systems, students are able to observe how their fellow students are performing then work together on their mistakes. The students' answers are displayed anonymously so the embarrassment for offering a wrong answer is decreased (Caldwell, 2007; Graham, et al., 2007). This is particularly effective in classes that discuss sensitive issues such as sex education (Fisher, 2006). Teachers can gauge the level of student understanding and increase the level of difficulty of the questions based on the number of right answers. As a result, teachers can have conversations with their students that elicit high levels of critical thinking (Caldwell, 2007).

A critical component to implementing any instructional changes is getting support from the teachers, particularly when the changes use new technologies that can have some learning curve for the instructors. SRS differ from many other technologies that are thrust upon teachers to improve their instruction in that they can see the immediate impact on improving classroom instruction (Kenwright, 2009; Koenig, 2010). Teachers see that interaction with entire class is instantly obtained with this technology. Instant feedback into student processing would be difficult to obtain without this technology.

Another positive side effect of the implementation of clickers in the classroom is the improved communities of practices amongst teachers. Teachers incorporating these devices in their classrooms have shown more inclination to meet with other instructors to plan their lessons and develop questions for the SMART presentations (Caldwell, 2007;

Koenig, 2010; Zhu, 2007). Communities of practice are formed by people who engage in a process of collective learning in a shared domain of human endeavor. They develop a shared repertoire of resources such as the following experiences, stories, tools, and ways of addressing recurring problems (Wenger, 2002). Preparation for lessons using clickers can help to improve teachers' communication.

Implications

The use of SRS provides teachers with a tool of formative assessment that can aid in student learning and promote higher levels of cognition, all while improving a teacher's ability to assess students (Addison, et al., 2009; Campbell, 2007; Fies & Marshall, 2006; Lowery, 2006). Clickers allow a teacher to assess students more frequently and with more speed. The immediate feedback students are given can improve the students' level of engagement and comprehension (Addison, et al., 2009; Beuckman, et al., 2007; Blood & Nell, 2008; Fies & Marshall, 2006; Herreid, 2006; Stowell & Nelson, 2007). The use of SRS as a tool for assessment does not appear to be a trendy creation designed to rid teachers of the work involved with grading students' tests. There are indications that using these devices can improve the quality of learning (I. Beatty, 2006; Beuckman, et al., 2007; Brewer, November 2004; Conoley, et al., 2006; Patry, 2009; Ribbens, 2007; Stowell & Nelson, 2007; Trees & Jackson, 2007) and quite possibly change the way educators view assessment as more of a tool for learning than as a measurement of what is learned.

Teachers are rarely receptive to change, except when they see it is clearly beneficial to learning, and even then it can be difficult (Finger & Houguet, 2009; Hall, 2010; Okojie, 2006). In many instances, the most problematic component of getting new

technology in the classroom is not getting the teachers to agree on its value, but actually getting them to use it (Hall, 2010). For teachers to adopt SRS into their pedagogy, they must believe in their ability to help students learn, and be given professional development to help them learn how to use this new tool.

Summary

Schools across the United States have been searching for ways to improve student learning to meet the ever increasing standards set forth by the federal and state governments (Blumenthal, 2006; Chapman, 2007; Scarpa, 2008) all in the face of an economic recession and possible far reaching budget cuts. School districts across the United States are attempting to improve instruction without spending any more money or having to cut their current expenditures (LaFee, 2009; Robelen, 2009). One possible solution is the increased use of formative assessment which researchers have demonstrated improves student learning with very little cost (Black, et al., 2006; Black & Wiliam, 2009; Chappuis & Chappuis, 2008; Keeley, 2008; McMahon, 2008).

While inexpensive to implement formative assessment, it is not always as easy to execute. Educators have increasingly sought out methods to implement formative assessment in their classrooms (K. T. Anderson, Zuiker, Taasoobshirazi, & Hickey, 2007; Baroudi, 2007; Chappuis & Chappuis, 2008; Harris, 2007). Most of the strategies for formative assessment implemented by teachers are flawed because most consume large amounts of class time (i.e., group discussions) or do not solicit participation from all students (i.e., student questioning). As a result, schools have turned towards new technologies such as handheld response systems. The response systems help teachers implement formative assessment that allows them to move through curriculum faster,

track student performance, and improve student engagement all while garnering 100% participation from their students (Ferriter, 2009; Graham, et al., 2007; Kollie, 2008). This new technology could change educator's attitudes towards assessment.

The widespread usage of SRS is still limited, despite indicators that they can help students learn (Bennett & Cunningham, 2009; Caldwell, 2007; Diers, 2008; Koenig, 2010). Economic factors may play a role in this due to the cost of this new technology. Another possible impediment may be teachers' outlook towards changing their pedagogy and general uneasiness that surrounds any substantial implementation of new technology (Hall, 2010; Okojie, 2006).

The next section will include the methodology used in this project study to gather feedback from teachers regarding the use of handheld response systems, and their impact on classroom instruction. This feedback will provide teachers' insight into the value of these devices and afford a plan for implementing them in the classroom. Section 2 of this project study will also include the research methodology used to obtain data for this study.

Section 2: The Methodology

Introduction

The use of SRS is designed to provide teachers with an effective instrument of formative and summative assessment that can aid in learning and promote higher levels of cognition all while improving teachers' ability to assess students (Addison, et al., 2009; Diers, 2008; Stowell & Nelson, 2007). Section 1 of this project study included a review of the current literature as it relates to the use of handheld response systems as tools for teachers to implement formative assessment in their classrooms as they relate to the overiding research question.

1. What are the best practices for utilizing student handheld response systems as a tool for formative assessment?

In section 2 of this study, the methodology used is presented. This section will include the design of the research project, the population studied, the sampling procedures, the instrumentation and materials used as well as a plan for collecting data obtained from the research.

Design

Qualitative research begins with assumptions and a broader theoretical framework regarding a problem followed by inquiry and a collection of data in a natural setting. This data is then analyzed by the researcher to determine if any themes emerge (J. W. Creswell, 2007). The researcher then transcribes a report to include the voices of the research participants as well as the analysis of the researcher. According to Merriam (2002), "The design of a qualitative study focuses on shaping a problem, selecting a

sample, collecting and analyzing data and writing up the findings" (p. 11). This study follows the design described by Merriam.

Within this project study, a theoretical framework for formative assessment as an effective technique to improve classroom instruction has been established in the literature review (i.e.Black & Wiliam, 2009; S. Brookhart, et al., 2008; Chappuis & Chappuis, 2008; McMahon, 2008). Researchers have also demonstrated that SRS may make the execution of formative assessment easier for teachers (i.e.I. Beatty, 2006; Diers, 2008; Koenig, 2010). The specific pedagogical strategies teachers should use to employ this technology successfully for formative assessment in the high school classroom was not clear in the current literature. The purpose of the qualitative design of this case study was to gather such data so that the information can be used by other teachers and school districts using SRS.

In this project study, I attempted to address the problem of teachers' difficulty developing formative assessment by extrapolating data from teachers using SRS. This project study met the requirements for an instrumental case study design because it will examine a particular case, namely the use of response systems for formative assessment using data gathered from online interviews (see Appendix E) to produce a case description and case-based themes as suggested by Creswell (2007). The instrumental design was focused on gaining an understanding of the general principles of a particular phenomenon, as detailed by Yin (2003). This design allowed me to gain an in-depth understanding of how SRS are used that would not be available in a quantitative design. The complexities and details of exactly how these devices are used by teachers most likely could not be garnered using a survey or other quantitative measuring device, as

implied by Rubin and Rubin (2005). Surveys are often limiting in the data they are able to produce. Participants are often passive and unable to elaborate on their answers (Rubin & Rubin, 2005). The open-ended format of the interview questions I used allowed the participants the freedom to answer the questions with as great a depth as they saw fit. This provided me with more detail, as well as a better overall perspective on the strategies teachers use with SRS for formative assessment.

The online interview (Appendix E) allowed teachers to answer a series of open-ended questions relating to the use of SRS in their classrooms. The online format was chosen because of the anonymity it provides all those who chose to participate in the research. All of the participants in this study were teachers at the Bergen County Technical School who were under my direct supervision. This bias, as pointed out by Creswell (2003), could promote participants in the research to provide answers they feel this researcher will approve . Creswell (2003) also pointed out some possible biases that can result from the research process when the researcher is also the interviewer. Allowing the interview to be conducted online mitigated this potential bias. Online and interviews conducted via e-mail have shown to be a successful data collection tool (James, 2007).

Qualitative Tradition

Case study methodology is used to study the development of a specific case that can be an individual case or a group (Yin, 2003). Interview data collection is frequently a strategy used by researchers choosing this qualitative approach (Merriam, 2002; Rubin & Rubin, 2005). A quantitative approach to this study was deemed inappropriate because I did not experiment with a theory, and did not seek to prove any causation between

variables. It also requires the collection of data that could not be accurately presented by traditional statistics. Phenomenological and ethnographic studies were considered but rejected because of their limitations on data collection, size of sample required, and rigorous data collection procedures. Grounded theory was ruled out because I do not attempt to develop a new theory. Ethnography was also eliminated because of the relatively small sample group I studied (J. W. Creswell, 2007; Hatch, 2002; Merriam, 2002). Having considered several other qualitative research approaches, the instrumental case study design was selected because of the flexibility of data collection, the examination of a single case, and the ability of the researcher to investigate the use of SRS with great depth using data from teacher's experiences in real life context.

Population

The population was high school teachers in the state of New Jersey of which there were 112,933 people as of June 2010 (Eduction, 2010). The average salary of New Jersey Teachers is ranked third nationally (Education, 2010). The median age of New Jersey teachers is 46 years old (Ingersoll, 2009).

Purposeful Sampling

The participants in this study were 11 science teachers at the Bergen County Technical High School in Teterboro, New Jersey. Participants in this research were selected because of their exposure to SRS. The online interview was sent via a hyperlink embedded in an e-mail. I do have direct supervision over the members of the sample group. All participation was voluntary and participants could have chosen to stop the interview process at any time. All interviews were anonymous and could have no impact on the evaluation or employment of those involved.

Instrumentation and Materials

After reviewing the literature, I did not find any available instruments that would answer the research question. Two of the largest manufacturers of interactive response systems in the world are SMART Inc. and Promethean and only Promethean has a professional development survey available on their website. This survey was conducted at the Tanglin Trust School in Singapore and it is focused on teacher satisfaction with a workshop they attended for training on an interactive white board. This type of survey would not yield data to answer the research question. Both SMART Inc. and Promethean have literature on their website supporting their products' value to improving student learning (i.e.Marzano, 2009; Oleksiw, 2007). The inherit biases in the finding of this research is clear, because it was published by the manufacturer and was not peer-reviewed. Hence, I created the interview questions used in this study with the assistance of an expert committee.

Expert Committee Credentials

Construct validity of the interview questions was established by a committee of experts in educational research. Each member of the committee evaluated the construction of each interview question and provided feedback to me. The individuals made their assessment about the relevance of the items in the interview, analyzed the ambiguity of their formulation, and decided if the interview questions will help me answer the research question.

Interview Construction

All participants were e-mailed a consent form for the research. The consent form informed all participants that their participation in this research was anonymous, and they

were not required to answer all the questions. The interview was constructed of 10 questions. Question 1 confirms that the participant uses sSRS. Question 2 asks the participant to identify their gender. The participant is given the option not to disclose this information. Questions 3-10 are all open-ended and focus on the teacher's perception of the effectiveness of the technology as a tool of formative assessment, as well as the student's perception. The answers to these questions have no minimum or maximum length. At the end of the interviews, the participants were given an opportunity to provide any additional information regarding handheld response systems and formative assessment that were not addressed by the posed questions.

Data Collection Plan

Official permission to conduct this research was granted by the IRB on April 11, 2011. The IRB approval number for this study was 04-11-0080104. Permission to conduct the study was given in writing by the Bergen County Technical School District's superintendent (Appendix F). An e-mail consent form was then sent to all the possible participants (Appendix D) explaining the purpose of the research and that they are under no obligation to participate and the survey poses no risk to their job status. The e-mail also stated that their answers would be completely anonymous, and they can opt out of the research at any time. The data collection for this study was done via an online interview. All of the participants were able to complete the online interview. None of the possible participants requested paper interviews.

The teachers had 7 days to complete the online interview before data collection began. After 3 days, another e-mail including the hyperlink to the interview was sent to the teachers reminding of them of their opportunity to participate in the research. Upon

the conclusion of the week designated for the interview completion, an e-mail was sent to all the science teachers in the school thanking those who chose to participate in the research.

The web-based data collection tool Survey Monkey® was used to administer the interview. The data that are collected via Survey Monkey® are held in reserve on a secure server that can only be accessed by me. Survey Monkey® takes great measures to ensure the security of all the data that it collects (Monkey, 2010). I will keep the data in a secure data file and I will not be share the data with anyone for a period of 5 years.

Research Assumptions

I assumed that all participants in the study provided truthful answers to all questions posed to them in the online interview. Since the online interview is anonymous, it is also assumed that the person answering the prompts is the teacher utilizing the student handheld response systems in their classroom.

Research Limitations

Limitations for this study emanate from its design. The study of one particular case, while allowing the researcher to gain great depth of data, also places limitations on the any analysis presented from this data. The relatively small sample size also limits the researcher's ability to make broad reaching statements regarding the phenomenon being studied. The data obtained from the research participants are inhibited by the truthfulness with which participants answered all interview questions. The online interview format is also limited because it does not allow the researcher to pose follow up questions. The format does also not allow the researcher to interpret the body language and expressions of the participants, which can be valuable data to analyze (James, 2007; Rubin & Rubin,

2005). Individuals who are not comfortable typing or who are not computer literate may have more difficulty expressing their opinions via an online interview then they would in person.

Scope and Delimitations

This study is focused on high school teachers' attitudes towards the use of SRS as a tool of formative assessment. I did not examine the use of this technology at other levels of education, such as elementary or postsecondary schools. I did not attempt to measure the effectiveness of SRS to improve student outcomes, but rather I attempted to present the feedback received from teachers as to the best practices for using SRS.

Protection of Study Participants

All of the participants in the study received an e-mail from me (Appendix D) explaining the purpose of the research and that they are not obligated to participate. This e-mail stated that their participation in this study would have no impact on their job status. All the answers provided were anonymous and the participants could opt out of the research at any time. I had no way of tracking which teachers chose not to participate in the study. Survey Monkey®, a web based data collection tool, was used to administer the interview. Survey Monkey® stores all of the data it collects on a secure server that can only be accessed by the researcher. Once the interviews were completed, the data were downloaded from Survey Monkey®. Each teacher who chose to participate was protected by using anonymous identifiers for data analysis. The participants were given distinctive identifiers such as "Participant A." These data will be kept in a secure file on my computer and will not be shared with anyone. After a period of 1 year after the research has been completed, the data will be erased.

