Title
The use of interactive learning technologies in elementary and middle school classrooms

Permalink
https://escholarship.org/uc/item/17w121cm

Author
Restrepo, Carmen L.

Publication Date
2011

Peer reviewed|Thesis/dissertation
UNIVERSITY OF CALIFORNIA, SAN DIEGO

The Use of Interactive Learning Technologies in Elementary and Middle School Classrooms

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Education

in

Teaching and Learning

by

Carmen L. Restrepo

Committee in charge:
James Levin, Chair
Edwin Hutchins
Christopher Halter
Elizabeth Simon

2011
The Dissertation of Carmen L. Restrepo is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

Chair

University of California, San Diego

2011
Dedication

This dissertation is dedicated to my son Jason, my family, and Rene’. Thank you for your endless support and patience. A special thanks to my niece and nephew who kept me grounded with play-dough, hide and seek, library books, and endless hours of fun and laughter.
# Table of Contents

Signature Page ........................................................................................................ iii
Dedication ............................................................................................................... iv
Table of Contents .................................................................................................. v
List of Figures ......................................................................................................... vii
List of Tables .......................................................................................................... viii
Acknowledgements .............................................................................................. ix
Vita ......................................................................................................................... x
Abstract of the Dissertation ................................................................................. xii

Chapter I: Introduction ............................................................................................ 1
  Definition of Terms ............................................................................................... 2

Chapter II: Literature Review .................................................................................. 4
  Audience Response Systems ............................................................................... 4
  Feedback and Technology .................................................................................. 10
  Engagement ......................................................................................................... 11
  Engagement and Academic Achievement ......................................................... 13
  Formative Assessment ......................................................................................... 14

Chapter III Research Methodology ......................................................................... 16
  Research Questions .............................................................................................. 16
  Methods ................................................................................................................ 16
  Conceptual Framework: Activity Theory ............................................................ 17
  Participants and Setting ....................................................................................... 20
  Sampling .............................................................................................................. 22
  Positionality ......................................................................................................... 24
  Measures ............................................................................................................. 25
  Data Collection .................................................................................................. 29
  Data Reduction ................................................................................................... 32
  Limitations and Implications .............................................................................. 33

Chapter IV: Findings ................................................................................................. 34
  Demographics of Survey Participants ................................................................. 34
  Demographics of Interview Participants ............................................................. 35
  Findings Related to Question 1 .......................................................................... 37
  Teacher Goals from Survey Data ....................................................................... 37
  Teacher Goals from Interview Data ................................................................... 39
  Findings Related to Question 2 .......................................................................... 40
  Survey Results – Classroom Uses ...................................................................... 41
  Observation Results – Classroom Uses ............................................................. 44
  Findings Related to Research Question 3 .......................................................... 50
List of Figures

Figure 1: A Teaching and Learning Activity Setting .......................................................... 19
Figure 2: Camera Positioning for Classroom Observation ........................................... 31
Figure 3: Subject Area Taught Using ARS ................................................................. 34
Figure 4: Amount of Time Teachers Use ARS from Survey Data ............................ 50
Figure 5: ARS in the Teaching and Learning Activity Setting – Teacher Focus .... 77
Figure 6: ARS in the Teaching and Learning Activity Setting – Student Focus ....... 78
List of Tables

Table 1: Research Questions and Data Collection Methods .................................. 29
Table 2: Teacher Participant Demographics .......................................................... 36
Table 3: Teacher Goals for Using ARS as Determined From Survey Data .............. 38
Table 4: Goals as Determined From Interview Data ............................................. 39
Table 5: Individual Teachers ARS Goals From the Interview Data ....................... 40
Table 6: Component Loadings From Survey Data for ARS Classroom Use .......... 43
Table 7: ARS Use in the Classroom by Teacher From the Observation Data .......... 45
Table 8: Correlations of Teacher Goals and Classroom Uses From the Survey Data . 51
Table 9: Perceived Effects of ARS on Student Engagement Based on Survey Data ... 53
Table 10: Correlations of Perceived Beliefs and Goals Categories From Survey Data 56
Table 11: Correlations of Perceived Effects on Student Engagement and Individual
         Goals........................................................................................................ 56
Table 12: Correlations of Perceived Effects on Student Engagement and Classroom
         Use From Survey Data .............................................................................. 59
Table 13: Active, Passive and Total Engagement Percents Across Grade Level and
         Subject Areas From the BOSS Rubric ....................................................... 61
Table 14: Connections – Goals, Classroom Uses, & Perceptions of ARS on
         Engagement ................................................................................................ 66
Acknowledgements