Data Analysis

Once the online interviews were completed by those who participated, I downloaded the answers into a Microsoft Excel spreadsheet. The data were then analyzed using a coding procedure for synthesizing information into categories or themes. I initially used inductive analysis to garner a holistic perspective on all the data collected via the online interviews. These themes are what Hatch (2002) referred to as frames of analysis or separate pieces of data, each with a unique idea related to the research question. Each category or frame of analysis discovered was assigned a code and was highlighted using a different color on the transcript. Six overarching themes emerged from the interviews and each was coded with a different color highlighter. The thoughts relating to improving time to cover content were coded in yellow. The positive responses teachers had towards the technology were coded in blue. The negative responses teachers had towards the technology were coded in red. Comments teachers made regarding improved formative assessment were coded in orange. Implementation strategies and planning for this technology were coded in purple. Student perception of the SRS was coded in pink. Lastly, comments teachers made about lesson pacing were coded in purple. Once the coding of data into categories was complete, I evaluated the data first within each category then across categories and determined that six themes materialized. All of these data have been presented and analyzed in the findings section of this project study.

Findings

A complete transcript of all the responses gathered from the online interviews is available in the appendix (Appendix B). The themes that emerged came from common

responses that each participant gave to the online prompts. For Question 1, all 11 participants indicated that they are currently using SRS (see Figure 1).

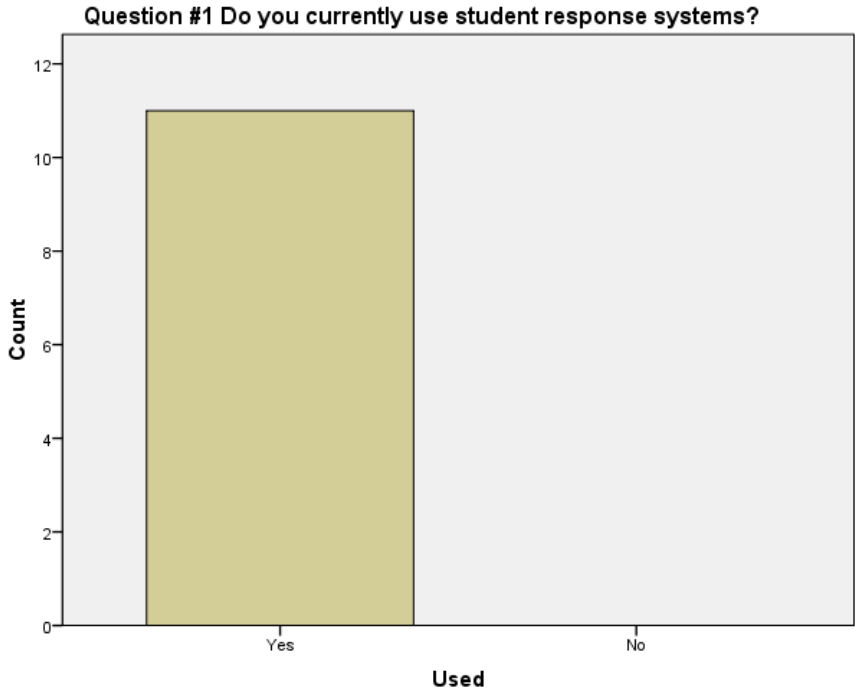

Figure 1. Partipants current use of SRS.

Figure 2 demonstrated that six males and five females chose to participate in the study (see Figure 2).

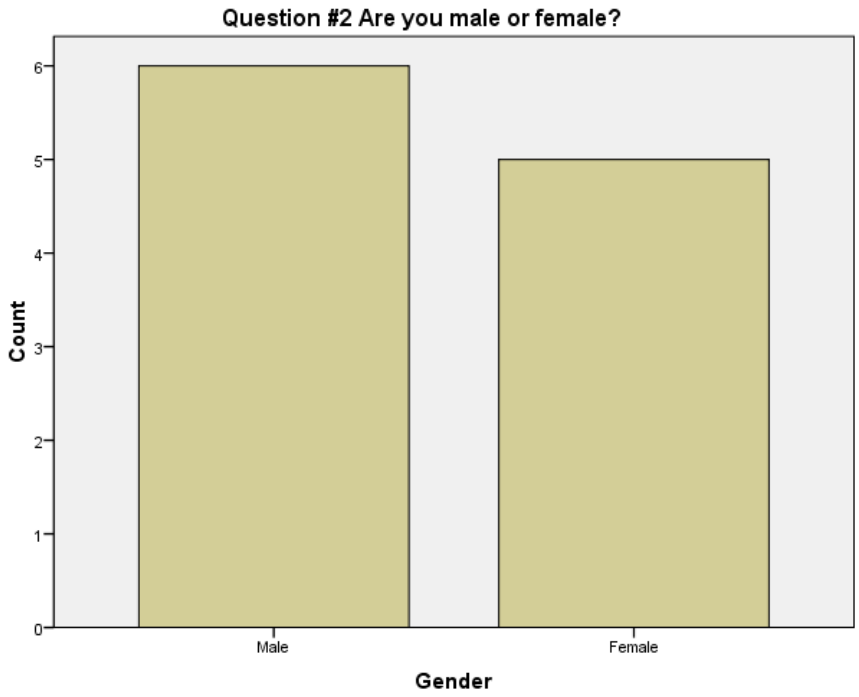

Figure 2. Gender of particpants using SRS.

Question 3 gathered data from participants regarding how long the participants have been teaching using a SRS (see Figure 3). Three teachers indicated they have been using the technology for 4 years, three for 3 years, three for 2 years, one for 2 1/2 years, and one for a year.

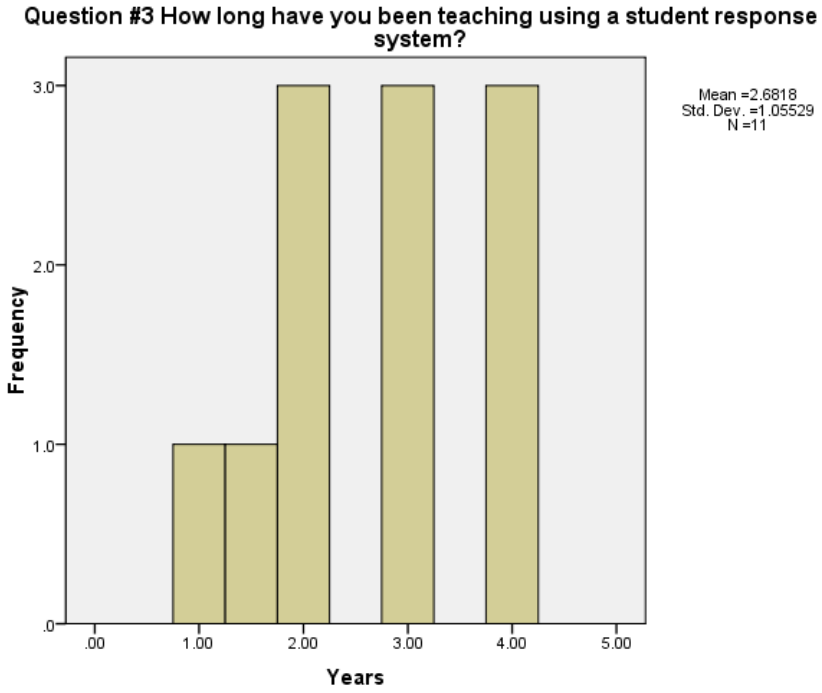

Figure 3. Participants' length of use (years) of SRS.

The responses to Question 4 indicated that most of the participants had positive experiences using this technology (see Figure 4). Participant E wrote, "This is great instructional technology." Participant F felt this without the response systems he would "not see any chance to teach successfully such advanced classes like AP Science." Participant G perhaps had the strongest comments stating that the technology "has revolutionized how I present my lessons." Two participants had somewhat negative comments regarding the SRS. I stopped reviewing here. Please go through the rest of your section and look for the patterns I pointed out to you. I will now look at section 3.

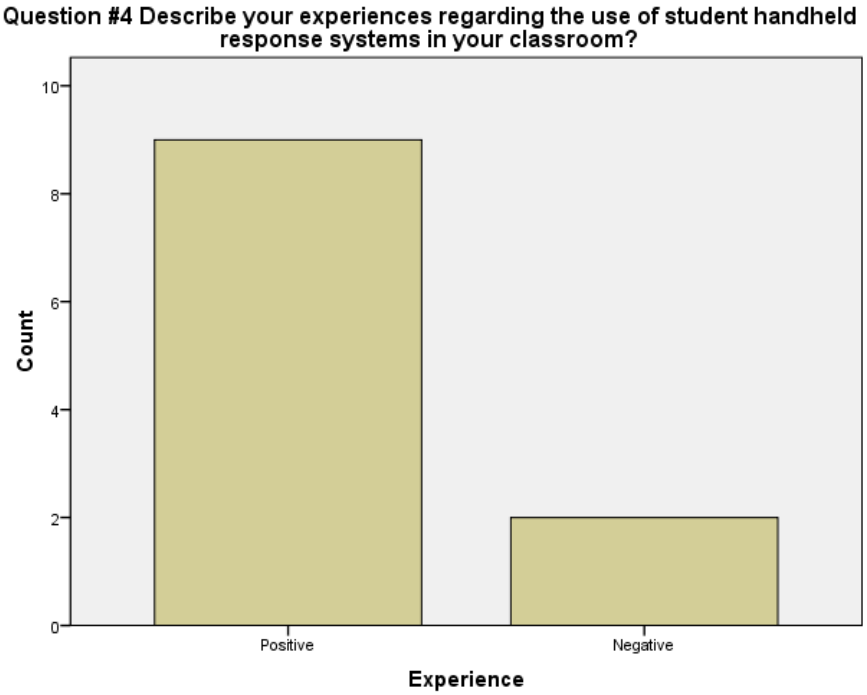

Figure 4. Particpants' perception (positive, negative) of their experience with SRS

Participant A referred to the technology as a "big pain" when the computer does not function correctly and Participant H felt "it is useful in certain circumstances such as multiple choice review."

The participants gave a variety of suggestions for strategies to implement this new technology in the classroom (see Figure 5) with most of the emphasis placed on preparation, with six teachers mentioning it. Collaboration amongst the teachers was cited by two of the participants as an important component of helping teachers use the response systems. Three teachers felt creating good clicker questions was an important factor for teachers to use this technology properly. One teacher mentioned breaking up lectures with clicker questions as effective strategy teachers could employ.

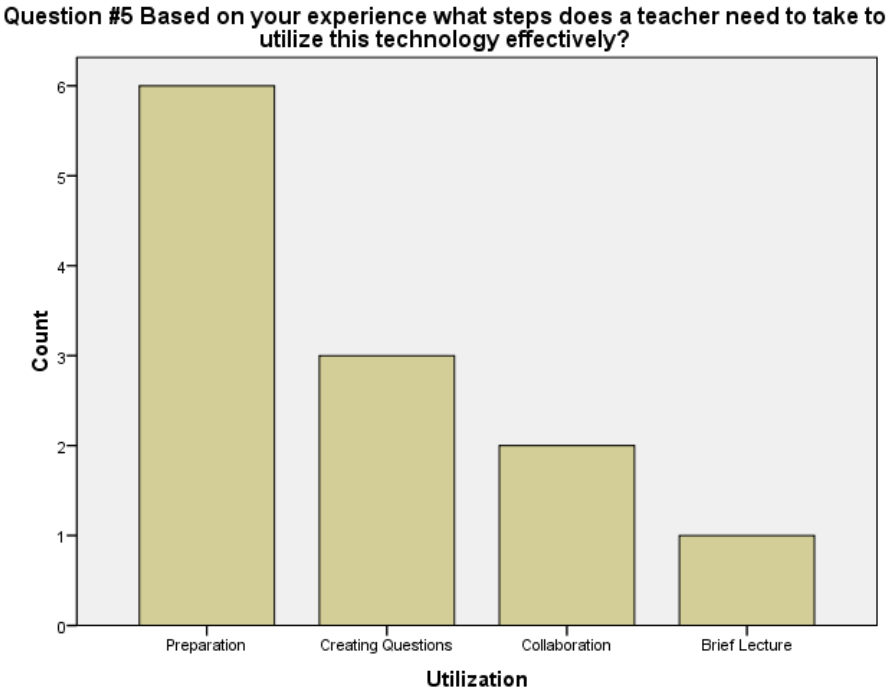

Figure 5. Participants' perception (preparation, creating questions, collaboration, brief lecture) of the steps needed to utilize SRS effectively.

Participant G commented that the SRS has "made the process much smoother as all teachers that teach the same subject use the same materials and same assessments." Participant E stated, "You need to work together because it's a lot of prep. Having common planning time and common assessment makes it easier." Participant D felt that "The use of the technology seems to help us plan our lessons better so one teacher does not fall behind. It would be hard to do this all by yourself." Participants H and I indicated that the use of the standardized use of the interactive white board software has helped more with collaboration then the response systems. Participant J felt that "with or without the response systems we would be able to plan effectively." Participants A and B both felt the technology had little impact on their ability to plan with their colleagues.

Preparation was mentioned as an important factor in using the SRS systems by

Participants F, G, H, I, and K. Participants D and G both felt that teachers should attend workshops to become more familiar with the technology before using in the classroom. Participant G commented, "A teacher really needs to take the time to learn how to use the system by either going to workshops or seeing it being used in action." Participant D mentioned that the school district had provided a training workshop that was helpful.

Participants B suggested that response questions be structured so they increase in difficulty so the teacher can gauge how well the students understand a concept. Participant E shared the sentiment that she only lectures "for brief periods of time maybe 3-4 slides…before giving the class some questions to answer.. She went further to say these "questions get increasingly harder as we delve deeper into a concept." Other implementation strategies mentioned by participants were placing time limits on students answering questions to reduce cheating (Participant C), preparing to reteach material (Participant K), and creating effective questions (Participant I).

The participants used a variety of formative assessment techniques before they had access to the clickers, and almost half of the participants felt formative assessment was more difficult before they began using the technology (see Figure 6).

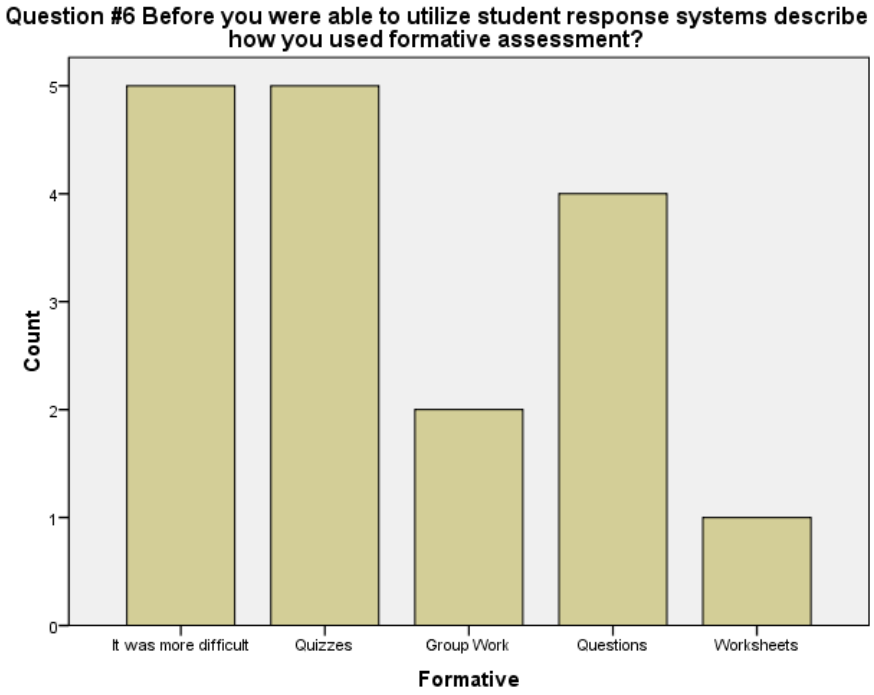

Figure 6. Participants' perceptions (it was more difficult,……) of how they utilized formative assessment before they had access to SRS.

Five of the partipants felt formative assesment was more difficult before they had the SRS technology. Almost all of the participants felt that the technology had an impact on not only the frequency but also the effectiveness of the formative assessments they give in class (See Figure 7). Three of the participants described a dramatic effect this technology had on the quality of their instruction. Only one teacher reported that there was very little change to how formative assessment was implanted in the classroom. Participant B felt it was "hard to recall" how she utilized formative assessment before having the clickers in her classroom. She went further to say that the SRS has "completely revolutionized how I utilize formative assessment." Prior to using the responders the participants described a wide variety of formative assessment techniques they utilized such as class polling, quizzes, group work and circulated the class to answer

questions.

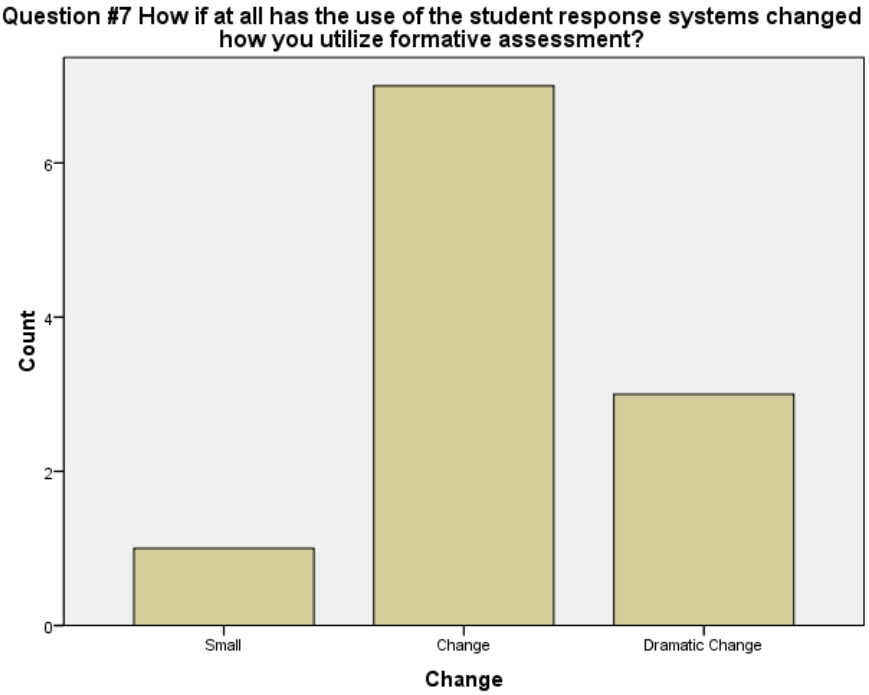

Figure 7. Participants' perception (small, change, dramatic change) of degree of change of their use of formative assessment change due to the use of SRS.

Participants B, C, E, and J all felt that using the responders allowed them to gauge the understanding of all the students in the class instantly. Participants C, D, E, and G indicated that using SRS has made formative assessment easier to implement. Participant I pointed out that he uses formative assessment more frequently now "because it becomes quicker, easier, and less "painful" for shy or unsure students. Therefore it makes the classroom environment more pleasant". Perhaps the strongest statement regarding SRS and formative assessment came from Participant D. He felt that "I cannot think of any tool that allows teachers to utilize formative assessment in a better and more efficient way." Participant A stood out as the only teacher who felt the technology had no impact on how she implements formative assessment.

Eleven positive comments were made regarding student perception towards the response systems with one negative comment. Three of the participants made very strong statements regarding student perception (see Figure 8).

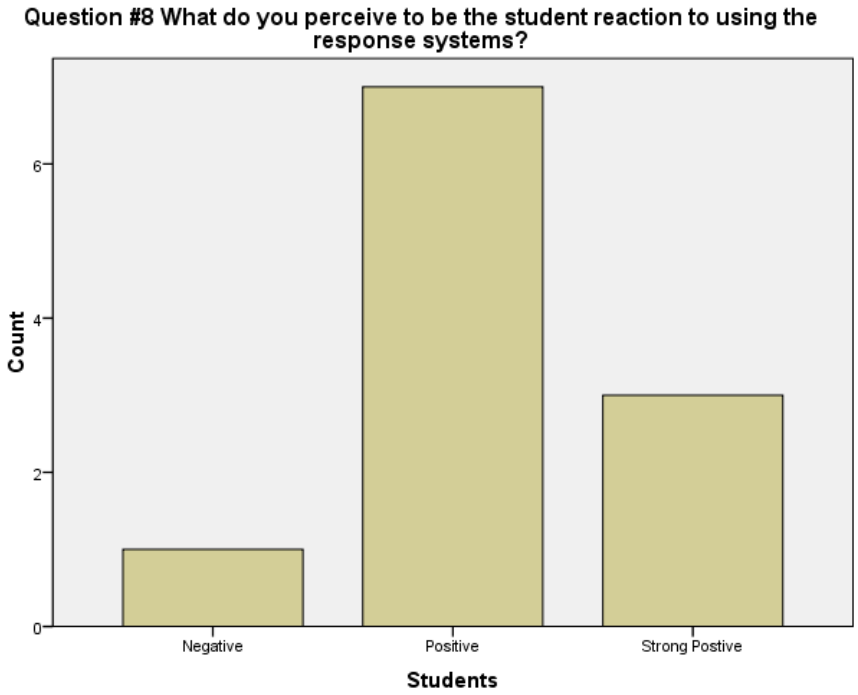

Figure 8 Participant's perception (negative, positive, strong positive) of the student reaction to SRS.

Three of the participants (D, E, and G) went even further stating that the students "love" using the clickers in class. Participant E feels that his students are "more engaged and pay more attention to the lecture." Participant J thinks her students are "disappointed" when they do not get to use the clickers in class. One negative comment about the student's perception of the SRS came from Participant B. She mentioned that students who "need a little more time to process concepts probably hate it because she usually shows the list of who the class is waiting for.

Only two of the participants felt the clickers had a small impact on planning while

four claimed little impact and two believed the use of the responders had no impact on their work with their colleagues (see Figure 9). Regarding the impact of response system on planning Participant A commented "We planned well before." Participant B went further saying, "I haven't really noticed the SRS has had an impact on my ability to plan with colleagues, we planned units as we do now." Only two of the participants stated the response systems helped them plan with their colleagues.

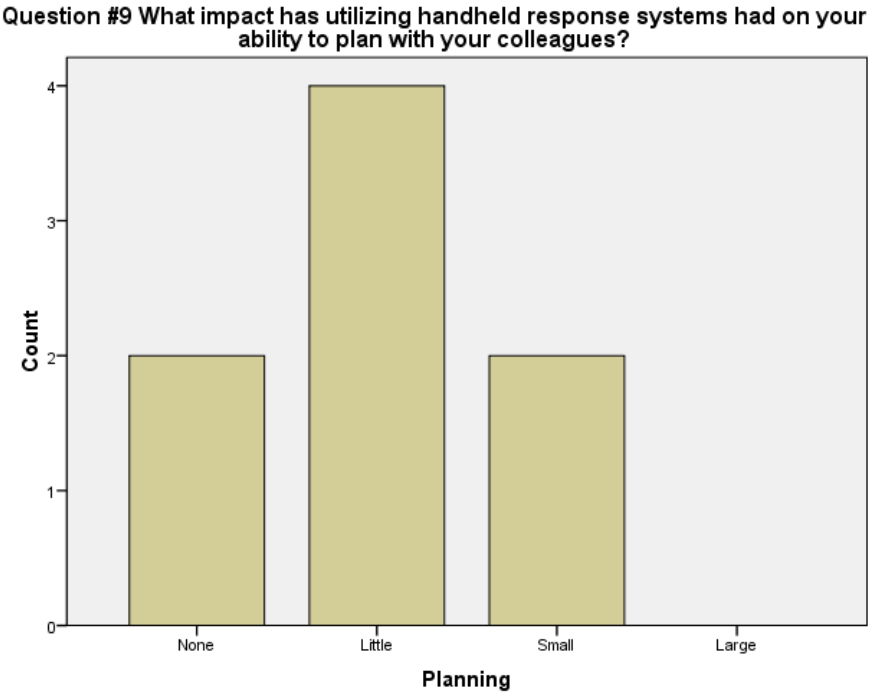

Figure 9 Impact (none, little, small and large the particpants felt SRS had on their abilty to plan with their collegues.

General Themes

A significant theme that was mentioned throughout the interviews was that the use of this technology helps teachers move through the curriculum faster (see *Figure 10)*.

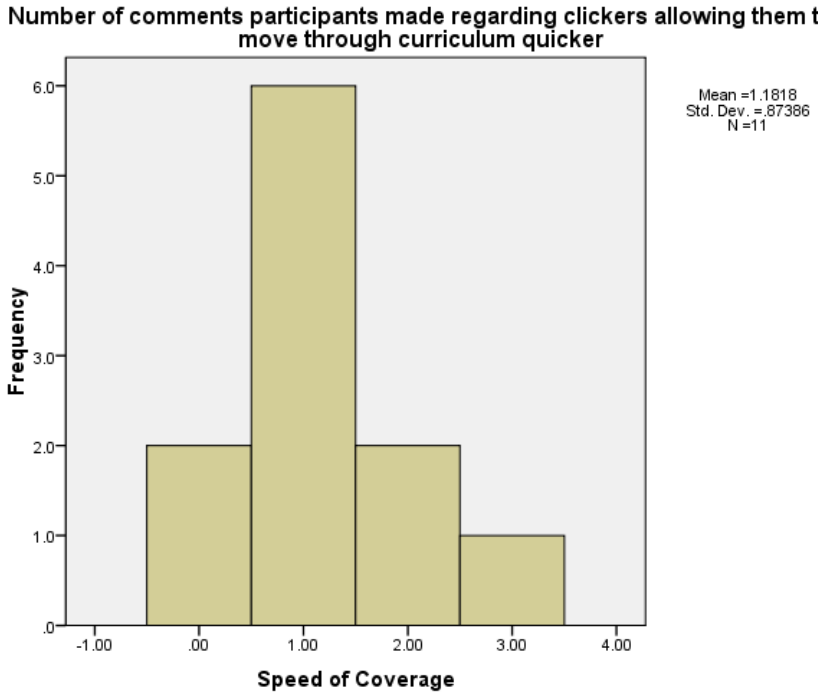

Figure 10. Number of comments made by participants througout their interview regarding how SRS allowed them to cover more content in less time.

Only participants A and K did not mention improving speed of coverage at all. Participants C, D, G, I, and J all mentioned that the response systems allow them to move faster. Participant I stated the SRS "alerts me when the students are not getting the subject matter." Participant D commented that the SRS allows him to "assess students as I teach instead of waiting for a test."

Another theme that emerged from the data was the difficulty teachers have implementing formative assessment without technology like the SRS. Based on the feedback from these online interviews these teachers feel that formative assessment is faster, easier and more effective using this technology (see Figure 11). Only participants A and C made no comments about the improved formative assessment using the response systems. Participants B, D, E, and J made four or more comments regarding the

improvement in formative assessment they has seen using this technology.

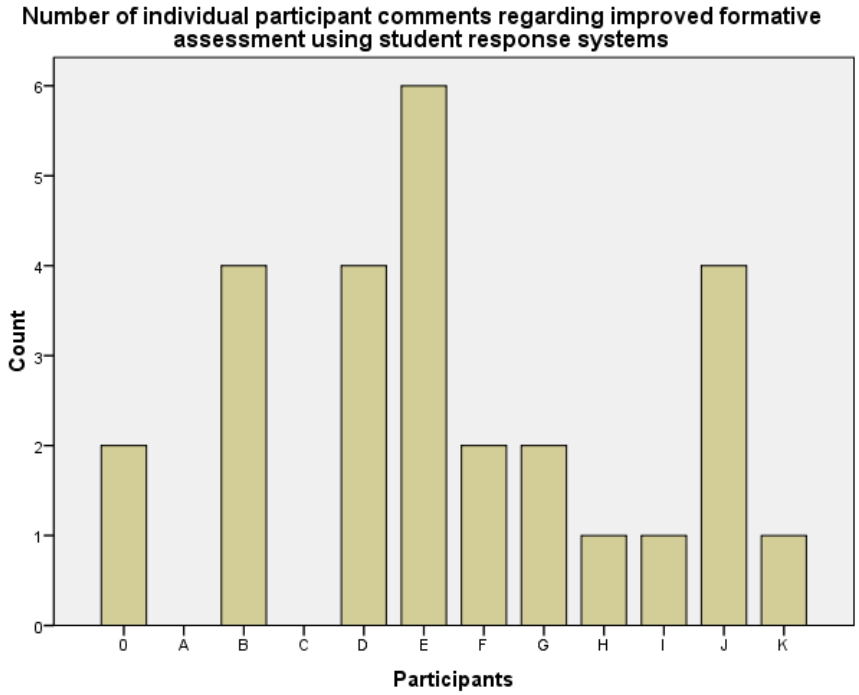

Figure 11. Number of participants comments regarding their perception of improved formative assessment using SRS.

The overall theme of the interview data was that the participants really like using the SRS in their classrooms (see Figure 12).