I want to thank my dissertation Chair James Levin for his constant support and patience. His relaxed demeanor and humor always kept me calmed in the most stressful moments. I want to thank Aliso Wishard Guerra who helped guided and assisted me in my statistical analysis. Her expertise, patience and guidance were invaluable.

I want to thank William R. Penuel who granted me permission to use his Student Response System Questionnaire in the current study on January 29, 2010.
Vita

Education

**San Diego State University**, San Diego CA
BA Liberal Arts & Sciences, Emphasis in Education, 1997

**San Diego State University**, San Diego CA
California Multiple Subject Teaching Credential, 1998

**San Diego State University**, San Diego CA
Master in Education, Emphasis in Educational Leadership, 2002

**San Diego State University**, San Diego, CA
Preliminary Administrative Credential, 2002

**University of California, San Diego**, La Jolla, CA
Doctor of Education, Teaching and Learning, 2011

Credentials

California Preliminary Administrative Credential, Tier I (2002)
San Diego State University

California Multiple-Subject Teaching Credential in English Education (1998)
San Diego State University

Multiple-Subject Supplemental Authorization in English (1998)
San Diego State University

Cross-Cultural Language, and Academic Development Certification (1998)
San Diego State University

**Teacher, Bostonia Elementary** 2008-Current
Supervise student teachers. Develop technology professional development seminars for teacher training in technology integration. Provide ongoing technology support for teachers and staff.

**Online Science Mentor, UC Santa Cruz** 2005-2008
In conjunction with the New Teachers Center at UC Santa Cruz and the National Science Foundation, I work online to support new science teachers in practices that promote excellence and diversity in science education.

**Teacher, Cajon Valley Middle School** 2003-2008

Lead teacher and mentor for technology and curriculum development. Developed professional development seminars. Cooperating teacher and mentor for SDSU Credential Program. District BTSA mentor.

**Teacher, Cuyamaca Elementary** 1998-2003

Cooperating teacher and mentor for SDSU Credential Program. Grade level team leader, School Site Council, PTA board member, and Technology Advisory Committee. Received Outstanding Teacher Award in technology.

**Administrative Assistant, Institute of Health Sciences** 1987-1992

Supervised employees, processed payroll, and loss prevention. Promoted new classes. Scheduled guest speakers. Recruited new student, and calculated financial aid eligibility. Resolved grievances and increased overall school revenue.
Abstract of the Dissertation

The Use of Interactive Learning Technologies in Elementary and Middle School Classrooms

by

Carmen L. Restrepo

Doctor of Education in Teaching and Learning

University of California, San Diego, 2011

James Levin, Chair

Audience Response Systems (ARS) increase interactions and active engagement by providing the means for students to electronically respond to questions presented to them during class. ARS immediately aggregates data and teachers and students have access to real time formative assessments of student knowledge. A large body of research exists for ARS in higher education, which supports ARS as tool for increasing interactivity, engagement, and participation in large university lecture
halls. A gap exists in research that explores ARS at the elementary and middle school levels.