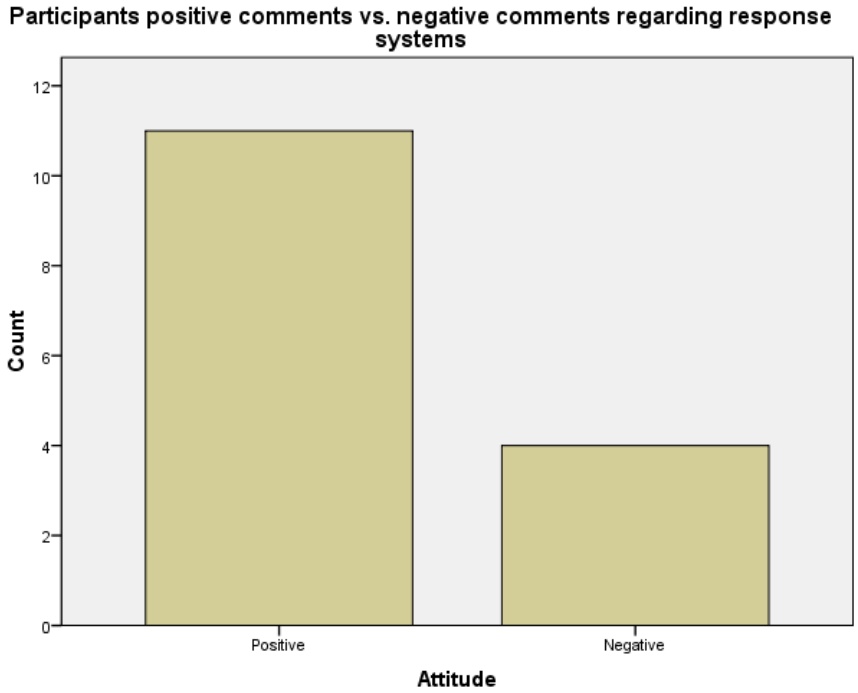

Figure 12. Attitude of participants (positive, negative) towards the use of SRS

There were 11 positive comments coded as positive and four negative throughout the entire interview transcript. In general, the participants in this research felt clickers provide an effective tool of formative assessment, make their classes more engaging, and fun for the students, and they are able to cover more material at a greater depth.

Analysis of Findings

The participants in this study have currently been using the response systems for several years. The experience of the teachers in this study with clickers makes them very qualified to provide feedback about best practices for using the devices. The large majority of the experiences these teachers have had with the clickers were positive (see Figure 4).

The teachers gave a broad spectrum of possible steps needed for other educators to prepare to use clickers in their classrooms. The participants placed an emphasis on

preparation. The feedback indicated that creating effective questions and infusing them into daily lesson planning takes a great deal of time. It is helpful if groups of teachers work together to create the presentation, to lessen the burden upon one individual.

The data indicated that formative assessment is much more efficient and effective when administered through SRS. Teachers in this study used a variety of formative assessment techniques before having access to clickers. These included quizzes, group work, questioning students, and worksheets. None of these techniques seems as efficient as the response systems.

The data did not show that there is an impact on staff collaboration due to the use of the SRS, yet there could be some factors that contribute to this. All but one of the possible participants worked in this school district prior purchasing of the clickers. They all met and planned their lessons collaboratively before this technology ever came along. The results could be different if this technology were introduced to a group of teachers who did not work collaboratively prior to its induction.

The participants felt strongly that the technology allows them to pace their lessons based on the student learning. Coverage of material is a constant battle all educators face. Based on the feedback of this sample the response systems allow their classes to move faster and not sacrifice student understanding, because the lessons only go as fast as the students permit.

Conclusion

Section 2 of this project study provided an overview of the instrument utilized by the researcher to gather data in the form of an online interview along with justification for why this method was most appropriate for answering the research question. Attention

was paid to the reliability and validity of the instrument. The data analysis section demonstrated the steps that were taken by the researcher to understand and describe the data. The findings section described in detail the themes derived from the coded interview data. The themes from each question were displayed using a bar graph.

The overarching themes of the data collected in this research appear to support the use of response systems. Not only did the teachers perceive that the students enjoyed using the response systems, but they also felt that the technology allows them to improve formative assessment execution, the pace of instruction and of amount of material covered. The following two sections will include a description of the project, and explanation of the data findings and any recommendations the researcher will make based on the data.

Section 3: The Project

Introduction

The purpose of this project study was to examine the use of SRS as tools for formative assessment. The design of this professional development case study was focused on determining the strategies and rationale that teachers have for using handheld SRS for formative assessment. Based on the first literature review, there is a lack of current researchers who have focused on using SRS in high school classrooms for formative assessment. The project involved gathering data via an online interview of teachers currently using SRS. The information gathered from these teachers, along with literature on formative assessment and SRS, provided the researcher the the material to create a professional development manual for the implementation of this valuable technology. This study included suggestions for educators and leaders of school communities as to how SRS can be used to improve formative assessment in classroom instruction.

Project Description

This qualitative, case, project study began by introducing the problem that would be addressed. Teachers find implementing formative assessment in the classroom to be difficult, and in many cases too time consuming (Elwood, 2006; Harris, 2007). A review of the literature on formative assessment and SRS was conducted, and data were gathered from teachers currently using the technology. This data were used to develop a best practices manual for the implementation of SRS for formative assessments in high school classrooms. The focus of this professional development guide is on pedagogical strategies that teachers can use to improve the implementation of SRS as effective tools

of formative assessment. In addition, the manual describes many of the possible positive outcomes associated with the use of SRS based on current literature, and from the data garnered from the study participants. This manual will give school districts and educators a basis introducing SRS in their classrooms.

Project Goals

The goal of this project was to provide teachers with a resource they could use to use to help integrate SRS into their everyday lessons as a tool for formative assessment. I also provided suggestions for the professional development needed to support SRS implementation. The goals of this project are based on the data collected from teachers currently using SRS, and on the scholarly research available on formative assessment and SRS.

Rationale

The reason for this project was to improve formative assessment in high school classrooms. For this project, SRS were specifically focused on since their use in high schools for formative assessment is not discussed in detail in the currently available literature. This project included the theories of formative assessment provided in the literature, incorporating them in alignment with the practical tips and applications suggested by teachers using the devices. This project was constructed based on both current literature and teachers' self-reported experiences. The data analysis provided in section two of this study indicated that teachers and students enjoy working with this technology. The teachers who participated in this study generally felt it was easier to implement formative assessment in the classroom using the SRS system. This project will add to the resources of teachers and school districts seeking to improve formative

assessment with SRS. The manual will not only provide instructors with pedagogical strategies for using the SRS but give school districts a basis for which to build the professional development programs necessary for successfully implementation.

Review of Literature

The first literature review included a theoretical framework for formative assessment. The literature review highlighted the positive student outcomes related to formative assessment. The literature also pointed out that despite its benefits, formative assessment is still not a common practice in the classroom. This review presented SRS as a possible tool to help teachers implement formative assessments.

The second literature review will include the research conducted on the implementation of SRS, and provide this researcher with the current "best practices" for inclusion in the SRS manual development. Professional development strategies for helping educators learn how to implement SRS will also be examined. This review of the current literature will expand not only upon the rationale for this project, but also on its implementation.

Implementing SRS

Introducing new technology in the classroom can be challenging. Primarily, acquiring technology can tax already stretched school budgets. Even with budget constraints aside, when the technology is available, teachers still need help to incorporate it into their daily pedagogy (Finger & Houguet, 2009; LaFee, 2009). School districts need to provide teachers with pedagogical, as well as technical support. The success of the implementation of SRS technology depends on teachers learning how to use the devices, buying into to their value, and committing the planning time to not only first

learn the technology, but to also create the SRS questions (Diers, 2008; Koenig, 2010; Kolikant, Drane, & Calkins, 2010; Sevian & Robinson, 2011; Sullivan, 2009). Collaboration amongst groups of teachers has shown to be a successful way to help teachers divide the workload involved with creating SRS questions. This type of collaboration amongst teachers also promotes better communication regarding student learning (Koenig, 2010; Premkumar & Coupal, 2008). When given proper support, researchers have indicated that teachers have shown a positive attitude towards this technology (Bush & McLester, 2007; Koenig, 2010; Kolikant, et al., 2010). Teachers should also be prepared with an alternative should the technology fail for some unforeseen reason.

SRS Pedagogy

While many researchers have pointed towards student satisfaction and improved engagement with clicker usage (I. Beatty, 2006; Gauci, et al., 2009; Graham, et al., 2007; MacGeorge, et al., 2008) there are fewer scholars citing their direct impact on improving specific learning outcomes such as standardized tests (Morgan, 2008). The current research data proposed that the teacher's pedagogical strategies for implementing this technology are just as important or even more important than the technology itself (Edens, 2008; Koenig, 2010; Milner-Bolotin, Antimirova, & Petrov, 2010; Morgan, 2008; Morse, Ruggieri, & Whelan-Berry, 2010; Sullivan, 2009).

Question Development

Developing good questions for SRS that promote engagement, but also help student learning, is an acquired skill that takes practice to refine and is a critical component of making SRS or "clickers" a useful teaching tool. Researchers have

indicated that it takes teachers considerable time and repetition to create good clicker questions and effectively integrate them into their daily lessons (Caldwell, 2007; Edens, 2008; Koenig, 2010; Morgan, 2008; Premkumar & Coupal, 2008; Sevian & Robinson, 2011; Sullivan, 2009; Yourstone, et al., 2008).

According to Premkumar and Coupal (2008), identifying the purpose of an SRS prompts is a critical step in question development. When designed correctly, student response questions can be more in concurrence with the way people learn and remember, more so the traditional lecture (Caldwell, 2007) The question should be related to the objectives of the day's lesson. Clickers are most effective when there is a synergy between the questions and the lesson content that appears natural (Caldwell, 2007; Sevian & Robinson, 2011). The reasoning for a question plays an important role in the type of question that is used. SRS questions that are used for formative assessment purposes would typically be inserted into a lecture style presentation (Koenig, 2010). These questions are designed to keep students engaged and to ascertain if they have grasped the concepts of the lecture. In general, these questions are multiple choice in format (W. A. Anderson & Noland, 2010). Questions can also be designed to start a discussion or peer-to-peer conversation. In this case, these types of questions can be worded in the form of a statement that students may be asked to agree with or disagree with(Premkumar & Coupal, 2008). Yet another style of question might involve sensitive material, such as topics that would be discussed in a health class. The SRS technology allows a student to answer sensitive questions anonymously. This feedback would be typically difficult to ascertain for teachers (Fisher, 2006). For the purposes of this project study, the focus was

on SRS questions used for formative assessment, but there are a variety of other applications

The number of SRS questions teachers use within their lesson should also be considered in planning, along with evenly dispersing the questions throughout the lesson (Premkumar & Coupal, 2008; Sevian & Robinson, 2011). The average student's attention span is approximately 15-20 minutes (Morgan, 2008; Premkumar & Coupal, 2008). In order to promote maximum engagement of all students, teachers should use one to three SRS questions every 15-20 minutes. These questions should be disseminated evenly throughout the lesson as well (Morgan, 2008; Premkumar & Coupal, 2008; Sevian & Robinson, 2011). Too many questions will not allow time for reteaching or peer interaction to occur which help promote learning (W. A. Anderson & Noland, 2010; Premkumar & Coupal, 2008; Wolter, Lundeberg, Kang, & Herreid, 2011).

Any teacher using SRS must ensure that all questions are valid and dependable (Premkumar & Coupal, 2008; Sullivan, 2009). In order to test reliability, teachers should project the questions on the interactive white board during their planning, and ensure that the size of the text font is legible from all areas of the room. Teachers should also check that the clickers are working before the start of any lesson. Sullivan (2009) suggested that the validity of the response system questions can be obtained by the evaluation of the questions fellow faculty members teaching the same material. Ideally, a group of teachers would work together to create questions for the SRS, but this is not always the case in all school districts. Teachers can also utilize questions provided to them by resources they may have for the course such as test banks. However, generally speaking

there are few resources available to provide teachers with SRS questions (Caldwell, 2007), which adds to the prep time needed for implementation.

Increasing the difficulty of questions as a topic is taught has shown to be an effective strategy, particularly in math and science classes (Koenig, 2010; Milner-Bolotin, et al., 2010; Strasser, 2010). This allows the instructor to teach at the level students are learning and to modify instruction based on the feedback they provide (Strasser, 2010). The ability to gauge student understanding of material while it is being taught also allows the instructor to move faster without sacrificing depth of content or student understanding. This can be crucial in higher-level math and science courses where the curriculums are rigorous (Brewer, November 2004; Sevian & Robinson, 2011; Strasser, 2010).

SRS and Peer Instruction

The use of SRS-- also known as clickers-- within a lesson, allows teachers to develop effective peer or collaborative learning (Caldwell, 2007; Gentry, 2009; Lowery, 2005; Morse, et al., 2010; Sevian & Robinson, 2011; Wolter, et al., 2011). When questions are posed within a lesson, those students who answer incorrectly can be paired with students who answered correctly. The student brings a different perspective to learning new material compared to the teacher. The student who has just learned a new concept may be able to help a student who is struggling by providing him or her with a unique insight because she just learned the concept herself. This type of peer instruction not only can assist struggling students but can reinforce content for students who already have a good understand of what has been taught (W. A. Anderson & Noland, 2010; Caldwell, 2007; Kolikant, et al., 2010; Wolter, et al., 2011).

Student Engagement and SRS

Convincing students that they should be participants in their own learning can be challenging for teachers (Gentry, 2009). There are numerous reasons why students do not participate in class. Students may be afraid of how their peers will respond to their participation, they may not be prepared to answer the question, they may not like the subject, or they simply may be shy and reluctant to volunteer to answer a question (Gentry, 2009; Morse, et al., 2010). Whatever the reason students choose not to participate, the clickers can overcome them by allowing for 100% anonymous participation instantly from the entire class. Currently, researchers have demonstrated that the use of SRS promotes increased student engagement, class discussion, and create a much more active learning environment (Morling, et al., 2008; Morse, et al., 2010; Mula & Kavanagh, 2009; Premkumar & Coupal, 2008; Wolter, et al., 2011).

Summary

Pedagogical strategies play a critical role in the successful use of SRS for formative assessment (W. A. Anderson & Noland, 2010; Boatright-Horowitz, 2009; Caldwell, 2007; Koenig, 2010; Kolikant, et al., 2010; Premkumar & Coupal, 2008; Sevian & Robinson, 2011; Strasser, 2010; Wolter, et al., 2011). Learning how to use the technology, developing SRS questions, integrating those questions into daily lessons, and incorporating peer-to-peer instruction all appear to be important factors in successful SRS implementation. The bulk of the literature available focused on the use of the response systems in college settings. This project study will combine the findings of the literature review, along with the data collected from teachers currently using the devices. Through

this combination, I will develop a professional development plan for the best practices for using the SRS in high school classrooms.

Project Implementation

The data collected in this study and the literature review have provided a framework for how SRS can be effectively used by high school teachers as a tool of formative assessment. This section will include the best practices teachers can use to get the most out of this technology. The implementation of SRS must involve a variety of stakeholders such as school administration, technology support, and most importantly the teachers using the devices. If one of these aforementioned parties does not support the effort, an effective integration of SRS into the high school classroom and pedagogy will be very difficult to accomplish.

Problem to Project Correlation

Formative assessment techniques are often reported to be difficult to execute and can be time consuming. SRS or clickers have emerged as a potential solution to help teachers overcome this problem. While this SRS technology is not new at the college/university, its widespread use at the high school level is limited. This project study provides high school teachers with an overview of how SRS can be used as an effective tool for formative assessment. Special attention was paid to pedagogical strategies that not only were shown to be effective based on the literature review, but were also elucidated in the data collection conducted by me.

Project's Content Development

The key factors in this project development were to identify the best practices and strategies for teachers to use SRS for formative assessment. This content was derived

from an extensive literature review on formative assessment as well as SRS. I also used data gathered from a small sample of teachers currently using the technology.

Resources Needed to Conduct Project

Several resources are needed to conduct this project. Each classroom needs to be equipped with an interactive white board and a SRS. A variety of different SRS or clicker systems are currently available. In the case of this study, the SMART board and the SMART Response System were used, but there are competitive products such as Promethean boards that offer the same functionality as the SMART products. This technology is typically not purchased directly from the manufacturer, but from an outside vendor so prices can vary. Generally, the interactive white boards cost between $1,000-$3,000 and the SRS/clickers are between $1,000-2,000 per class set. There may be a variety of factors that influence the cost of this technology, such as the region of the country the district is located in, or the number of boards and response systems the district purchases. It is essential that the equipment is purchased, installed, and completely functional before any teacher training can begin.

Once the technology has been purchased and installed, the district must provide teachers with professional development as to the basic functionality of the boards and SRS. In order to successfully implement the interactive white boards and SRS into their classrooms, teachers need to feel comfortable using both devices. In light of this need, training workshops should be offered to all teachers involved. These workshops can be facilitated by outside vendors or by the district's technology department. The cost of hiring outside vendors for training workshops will vary depending on the length of the workshop and the number of teachers involved. These workshops are typically no longer

then 2-3 hours in length and cover the basic operations of the interactive board, as well as the response systems. The teachers should also be provided with the manufacturer's instructional manual(s) for the devices. These manuals are free and come with the SRS and white boards.

It is recommended that a school district implement this project with a small group of teachers (approximately 5-10) all teaching the same course or subject area. The smaller group size will lessen the cost of implementation and make the project easier for the administration to manage. Developing SRS questions and presentations is time consuming. Having small groups of teachers who teach the same course working together lessens the burden of question creation on the single individual.

In order to implement this project, school districts need to provide funding for the required technology and professional development needed. Strong commitment is required from the district's administration and the teachers involved in order for this project to be successful. In order to implement new technology in the classroom, the teachers need to buy in to its effectiveness to improve student learning. This can only truly happen once they are given the funding and professional development support from the district, and begin utilizing the technology.

Existing Supporters and Potential Barriers

The strongest support for implementation of SRS is the teachers currently using the technology. The feedback from teachers using this technology is overwhelmingly positive. Teachers already using the technology can provide valuable feedback and support to those just starting out. A potential barrier to this project could be a lack of support from the administration or technology department. The school administration

may be reluctant to change, particularly when it comes with a price. This may also be the case for a school district's technology department, which may already be overwhelmed.

With the current economic constraints, districts many school districts have seen cuts in their operating budgets. This could also present a barrier as the technology does come at a cost that could prohibit its widespread adoption. Contracting vendors to provide professional development workshops may prove to be cost prohibitive as well. Teachers may also lack the planning time to learn how to use the SRS and integrate them into their lessons. Common planning time is a critical component to facilitate a teacher's ability to collaborate on SRS lessons. School districts may not be able to provide their teachers with schedules that allow time for this collaborative planning.

Project Evaluation

The product of this project study is a professional development program for implementing SRS in secondary schools. The goal of this program is to provide teachers with the best practices and pedagogy for using this technology for formative assessment. The lack of current literature available on high school implementation of SRS for formative assessment presented a need for this program.

A follow-up questionnaire at the end of the school year will provide the school administration with feedback regarding the program success. The questionnaire, which is included in the professional development manual (Appendix A), can also help ascertain any modifications that could be made to improve SRS implementation. This questionnaire should be completed by the teachers utilizing the devices for an entire school year and will be analyzed utilizing qualitative data analysis techniques. The

questionnaire can be given in an anonymous web format (such as survemonkey.com or zoomerang.com) that will improve the validity of the findings.

The goal of the manual's evaluation survey is to determine if the teachers felt that they have a better understanding of how to use SRS as a tool for formative assessment after reading the manual. The survey also sought to measure the level of comfort the teachers now have using the SRS. Lastly, the instrument seeks to gain suggestions for possible future professional development the teachers might need to improve their use of this technology.

Because of the relatively small nature of this project it may be difficult for school districts to quantify if it has or has not improved student learning. One possible standardized indicator of student success could be the number of students who enroll in Advanced Placement courses after taking a class that uses SRS. The test results of these students could be tracked as well. A student satisfaction survey has also been included in the project (Appendix A). The goal of this survey was to gauge the student's perception as to how well they learned using SRS. Also, the survey will provide feedback as to the level of engagement the students felt in the classes that utilized the SRS when compared to other courses that do not use this technology. Lastly, the student survey asked the students for feedback as to how the teachers could improve the usage of SRS for future classes.

Project Implications

Social Change Implications

This wide spread use of SRS can help increase the amount of formative assessment employed by teachers on a daily basis by making it easier and more efficient.

The use of assessment to modify instruction and improve student learning would be a dramatic shift in the current paradigm of how assessment is used in education. SRS present teachers with a fast and effective way to determine if their students are learning what is being taught. Making assessment less about a grade, and more about helping students learn, can promote overall better instruction, and in turn improve student outcomes on large summative assessments.

Importance of Project to Stakeholders

School districts across the country are constantly searching for tools that can help improve classroom instruction The impact on teachers who are able to use this technology is significant. The use of SRS for formative assessment has shown to help teachers move through content at a quicker pace without sacrificing student understanding. This is particularly valuable in advanced placement courses where teachers may have difficulty covering all the voluminous material.

Conclusion

This project was created to provide teachers and school districts with a guide for using SRS as a for formative assessment tool. The professional development handbook created can lead to more teachers implementing formative assessment in their classroom. Without this valuable technology, formative assessment is typically time consuming and difficult to implement. The availability of a professional development manual for SRS should help school districts implement this technology and improve instruction.

Section 4: Reflections and Conclusions

Introduction

This study was designed to discover the best teaching strategies for using SRS as tools of formative assessment, and organize them into a professional development manual. In the final section of this study, the numerous components of this project study are evaluated. Recommendations for the future research and the implications of the study are also discussed. This section also includes the summary of the strengths and limitations/weaknesses of the study. Finally, a self-reflection on the research process and analysis of the impact this project is included.

Project Strengths and Limitations

Strengths in Addressing the Problem

The strength of this project was not only that it is grounded in the literature review findings, but that it also includes data gained from instructors currently using SRS as tools for formative assessment. Furthermore, the method used to gather data allowed the teachers to provide anonymous feedback on the best practices they use while teaching with SRS. Many of the comments made by the participants were aligned with and are well supported by the research presented in the literature review. This project was focused on specific teaching strategies for using this technology for formative assessment at the high school level. In the extensive literature review that was conducted, I was unable to find a similar resource or handbook available for teachers at the high school level.

Recommendations for Remediation of Limitations

The small sample size limits used for this study limited my ability to make broader reaching statements regarding the data obtained. It is recommended that to increase the generalizability of the findings, a larger sample size be considered in future research. The online interview format that was used because of the role of the researcher as a supervisor in the building is also limiting. One possible solution is that that future data collection could be conducted by someone who is not a direct supervisor over the participants in the study. This would allow more traditional, face-to-face interviews to be conducted. This type of interview would allow for follow-up questions and perhaps help gather richer data. Focus groups could also be an option to consider for future research. Individuals who are not comfortable using a computer would also benefit from the traditional interview. Another possible suggestion would be to have an interview with teachers before they begin using the technology and then after. In the case of this study, all of the teachers in the studied school were already using the response systems when the research started. By interviewing teachers before they start using the SRS, further insight can be gained into how the technology changed their approach to formative assessment.

Project Development and Evaluation

The process of developing a project study has given me great insight into the research process. I learned that writing a project study is about putting theory and research into an action plan that must be written in a way that facilitates implementation. Additionally, I also learned about how to protect the rights of those who participate in the

research. Finally, I became aware of the implementation process needed for the project, as well as how the project can be evaluated.

Scholarship

It is somewhat presumptuous to consider oneself a scholar regarding any particular subject; however, after finishing this project I feel comfortable calling myself a scholar of this particular technology. I conducted an extensive literature review and in the process read over 100 peer-reviewed journal articles related to formative assessment and STS. I also became familiar with the process required for collected and analyzing data for a doctoral level research project. This component proved to be the most difficult for me as I had little experience conducting research. As a result of all of the work I have done, and with the help of the Walden faculty, I have learned how to write from more of a scholarly approach.

There were many challenges in my doctoral study; finding journal articles that focused on specific pedagogical strategies for using SRS was not easy. This process involved several months of time searching for articles and analyzing those articles. I was unable to find a substantial amount of literature that was focused specifically on high school teachers using SRS. This reinforced my belief that the study I conducted was needed. The development of my research methodology proved to be challenging as well. As a scholar, I have learned that many of my preconceived ideas about how research is conducted were simplistic. As a result, there were several iterations of my methodology section and a complete change in the type of data collection I would use. While frustrating, the steps I took to find the appropriate method for my research strengthened my skills as a scholar. Another challenge I faced was not allowing my own personal bias

to enter into my writing. I have worked closely with many of the teachers using this technology and feel strongly about its positive impact on instruction. Knowing this I made sure to focus on the data and literature and omit my own experiences.

Upon entering Walden, I thought of myself as a good writer. After going through the dissertation process, now I know that scholarly writing is for more intense than anything I had every worked on before. Drawing my own conclusions from the literature opposed to simply summarizing what I read is a skill I have honed greatly. My content knowledge regarding formative assessment and SRS has also grown vastly as a result of the research I have conducted. The theoretical framework for formative assessment allowed me to see how the idea developed, and provided more depth to my understanding of the concept and how it can be used. As a result of this study, I improved my writing and enhanced my knowledge, and am now able to take these acquired skills and apply them to other areas of education.

Leadership and Social Change

Implementing new technology that has the potential to change how teachers approach assessment requires strong leadership. Making student assessment more of a tool for improving instruction, instead of a simply a measurement of what the students have learned, is a dramatic shift from traditional norms. This type of change requires a visionary leader willing to commit to this different approach. In order for the implementation of SRS to be successful, the administration of the school district and school must be willing to commit the funds to buy the equipment, as well as provide teachers with the need time for professional development. Without such a commitment, it would be difficult to implement this technology.

SRS can revolutionize classroom instruction. Never before has a tool existed that would allow teachers to instantly gain insight into the level of understanding of all of their students instantly. Using SRS for formative assessment allows teachers to cover more material while allowing the students to pace their own learning. The class only moves as fast as the students are able to learn. The focus of this technology is on improving formative assessment and in turn, improving instruction. The strong focus placed on how school districts can raise standardized test scores may cause many to lose sight of one of the most significant factors in improving student learning; the *quality* of instruction a student receives. Based on my research, the SRS has a chance to be the single most significant piece of technology for improving instruction, and thus become an impetus for tremendous social change.

Self-Reflection

The journey of writing a dissertation is one filled with many peaks and valleys. There were many nights and weekends I spent in front of my computer wondering if it is all really worth it. As I am at the end of the journey now, I can say that it was all worthwhile. The experience I have gained working with all the Walden professors, particularly the members of my dissertation committee, has helped me grow as an individual and professional. When initially considering doctoral programs, I was attracted to Walden due to the school's emphasis on social change. I wanted to conduct research that can make a real difference in my local school community and possible impact the field of education on a broader scope. The tools that I have developed during my years of study at Walden, and particularly the doctoral process, are ones I will take with me for the rest of my life. I know my higher purpose in life is to help educate young

girls and boys as they approach adulthood. Walden has strengthened my skills as a scholar, improved my content knowledge, and motivated me to improve the educational community I work in every day and hopefully other communities as well.

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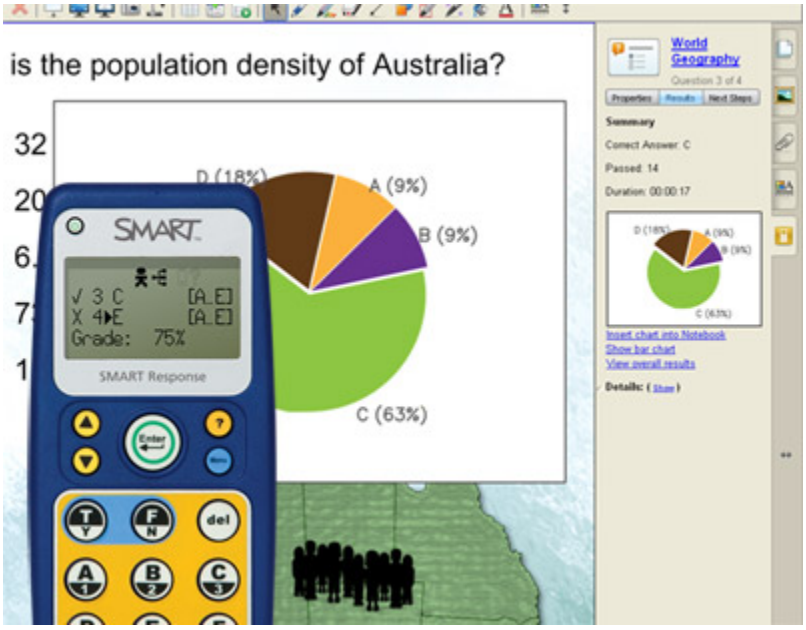
Appendix A

Clickers for Formative Assessment



A Guide to the Effective Use of Student Handheld Response Systems as Tools of Formative Assessment

Prepared by Jon Chevalier

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Introduction

Wouldn't it be great if every teacher could read their students' minds to find out if they were learning what was being taught? How powerful would this information be? Teachers could change their instruction instantly based on the level of understanding of their students. Students who are struggling could be identified and provided with remediation before their difficulties grew. The class could be paced based on the students' ability and not on a preconceived notion of what the teacher thinks should be covered. The instructor does not have to be a mind reader to gain all this insight. There is technology out there than can do it. The student response system (SRS), or clickers as they are commonly referred to, are an amazing assessment tool that makes formative assessment effective and efficient.

This guide was written to help teachers implement SRS as tools of formative assessment. Like any technology, in order to be effective, teachers need professional development to implement it correctly. When implemented, SRS can dramatically change how teachers view assessment as a tool to improve student learning and not just as a method of determining what a student has learned. Making assessment more about improving instruction, and less about grades, is a dramatic change from the traditional norms in education. Typically, formative assessment can be difficult to execute and may have slowed down the progress of a class. The SRS has the exact opposite effect on instruction, typically speeding it up without sacrificing depth of content.

Why Clickers?

The pressure on teachers to improve student assessment has increased drastically since the federal government's implementation of No Child Left Behind (NCLB) in 2001 (Chapman, 2007). The passage of NCLB has clearly made assessment a priority for schools across the country (Chapman, 2007; Goertz, 2005). With the recent economic recessions, school districts are searching for answers for how to meet the standards the government has put in place, without spending any more money, or in some cases while dealing with pending budget cuts (LaFee, 2009; Robelen, 2009). Out of this new focus on high stakes testing and cost efficiency, formative assessment has emerged as a tool educators can employ to improve student performance. This emergence is perhaps because of the remarkable ability of formative assessment to improve student learning and decrease gaps in achievement (Black & Wiliam, 2009; Cotner, et al., 2008; Dorn, 2010; Harris, 2007; McMahon, 2008). In addition to its influence on achievement, formative assessment is also depicted as a significant factor in motivating learning (Cotner, et al., 2008; Eldridge, 2008; McMahon, 2008; Shute, 2008). While formative assessment has shown to improve student outcomes it is often difficult to execute and very time consuming (Baroudi, 2007; Dorn, 2010).

Schools have gradually turned towards technology such as student handheld response systems (SRS) as the means of providing assessments that not only promote higher learning, but also prepare students for the rigors of standardized testing (Cotner, et al., 2008; Kenwright, 2009; Koenig, 2010; Penuel, et al., 2007; Salemi, 2009). The utility of SRS is central to effective formative assessment in today's educational climate. The SRS, or "clickers," have shown to provide educators with a tool that improves

student engagement, provides immediate feedback, and promotes higher levels of cognition (Blood & Nell, 2008; Cotner, et al., 2008; Diers, 2008).

The potential of formative assessment to improve student outcomes has led to a variety of products and services being sold to schools as tools of formative assessment. Unfortunately, very few of these products live up to the principles of formative assessment established by researchers such as Black and Wiliam (2009), Morning, et al. (2008), and Popham (2006). SRS, however, do meet all the necessary requirements of effective formative assessment, and provide teachers with a tool that harnesses immediate feedback from students (Addison, et al., 2009; Cotner, et al., 2008; Kenwright, 2009). The speed in which the feedback is obtained allows teachers to make critical interventions to aid student learning and promote higher levels of critical thinking (DeBourgh, 2008).

Students are each assigned a clicker when they enter the classroom. The teacher can enter questions into a lesson that is displayed on an interactive white board. The students are then asked to enter in the answer to the question into their handheld devices. All of their answers are anonymous, and the STS instantaneously gathers and organizes every student's response. The interactive white board creates a visual presentation of the students' responses, and in many instances is presented in the form of a graph. From the graph, the teacher and students can observe if there were a large number of students who failed understand the concept (Caldwell, 2007; Kenwright, 2009; SMART, 2010).

While technology is very simple, research has indicated it can be a powerful tool (Bennett & Cunningham, 2009; Diers, 2008; Gauci, et al., 2009; Kollie, 2008; Patry,

2009; Ribbens, 2007). The research regarding the handheld SRS has found the technology can improve student engagement and learning (Addison, et al., 2009; Cotner, et al., 2008; Stowell & Nelson, 2007; Yourstone, et al., 2008). The instant feedback students receive in classes utilizing clickers is far greater than they would receive in a traditional classroom. When using SRS, students are able to observe how their fellow students are performing, and then work together on their mistakes. The students' answers are displayed anonymously so the embarrassment for offering a wrong answer is decreased (Caldwell, 2007; Graham, et al., 2007). This is particularly effective in classes that discuss sensitive issues such as sex education (Fisher, 2006). Teachers can gauge the level of student understanding and increase the level of difficulty of the questions based on the number of right answers. As a result teachers can have conversations with their students that elicit high levels of critical thinking (Caldwell, 2007).

Another positive side effect of the implementation of clickers in the classroom is the improved communities of practice amongst teachers. Teachers incorporating these devices in their classrooms have shown more inclination to meet with other instructors to plan their lessons and develop questions for the SMART board presentations (Caldwell, 2007; Koenig, 2010; Zhu, 2007). Communities of practice are formed by people who engage in a process of collective learning in a shared domain of human endeavor. They develop a shared repertoire of resources such as experiences, stories, tools, and ways of addressing recurring problems (Wenger, 2002). Preparation for lessons utilizing clickers can open the door to improve teachers' communication and collaboration and thus improve the community as a whole.

The use SRS provides teachers with a tool of formative assessment that can aid in student learning and promote higher levels of cognition, while also improving a teacher's ability to assess students (Addison, et al., 2009; Campbell, 2007; Fies & Marshall, 2006; Lowery, 2006). Clickers allow teachers to assess students more frequently and with more speed. The immediate feedback students are given can improve the students' level of engagement and comprehension (Addison, et al., 2009; Beuckman, et al., 2007; Blood & Nell, 2008; Fies & Marshall, 2006; Herreid, 2006; Stowell & Nelson, 2007). The use of SRS as a tool for assessment does not appear to be a "trendy creation" designed to "rid" teachers of the work involved with grading students' tests. There are strong indications that using these devices can improve the quality of learning (I. Beatty, 2006; Beuckman, et al., 2007; Brewer, November 2004; Conoley, et al., 2006; Patry, 2009; Ribbens, 2007; Stowell & Nelson, 2007; Trees & Jackson, 2007) and quite possibly change the way educators view assessment. SRS can help teachers view assessment as more of a tool for learning rather than as a simple measurement of what is learned.

Clicker Formative Assessment Strategies

Classroom Setup

Setting up your classroom is a critical and easily overlooked element of successfully implementing clickers for formative assessment. The SRS should be located in a place in the classroom that all students can access upon entering. They should also be in the same place each day so the students know exactly where to find them. The less time it takes for all the students to grab their clickers, login in using the clicker code provided by the instructor, and open their notebooks, the more instruction can take place. Each student should be initially be assigned a login number that he or she will use to operate the clicker. This login will also allow teachers to know how each student responds to a SRS question without anyone in the class knowing. Typically, the process of students logging in will be slow in the beginning, and then accelerate as the students grow more acclimated. It should be noted that at the end of every lesson all the clickers should be returned to the cases. This should be checked by the instructor.

Classrooms can be arranged in a variety of configurations, and still provide teachers with valuable feedback while using SRS. However, in order to best promote peer to peer instruction, four to five students should be grouped together either at a round table or at a grouping of desks. This classroom setup will allow groups of students to work together to solve problems. The SRS allow the student themselves to instantly see if they got the right answer to the question. The students who have successfully answered the

question can then help other students in their proximity solve the problem, or come up with a new answer to the question. This works particularly well in math and most science classes. A student who has just learned how to solve a problem can provide other students with insight that the teacher cannot. Peer to peer instruction has long been a method of formative assessment promoted by literature (Black & Wiliam, 2009), and using SRS facilitates this collaborative form of instruction.

Question Development

Developing good questions for SRS that promote engagement, but also help student learning, is an acquired skill that takes practice to refine, and is a critical component of making clickers a useful teaching tool. The literature indicates that it takes teachers considerable time and repetition to create good SRS questions and effectively integrate them into their daily lessons (Caldwell, 2007; Edens, 2008; Koenig, 2010; Morgan, 2008; Premkumar & Coupal, 2008; Sevian & Robinson, 2011; Sullivan, 2009; Yourstone, et al., 2008).

According to Premkumar and Coupal (2008) identifying the purpose of SRS prompts is a critical step in question development. When designed correctly, SRS questions can be more aligned with the way people learn and remember than questions in the traditional lecture format (Caldwell, 2007). The SRS question should be related to the objectives of the day's lesson. Clickers are most effective when there is a synergy between the questions and the lesson content flows naturally (Caldwell, 2007; Sevian & Robinson, 2011).

The reasoning for a question plays an important role in the type of question that is utilized. SRS questions that are used for formative assessment purposes would typically

be inserted into a lecture style presentation (Koenig, 2010). These questions are designed to keep students engaged and to gauge if they have grasped the concepts of the lecture. In general, these questions are multiple choice in format (W. A. Anderson & Noland, 2010). Questions can also be designed to start a discussion or peer-to-peer conversation. In many instances, these types of questions can be worded in the form of a statement that the students may be asked to agree or disagree with (Premkumar & Coupal, 2008). Yet another style of question might involve sensitive material such as topics that would be discussed in a health class. The SRS technology allows student to answer sensitive questions anonymously. This feedback would be typically difficult to ascertain for teachers (Fisher, 2006). For the purposes of this project study, the focus was on SRS questions utilized for formative assessment, but there are clearly a variety of other applications.

The number of SRS questions a teachers uses within their lesson should also be considered in planning, along with evenly dispersing the questions throughout the lesson (Premkumar & Coupal, 2008; Sevian & Robinson, 2011). The average student's attention span is approximately 15-20 minutes (Morgan, 2008; Premkumar & Coupal, 2008). In order to promote maximum engagement of all students, teachers should utilize one to three SRS questions every 15-20 minutes. These questions should be disseminated evenly throughout the lesson as well (Morgan, 2008; Premkumar & Coupal, 2008; Sevian & Robinson, 2011). Too many questions will not allow time for re-teaching or peer interaction to occur, which both help promote learning (W. A. Anderson & Noland, 2010; Premkumar & Coupal, 2008; Wolter, et al., 2011).

Any teacher utilizing SRS must insure that all questions utilized are valid and dependable (Premkumar & Coupal, 2008; Sullivan, 2009). In order to test reliability, teachers should project the questions on the interactive white board during their planning, and confirm that the size of the text font is legible from all areas of the room. Teachers should also check that the clickers are working before the start of any lesson. Sullivan (2009) suggests that validity of SRS questions can be obtained by the evaluation of the questions from fellow faculty members who are also teaching the same material. Ideally a group of teachers would work together to create questions for the SRS, but this is not always the case in all school districts. Teachers can also utilize questions provided to them by the resources that they may have for the course, such as a test bank. However, there are often very few resources available to provide teachers with SRS questions (Caldwell, 2007). This lack of resources adds to the prep time needed for implementation of SRS.

Increasing the difficulty of questions as a topic is taught has shown to be an effective strategy, particularly in math and science classes (Koenig, 2010; Milner-Bolotin, et al., 2010; Strasser, 2010). This allows the instructor to teach at the level the students are learning and to modify instruction based on the feedback they provide (Strasser, 2010). The ability to gauge student understanding of material while it is being taught also allows the instructor to move faster without sacrificing depth of content or student understanding. This can be crucial in higher-level math and science courses where the curriculum is very rigorous (Brewer, November 2004; Sevian & Robinson, 2011; Strasser, 2010).

Teacher Led Instruction

Using SRS to gauge student learning in a lecture setting is a very effective way to pace the class based on student understanding while keeping all students engaged. The SRS questions should be designed to determine if the student have understood what was covered during the lecture component. If the instructor sees that majority of student get the questions correct, then the instructor can move on to another concept or perhaps expand upon the current one. The questions should also increase in difficulty to allow the teacher to determine the level of understanding of the class and pace the instruction appropriately. If at any point many students are unable to correctly answer a question, the instructor can use a number of interventions help them. These may include peer-to-peer instruction, re-teaching, and group discussion. After the appropriate intervention has been made, the instructor can assess the students again with SRS questions to determine if any progress has been made. Students who continue to struggle to answer questions may need to seek extra help to avoid slowing the entire class down. This type of identification of struggling students typically could not take place until a test or quiz was administered. The clickers allow the teacher to help these students long before they are required to take a graded assessment.

Clickers and Peer Instruction

The use of clickers within a lesson allows teachers to develop effective peer or collaborative learning (Caldwell, 2007; Gentry, 2009; Lowery, 2005; Morse, et al., 2010; Sevian & Robinson, 2011; Wolter, et al., 2011). When questions are posed within a lesson those students who answer incorrectly can be pared with students who answered correctly. The student brings a very different perspective to learning new material when compared to the teacher. The student who has just learned a new concept may be able to

help a student who is struggling by providing them with a unique insight because they just learned the concept themselves. This type of peer instruction not only can assist struggling students, but can also reinforce content for students who already have a good understand of what has been taught (W. A. Anderson & Noland, 2010; Caldwell, 2007; Kolikant, et al., 2010; Wolter, et al., 2011).

Lesson Pacing

The use of SRS for formative assessment can be used to pace instruction to maximize learning successfully. A teacher can introduce a simple topic in lecture format. The lecture should only last between 10-15 minutes. At that point, the teacher can give the class two to three response questions to determine if they have understood the new concept. If a large majority of students get the questions right, the teacher can then move on to more complex ideas. This process of lecture, and then clicker questions, can be repeated until the instructor sees that less than half of the students are answering questions correctly. At that point, the teacher has several choices to modify instruction. One suggested strategy is for the teacher to reteach the concept and possibly break down the problem by providing students with a visual representation of how it can be solved. Another strategy would be to pair the student who have answered correctly with the students having difficulty and ask them to work together to solve the problem. Once instructional modifications have been made, the teacher can give another series of SRS questions to the class. If large majorities of students now understand the concept, then the teacher can then move forward. For those students still having difficulty, the instructor should offer to provide extra help after class. Using the SRS in this fashion allows teachers to move only as fast as the class is able to learn the material.

Without SRS, teachers would typically have to wait until they give a test or quiz to get feedback from the entire class and identify students who are struggling. The clickers allow teachers to provide instructional interventions to students at the critical moment when they are first learning a new concept. If a teacher has to wait for the results of a test, it may be too late for that student to catch up with the rest of the class. In using SRS, students become self-aware of their progress and do not have to wait for a summative assessment to figure out how well they are doing in a class. If a student sees they are consistently getting clicker questions wrong, that student may then realize that they need extra help or possibly a tutor. This type of early intervention can help student avoid discouraging grades on large summative assessments.

Clicker Led Classroom Discussion

The SRS units can be used by instructors as a facilitator for classroom discussion. The teacher can present an analytical question at the heart of a controversial topic or subject matter to the class. The students will then use their clickers to answer the prompt anonymously. The teacher can then instantly display a visual representation of the students' answers (e.g., pie chart). This type of visual allows the individuals in the class to discover the variations in the group's ideas without revealing individual contributions. The teacher can then place students in small groups based on which answer they choose. These students can discuss and defend the choice that they made. These types of discussions can force students to challenge their own beliefs and think critically. Another approach can be to use clickers to introduce controversial personal topics in a health class (Fisher, 2006).

Clickers and Student Perception

Teachers should resist the urge to use SRS as a summative evaluation tool. Student perception of clicker usage has shown to very positive when they are used as tools of formative assessment and not for summative grading or attendance. However, when the SRS is used as a tool for grading students, the perception becomes increasingly negative (Morling, et al., 2008; Sevian & Robinson, 2011; Wolter, et al., 2011). The clickers should be seen by the students as a fun way they can interact with their teachers and classmates. When teachers begin to correlate the use of SRS to a grade, students may be more reluctant to answer questions and will enjoy using the technology less. The most effective formative assessment strategy for SRS is not to use them to test or track the performance of the students, but to provide the instructor with feedback to help the student learn better. The grade should not be the most important component of the process—the SRS focus should always be on student learning. If the instructor decides to grade students on how they answer SRS questions, the clickers are no longer the fun part of class, but the vehicle by which the student gets a grade. While many may be tempted to speed up the process by giving short quizzes using SRS, this should be avoided.

Conclusion

This handbook was created to provide teachers and school districts with an implementation guide regarding the use of student handheld response systems (SRS) as tools for formative assessment. It is my hope that this handbook will lead to more teachers implementing formative assessment in their classroom using SRS, or clickers. Without SRS, formative assessment is typically time consuming and difficult to implement. This technology is a tremendous breakthrough in education, and may revolutionize how teachers view assessment as a tool to improve learning.

Manual Evaluation Teacher Survey

On a scale of 1-5 with 5 being very helpful and 1 being no help please rate the usefulness of this manual for the following.

1) Your understanding of how to use student handheld response systems
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

2) Your understanding of how to use student handheld response systems as a tool for formative assessment.
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

3) Improving your comfort level with student response systems.
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

4) Your ability to create effective lessons using student response systems for formative assessment
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

5) Please provide any suggestions for future professional development you might need to use clickers in your classroom as a tool of formative assessment.

Student Satisfaction Survey

1) Which of these describes your experience in classes using student response systems (clickers)?
    a. I feel like I learned a lot more
    b. I feel like I learned more
    c. I don't feel like there was any difference
    d. I feel like I learned less
    e. I am not sure

2) Which of these statements best describes your opinion about the student response system?
    a. I really like using the clickers in class
    b. I like using the clickers
    c. I dislike using the clickers in class
    d. I strongly dislike using the clickers in class
    e. I have no opinion on using the clickers

3) Which of these statements best describes how you feel about the student response systems effect on your ability to focus in class?
    a. I felt much more focused when they were used
    b. I felt a little more focused when they were used
    c. I felt no difference in my level of focus when they were used.
    d. I felt less focused when they were used.
    e. I am not sure if they affected my ability to focus

4) Please provide any additional comments or feedback as to how the school could use the student response systems better.

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Appendix B

Participant	**Question 1** *Do your currently use student response systems?*	**Question 2** *Are you male or female?*	**Question 3** *How long have you been teaching using a student response system?*	**Question 4** *Describe your experiences regarding the use of student handheld response systems in your classroom?*
A	Yes	Female	4 years	They are good but a big pain when the computer doesn't work or when they are broken or when there isn't enough for the whole class
B	Yes	Female	2-1/2 years	Very positive. It helps me "read my students' minds" by letting me know if they understand a particular concept or can perform a particular skill. It also allows me to cover more material in less time.
C	Yes	Male	3 years	They are more effective at the beginning of the school year. As the year goes on they seem to care less about making the right response. They go for the laugh with the worst answer. As they learn who the smart kid at their table is, they wait for his/her answer before entering their own.
D	Yes	Male	3 years	This great technology. Helps move through curriculum much faster. It allows me to assess students as I teach instead of having to wait for a test. There is a lot of prep required to impute all the questions.
E	Yes	Female	4 years	This is great instructional technology. Makes it much easier for me to engage all students and gauge how well they are getting the material. I have had nothing but positive experiences.
F	Yes	Male	4 years	I use response system for two different purposes: when I present a new material and to check on student's homework. The response system accelerates the entire process and gives me an immediate understanding where I need to improve. I do not see any chance to teach successfully such advanced classes like AP Science without the response system. Also, the system increases the level of cooperative learning in my classes.

G	Yes	Male	3 years.	It has revolutionized how I present my lessons. I get instant results on the spot that let me know if the students are "getting it" or not.
H	Yes	Male	2 years	It is useful in certain circumstances, such as multiple choice review. I think that it slows down the class for some of the questions interspersed in the presentation. Makes covering large amounts of material easier.
I	Yes	Male	1 academic year	very good, it is useful because it alerts me when students are not getting the subject material and helps to clarify. Going over the questions helps me refine explanations of the material. In preparation it forces smaller chunks of information which has helped me create more intuitive lessons.
J	Yes	Female	2 years	A major benefit of student response systems is that they give all students the opportunity to participate rather than have a few strong or vocal students lead the class.
K	Yes	Female	Two years	A very good tool for measuring the content knowledge of students immediately after the lesson is delivered. This provided an environment where the students were actively engaged in thinking and solving the problem/question. It also provided a feed back to the teacher upon how well the lesson is delivered. It provided room for the teacher to improve and modify the content delivery in a different way when needed.
Participant	**Question 5** *Based on your experience what steps does a teacher need to take to utilize this technology effectively?*	**Question 6** *Before you were able to utilize student response systems describe how you implored formative assessment in*	**Question 7** *How if at all has the use of the student response systems changed how you utilize formative assessment?*	**Question 8** *What do you perceive to be the student reaction to using the response systems?*
A	It's very simple	In daily lessons, questions for class, group work, quizzes.	Hasn't changed much	It's fun.

B	A teacher should look at the unit plan and/or daily objectives and write 3-4 questions for a specific concept or skill, with increasing difficulty. The first question should be very easy, perhaps just a simple definition that was stated on a preceding slide. Then, have a few application questions, all approx. the same level of difficulty, then maybe a challenge one that could be optional, used only if time permits.	It's hard to even recall, but most likely by asking questions, which would be answered by individual students, rather than by the entire class which the SRS provides.	Using the SRS has completely revolutionized how I utilize formative assessment. Seeing the results during a lesson helps me know when it is safe to move on or when students are completely lost. Once in a while, I use 1-2 questions at the start of class to review the previous day's lesson. If time is running out, we will do the odds and save the evens for review the next day.	Generally, I feel that it is positive. A very small percentage of students I feel find it tedious, annoying, or burdensome. But it's like having a mini-quiz that's not being graded, so I think they don't feel intimidated about using the SRS. Those kids who need a little more time to process concepts probably hate it (because I usually show the list of who we're waiting for. . .)
C	Put a time limit on answering the question so the students don't have time to get the answer from someone else	ask a question-call on a student to answer.	Completely changed makes it so much faster and easier to implement.	At first students are intimidated, as they get used to it they enjoy it.

D	Working with other teachers helped. The district offered training workshops that helped me get acclimated.	It was very different and more difficult. I had students do problems at the board or in groups. I also gave quizzes. But nothing is as fast or gets every student involved like the clickers. It makes it much easier to identify struggling students and pace the class so you're not slowing down too much which could frustrate students who already understand the material.	It's much more efficient with the clickers. I use formative assessment much more often now than when the technology was not in my room.	The kids love them. They are competitive and seem to focus more when we use them. It also promotes a more social constructivist environment by identifying struggling students immediately and having them work with students who are doing well.

E	Teachers need to work together to develop the questions because it can be time consuming. The remotes should not be used for grading but for in class formative assessment to modify instruction. I only lecture for brief periods of time maybe 3-4 slides of material before giving the class some questions to answer. This allows the me to immediately gauge how the students are doing and modify my instruction. The questions get increasingly harder as we delve deeper into the concept. Without this technology I am not sure how I would do this.	Small quizzes, collaborative projects, asking students questions. The problem with all of these is they all take a lot of time and do not get 100% of the students to participate. The remotes give me immediate access to how well they understand.	Completely changed makes it so much faster and easier to implement.	Students love it. Makes class fun they are more engaged and pay more attention to lecture because they know the questions are coming. I think it also give them an idea where they stand compared to the rest of the class so they can come for extra help. Students can sometimes be reluctant to raise their hand and let me know they are not getting something this technology does it for them without having to be identified. I can then help them immediately. Before I would probably have to wait until they failed a quiz to know they were struggling.
F	First and the most important: prepare lesson materials in advance. Second: be consistent with using the response system, it doesn't work when we use it occasionally.	By asking random questions and doing some problems, quizzes, and tests	It becomes more dynamic and a teacher can see the entire picture of the students in the classroom.	All my students feel very comfortable working with the response system. It is almost like they use any technology at home. They are very open to discuss and correct each other during answering questions.

G	A teacher really needs to take the time to learn how to use the system by either going to workshops or seeing it being used in action. It is not hard to learn but you need to get comfortable with it, especially incorporating it into your lessons.	By using worksheets, group problem solving,etc. followed by question/answer sessions where students would have to explain their answers.	It has definitely streamlined the process so that I am now able to cover material in more depth in a shorter period of time.	My students love it. It has become automatic for them to pick up a responder as they enter the classroom. They enjoy talking about the questions with their classmates, which I actually encourage, before answering a question. It is amazing to see even quiet students explaining why the answer is "A", let's say, instead of "B". It gives the students a chance to "be the teacher" by explaining concepts to other students and this is one of the best methods of learning (by teaching others).
H	Mainly the preparation is in setting up the notebooks to work with the response system. Setting up rosters is fairly straightforward.	I asked individual students to respond to questions.	It allows all students to respond to each question and gives an overview of the class understanding of the concept.	Most students like the system.
I	Planning. Effective questions in the correct location are key to a presentation that utilizes a response system. Also, at the beginning of the year, using some class time to do a mock, fun lesson to familiarize students with the tech.	Orally asking questions and randomly selecting students, usually those that raise their hand.	I use formative assessment much more because it becomes quicker, easier and less "painful" for shy or unsure students. Therefor it makes the classroom environment more pleasant and opens the door for conversation about the current topic.	overall good, students stay more involved when we utilize the system. Lessons become interactive and students seem to be pay more attention. When any question is asked, throughout a 40min period, 100% of the class always answer.

J	A teacher needs to be able to create formative assessment questions geared to probe for common misconceptions and mistakes so that they can be corrected.	Before the student response system, I had to take more time to walk around the classroom to see how students were solving problems so only a few students could be viewed at a time.	The system allows me to poll all of the class at once for every question.	Students seem to like using them and are disappointed when we don't use them.
K	The teacher need time and space to perform the response assessment in every class/lesson. The teacher needs to be ready to reteach and discuss the content if necessary.	By giving random problems from the lesson or homework material at some point through the lesson. By asking questions or solving problems after 20 min in to the lesson if possible. By giving short quizzes or assessments on alternate days to assess.	Because of the use of response systems, the frequency of major quizzes or tests has been reduced. Less paper grading or homework grading.	They really like to use the response system. For them it is like calling out answer to show their smartness in the class and also to call up on their peers.

Participant	Question 9 *What impact has utilizing handheld response systems had on your ability to plan with your colleagues?*	Question 10 *This last section is for you to provide any additional information you would like to add regarding response systems that was not addressed in the questions provided.*
A	Not much. We planned well together before, it also is not the response system that helps wig the planning, its the note book files.	
B	I haven't really noticed much impact the SRS has had on my ability to plan with colleagues. In the years prior to using the SRS, we planned units together as we do now. It is beneficial that our HW for each unit is (not only consistent among all teachers but also) available in notebook format so that review of HW questions is easily accomplished. When Johnny asks to go over #19, then everyone benefits by seeing the question, the choices, and the teacher's explanation right in front of them, rather than simply on a piece of paper. Then, the entire class can	After a weekend, for example, I may ask students to randomly pick 5-6 numbers from the HW which we will review before starting the new lesson. It's a good way to warm up their brains.

	try to answer #20 using the SRS.	
C	It assures we are covering the same material.	
D	We all work together to formulate the questions. The use of this technology seems to help us pace our lessons better so one teacher does not fall behind. It would be hard to do this all by yourself.	I think every teacher should use this technology. I cannot think of any tool that allows teachers to utilize formative assessment in a better and more efficient way. I have been teaching for over 10 years and wish I had them all along.
E	We work together much more to create the slides. You need to work together because it is a lot of prep. Having common planning time and common assessments makes it easier.	This is the best instructional technology I have every used. It has completely changed my approach to teaching and formative assessment. I really think it makes learning more fun for kids and allows us to push them to higher levels.
F	We meet every week to talk and plan for the next chapter and every teacher uses the same set of assignment.	I truly believe that all teachers should use the response system not just only certain departments. It will increase student's performance to a really high level.
G	It has made the process much smoother as all teachers that teach the same subject use the same materials, utilize the same assessments, etc. It has made it easier to all be on the same page.	I wish I had them when I was a student.
H	I think that the overall planning is not really changed by the response system alone. The notebooks, however, had a very positive effect on planning.	I think that the hand held response systems are good in a limited application.
I	It is not the response system itself that helps with collaboration. The presentation software that must be utilized to use a response system helps teachers share ideas and use the same materials while conducting a class.	The best response questions are those that require a synthesis of pieces of information to solidify the relationship of topics. In other words, each question should get progressively more difficult because it is taking into account all of the topics that have been covered prior. Factual recall should be used to a minimum.
J	I think that with or without the response systems we would be able to plan effectively.	The most important benefit of the response system is that it allows me to use class time more efficiently by allowing all students to participate while moving quickly through the lesson.

K	Since there is a standardized /unified approach, at any time we could add or remove any assessment or question from the study material. The preparation time can be greatly reduced. Any change incorporated will be immediately available to all.	none at this point.

Appendix C

Email to the Superintendent

I am writing to seek permission to conduct research involving an online interview of teachers currently working at the Bergen County Technical High School. The purpose of this research project is determining the best practices for the utilization of student handheld response systems as a tool of formative assessment. This is a research project being conducted by Walden University for the purpose of obtaining my doctoral degree.

The teachers participating in this research study will be on a voluntary basis. They may choose not to participate and may withdraw at any time.

The data collection procedure involves completing an online interview that will take will be e-mailed to the participating teachers via their school email address. The teacher's responses will be confidential. No information such the teachers name, email address or IP address will be collected. The results of this study will be used for scholarly purposes only and may be shared with Walden University representatives.

If you have any questions about the research study, please contact me. Before actually conducting research and contacting faculty members this research proposal will be approved by Walden University and the International Review Board.

Below is a hyperlink to the survey for your review.

www.survey.com

Please let me know if you have any questions or concerns. I can be reached by email at jonche@bergen.org.

Sincerely,

Jon Chevalier

Appendix D

RESARCH CONSENT FORM

You are invited to take part in a research study of formative assessment using handheld response systems in the high school classroom. You were chosen for the study because of your experience using student handheld response systems. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.

This study is being conducted by a researcher named Jon Chevalier, who is a doctoral student at Walden University.

Background Information:
The purpose of this research project is determining the best practices for the utilization of student handheld response systems as a tool of formative assessment.

Procedures:
If you agree to be in this study, you will be asked to:

- Complete an online interview regarding your use of student handheld response systems for formative assessment.
- This interview will be 10 open ended questions.

Voluntary Nature of the Study:
Your participation in this study is voluntary. This means that everyone will respect your decision of whether or not you want to be in the study. No one at Bergen County Technical High School will treat you differently if you decide not to be in the study. If you decide to join the study now, you can still change your mind during the study. If you feel stressed during the study you may stop at any time. You may skip any questions that you feel are too personal.

Risks and Benefits of Being in the Study:
The benefit of participation in this study is you will be contributing to the current research available on utilizing student response systems for formative assessment. There are no apparent risks to your participation in this research.

Compensation:
You will not be compensated for your participation in this study.

Confidentiality:
Any information you provide will be kept anonymous. The researcher will not use your information for any purposes outside of this research project. Also, the researcher will not include your name or anything else that could identify you in any reports of the study.

Contacts and Questions:

You may ask any questions you have now. Or if you have questions later, you may contact the researcher via email at jonche@bergen.org or phone at If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 1-800-925-3368, extension 1210. Walden University's approval number for this study is **IRB will enter approval number here** and it expires on **IRB will enter expiration date.**

The researcher will give you a copy of this form to keep.

Statement of Consent:

I have read the above information and I feel I understand the study well enough to make a decision about my involvement. By hyperlink to interview I am agreeing to the terms described above.

Printed Name of Participant

Date of consent

Participant's Written or Electronic* Signature

Researcher's Written or Electronic* Signature *Jon Chevalier*

Electronic signatures are regulated by the Uniform Electronic Transactions Act. Legally, an "electronic signature" can be the person's typed name, their email address, or any other identifying marker. An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically.

Appendix E

Student Handheld Response System Interview Questions

Directions

This interview is completely anonymous. Please answer the questions to the best of your ability. You may stop at any time and are not required to answer all the questions.

1) Do your currently use student response systems?
   - **a.** Yes
   - **b.** No

   If you answer no to Question #1 the interview is now complete thank you for your participation.

2) What is your gender?
   - **a.** Male
   - **b.** Female
   - **c.** Choose not to disclose

3) How long have you been teaching using a student response system?

4) Describe your experiences regarding the use of student handheld response systems in your classroom?

5) Based on your experience what steps does a teacher need to take to utilize this technology effectively?

6) Before you were able to utilize student response systems describe how you implored formative assessment in your daily lessons.

7) How if at all has the use of the student response systems change how you utilize formative assessment?

8) What strategies have you used to conduct formative assessment using student response systems?

9) What impact has utilizing handheld response systems had on your ability to plan with your colleagues?

10) What do you perceive to be the student reaction to using the response systems?

This last section is for you to provide any additional information you would like to add that was not addressed in the questions provided.

Appendix F

Patricia Carroll, Ph.D

WORK HISTORY

1987-Present ***School Psychologist*** ***Bergen County Technical Schools***

Assessment

- Administer individual psychological and other appropriate assessment instruments to determine initial and continued eligibility for special education services
- Collaborate with members of a multi-disciplinary team regarding the assessment of student needs
- Interpret test results and recommend remedial procedures; in written reports and at parent meetings
- Develop and coordinate transition plans

Consultation

- Consult with students, parents, teachers, and administrators regarding academic, social and behavioral progress
- Assist teachers in preparing educational objectives for at-risk students and students identified with exceptional needs
- Prepare and implement behavioral intervention plans and individual education plans
- Collaborate with teachers, administrators, local school districts, parents, and outside agencies to provide services to students

Counseling

- Conduct individual, group, conflict resolution, and crisis counseling

1984-1987 ***Office Manager*** ***Apec Display***

Coordinated sales personnel; designed and maintained computer files; handled purchasing of supplies and materials

1982-1984 ***Operations Coordinator*** ***Medical Media Associates***

Organized quarterly seminar schedule for international continuing education firm; managed office staff; prepared brochures; arranged mailings; coordinated and chaired meetings on-site in six cities; performed various customer service responsibilities

1981-1982 ***Teacher*** ***Bogota Public Schools***

Provided supplemental instruction to grade school students; implemented IEP's, provided remedial instruction to elementary students; reinforced math and reading skills; taught study skills

1977-1981 ***Teacher*** ***Cliffside Park Public Schools***

Taught basic skills math and English to high school students; taught Spanish I and II to ninth through twelfth grade students; prepared and implemented IEP's for high school special education students; taught kindergarten; coached cheerleading

EDUCATION

2001	Ph.D.	Fordham University
1985	MA	Montclair State College
1977	BA	Glassboro State College

CERTIFICATES

New Jersey Permanent School Psychologist, Teacher of Elementary Education, Teacher of Spanish, and Teacher of Psychology

REFERENCES FURNISHED UPON REQUEST

Appendix E

Robert Goodman

EDUCATION

Post Masters Certificate: Advanced Educational Leadership 2007
The College of New Jersey

Ed.D. Science Education 2006
Rutgers University: Graduate School of Education
Dissertation: *A New High School Science Program and its Effect on Student Achievement in Mathematics and Science*

Project Lead the Way Engineering Certifications 2000
Rochester Institute of Technology

M.A.T. Physics 1997
The State University of New York at Stony Brook

B.S. Physics 1975
Massachusetts Institute of Technology
Thesis: *The Effect of Illumination on the Semiconductor Electrolyte Interface*

AWARDS

2006 New Jersey State Teacher of the Year 2000-Present
I CAN Learn – NEA Award for Teaching Excellence 2007
Kappa Delta Pi's *Delta Xi* Award for outstanding dissertation 2006
2005-06 Bergen County Teacher of the Year 2005 - 2006

EDUCATION EXPERIENCE

Director of the New Jersey Center for Teaching and Learning (on leave from the Bergen County Technical School District) 2009 - Present

Science and Engineering Teacher; Chair of Science and Engineering 1999 - Present Bergen County Technical High School at Teterboro

Director of Curriculum 2002 - 2003
The Englewood Public Schools (on leave from the Bergen County Technical School District)

Teacher of Physics and Mathematics 1991 - 1993
Friends Academy, Locust Valley, NY

BUSINESS EXPERIENCE

President of TS2, Inc. and International Operations 1995 - 1999
Launched and managed two new audio engineering companies

President of Onkyo International Operations
Managed more than 1000 employees, located in four countries, who conducted 500+ million (2009 dollars) in business in 75+ countries. 1993 - 1995

Inventor
Designed, and received royalties on, subwoofers adopted by JBL, Infinity, KEF, Celestion and others. 1990 - 1991

President of Harman Kardon and of JBL Consumer Products: 1985 - 1990
Executive Officer of Harman International (A Fortune 1000 Company)
Managed 100+ employees who conducted more than 250 million (2009 dollars) in business.
Harman Kardon was the largest US audio electronics company and JBL was the second largest loudspeaker company in the world.

Executive Vice President of Harman Kardon	1979 - 1985
National Sales Manager of Tannoy-Ortofon	1977 - 1979
Harman International New England Sales Representative	1975 – 1977

NEW JERSEY LICENSES

School Administrator	2007
Principal	2007
Supervisor	2002
Teacher of Mathematics	2000
Teacher of Physical Science	1999

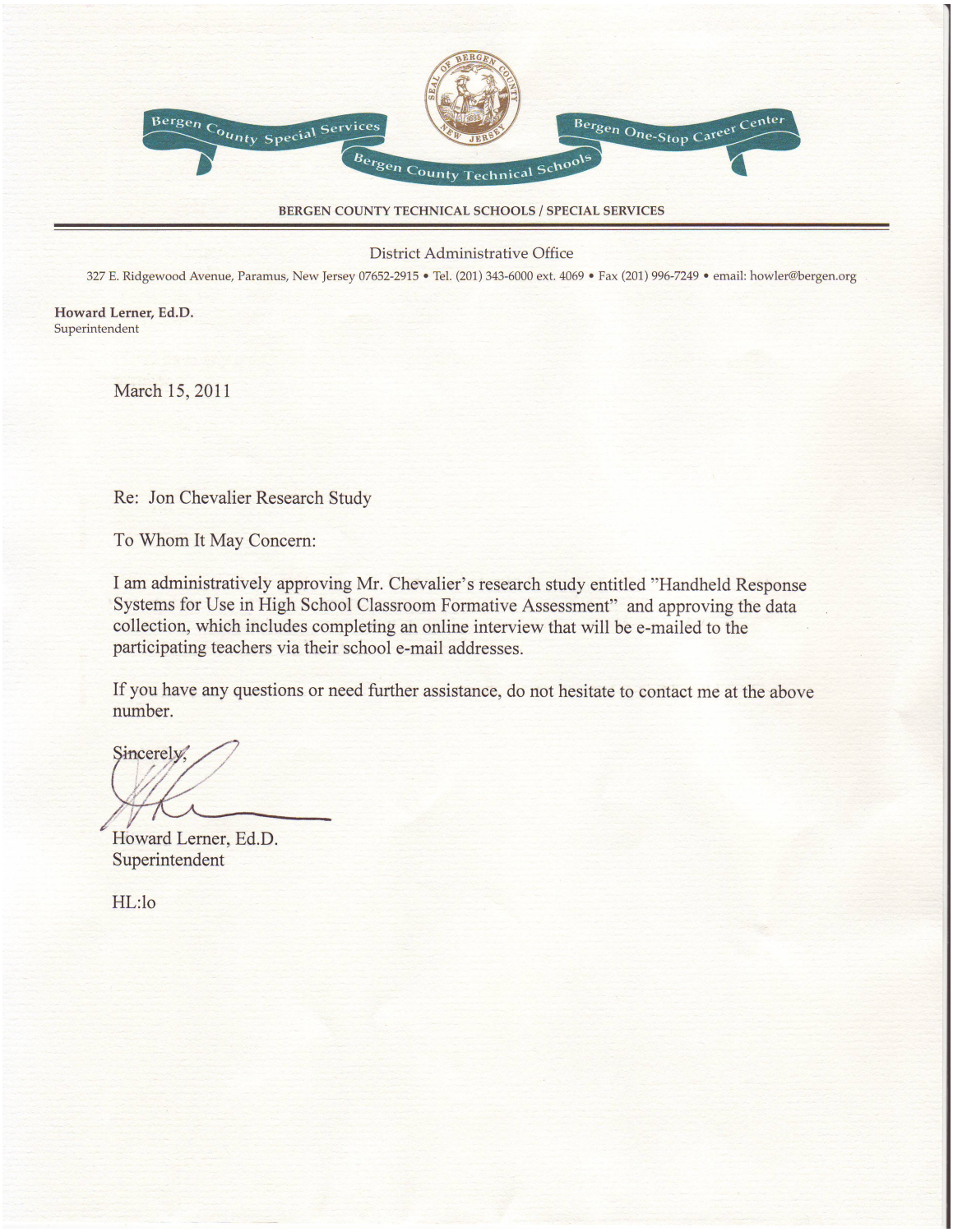
RELATED EXPERIENCE

2006 New Jersey State Teacher of the Year	2005 - Present
Consultant – Content Expert Reviewer in Science for Achieve, Inc.	2007 - Present
Field Reader for the United States Department of Education, Office of Postsecondary Education Grant Programs	2009 - Present
Member of Liberty Science Center's Educational Advisory Committee	2006 - Present
Vice-Chair of the Northern New Jersey MIT Educational Council	2002 - Present
Vice-Chair of the New Jersey Center for Teaching and Learning	2006 - 2009
Workshop presenter at the NYC Celebration of Teaching and Learning	2009 & 2010
Workshop presenter at the National AP Conference	2008 & 2009
Panelist at the i^3 Conference – Liberty Science Center	2008
Workshop presenter at the NJEA Convention	2008 & 2009
Workshop presenter at the Great Teachers for Urban Schools Conference	2008
Member of the NJ High School Redesign Advisory Committee	2007 - 2008
Subject of NJN Television Broadcasts: Classroom Close-up	2006 & 2008
Presenter at the NJ American Association of Physics Teachers	2007
Workshop presenter at the NJ School Boards Annual Meeting	2006
Moderator and Co-organizer of the NJ Educational Forum	2006 & 2007
Panelist at two ETS sponsored Educational Conferences	2006
Education Advisor to Governor Corzine's Transition Team	2005 – 2006

PUBLICATIONS

Squaring the Circle: A Mathematically Rigorous Physics First Published in *The Physics Teacher* in April, 2008	2008
Physics First + Mathematical Rigor = Improved Science Achievement Submitted to *School Science and Mathematics* in January, 2008	2008
Saving Science Published in the *NJEA Review* in October, 2006	2006
Photoelectrolysis of water: Si in Salt Water Published in the *Journal of Applied Physics* in June, 1976	1976

Appendix H



Bergen County Special Services
Bergen County Technical Schools
Bergen One-Stop Career Center

BERGEN COUNTY TECHNICAL SCHOOLS / SPECIAL SERVICES

District Administrative Office

327 E. Ridgewood Avenue, Paramus, New Jersey 07652-2915 • Tel. (201) 343-6000 ext. 4069 • Fax (201) 996-7249 • email: howler@bergen.org

Howard Lerner, Ed.D.
Superintendent

March 15, 2011

Re: Jon Chevalier Research Study

To Whom It May Concern:

I am administratively approving Mr. Chevalier's research study entitled "Handheld Response Systems for Use in High School Classroom Formative Assessment" and approving the data collection, which includes completing an online interview that will be e-mailed to the participating teachers via their school e-mail addresses.

If you have any questions or need further assistance, do not hesitate to contact me at the above number.

Sincerely,

Howard Lerner, Ed.D.
Superintendent

HL:lo

Appendix I

Jon Chevalier

BERGEN COUNTY TECHNICAL HIGH SCHOOL, Teterboro, NJ August 2006 - Present

Supervisor of Instruction

- Supervise academic and technical curriculum
- Supervise staff evaluation and professional development
- Supervise 9th and 10th grade student discipline
- Supervise scheduling and admission process

Highlighted Achievements

- Facilitated the development of the first every high school Culinology® program in the entire country. This program was featured on the NJEA television show Classroom Close-up.
- Supervised the creation of the Automotive Engineering and Design program. This program is a blend of our automotive and engineering programs with a heavy emphasis on green technologies.
- Established corporate partnerships with BMW of North America, Subaru Inc., Pepsi Inc. and several others companies to insure that all of our technical programs' curricula are up to the lasted industry standards.
- Facilitated articulations with Rutgers University, Kean University, NJIT and Fairleigh Dickinson University. These agreements allow our students to gain college credit while enrolled in high school.
- Assisted in the expansion of the Progressive Science initiative which started in Physics and now includes Chemistry and Biology. This program has brought state and national recognition to Teterboro.
- Worked extensively with our academic teachers to align our curriculum to Advanced Placement exams.
- In 2011 Bergen Tech, Teterboro was ranked 7th in state and 96th in the nation in Newsweek's "America's Best High Schools" rankings.

BERGEN COUNTY TECHNICAL HIGH SCHOOL, Teterboro, NJ September 1999 – June 2006

Social Studies Instructor

- Revised entire social studies curriculum.
- Served as a member of the Principal's Advisory Team
- Worked as a lead teacher on a federal grant to infuse local history into our curriculum.
- 2007 Bergen County Technical Schools Teacher of the Year

EDUCATION

Doctoral Candidate, Education Administration, Walden University, Minneapolis, MN 2007-Present (Dissertation scheduled for completion in August 2011)

M.S., Education Administration- The University of Scranton, Scranton PA 2006

B.S., History, Montclair State University, NJ 1999

ASSOCIATIONS & CERTIFICATIONS

New Jersey Principal's Certificate
New Jersey Supervisors Certificate
New Jersey Teacher of Social Studies Certificate
NJPSA Member