This study examined how ARS is used in elementary and middle school classrooms and focused on teachers’ goals for using ARS, current classroom practices, and teachers’ perceptions of how ARS affects student engagement. Activity theory provided a framework for examining the teaching and learning environment within the classroom setting. A principal component analysis revealed that teachers used ARS for two specific goals, to enhance teaching and learning, and to enhance assessment. Three types of ARS classroom use were found for teachers in K-8 classrooms. The first type of classroom use included strategies that promoted discussion and student thinking. The second type of use utilized ARS feedback to modify and adjust instruction. The third type of use capitalized on ARS feedback to monitor student understanding without assigning grades. Teachers perceived that students were more actively involved and engaged in their learning while using ARS. Future research should look at classroom uses and pedagogical practices that promote the greatest growth in academic learning.
Chapter I: Introduction

Accountability for student achievement is a major focus for teachers and school districts. School districts continuously employ research-based strategies in order to improve school-wide academic achievement via instructional practices within the classroom. Many districts consider themselves data-driven, and extensive training and online databases assist teachers, principals, and district personnel in analyzing trends and targeting gaps in achievement (Wayman & Cho, 2008). Although teachers view systematic assessment as a means to evaluate, measure, and quantify learning, some teachers rarely see systematic assessment as a viable form to guide instruction (Knapp, Copland, & Swinnerton, 2007). Knapp et al. (2007) found that data collected by teachers to inform instruction is often informal, formative, and collected during the learning process. Teachers utilize informal formative assessment data to guide instruction rather than formalized summative measures. Tension emerges when the purpose between formative and summative assessments is unclear (Knapp et al., 2007) Teachers and schools rely heavily on formative assessment results to identify instructional need, but the same formative measures do not provide an adequate view of trends and performance over time. Earl and Fullan (2003) agree that a shift is needed for educators to use data as a means of instructional improvement and a blueprint for moving forward. Audience Response Systems (ARS) may create such a shift. ARS offer teachers a method for immediately assessing student learning during the instructional process, which assist teachers in creating immediate instructional modifications. ARS can serve as a data assessment tool and bridge the gap between
summative assessments and classroom instructional change. ARS can potentially change the dynamics of the teaching and learning environment. The immediacy of information and feedback derived from ARS provides teachers with precise information about student learning thus affording the ability to move students to next desired proficiency level. In order to advance and strengthen pedagogical practices with ARS in the elementary and middle school classrooms, research is needed to uncover current pedagogical uses of ARS in K-8 classrooms.

**Definition of Terms**

Audience Response System (ARS) is a generic term for a technology system that allows teachers to survey student responses to questions and display aggregated results. All ARS systems include hardware and software components. ARS hardware includes handheld remote control devices for student use and a range of receivers. Some response system models include a central base or USB receiver, while newer models can access results via a web browser. Software components include a database to aggregated and display results. ARS systems provide several methods for presenting and asking questions. Multiple-choice formats are the most common.

*Clicker* is a common generic term for ARS. Clickers are handheld remote control devices used to transmit student responses to a central base receiver.

*Classroom Performance Systems (CPS)* is a term used by eInstruction, an ARS company, to identify their specific response system model.
CPS for PowerPoint is a specialized PowerPoint program designed to allow polling responses within each slide of a PowerPoint presentation, specifically designed to work with eInstruction’s product line of ARS.
Chapter II: Literature Review

Audience Response Systems

The use of Audience Response Systems (ARS) for answering questions has been around for over 40 years. The first system in higher education appeared in a Stanford University lecture hall in 1966, followed by the introduction of a system at Cornell University in 1968 (Banks, 2006). Verbal reports from initial users of ARS at Stanford stated that the system either “never worked,” or “was a total pain to use” (Banks, 2006, p.3). Before 1999, cost created a major hindrance for widespread use of Audience Response Systems (Abrahamson, 2006; Beatty, 2005; Kay, 2009). Since then, response systems have improved in functionality and affordability. The latest versions of ARS have radio frequency receivers and greater reliability. Expanded use of ARS began in 2003 with colleges and universities employing the greatest amount of use and documented research (Caldwell, 2007; Kay & LeSage, 2009; Simpson & Oliver, 2007). Currently, few studies investigated the use of ARS in K-8 classrooms and a large gap exists between profiles of use in higher education and instructional practices used in K-8 classrooms (Conoley, Croom, Moore, & Flowers, 2007; Grissom, 2006; Kay & Knaack, 2009; Marks, 2000; Mun, Hew, & Cheung, 2009; Musselman, 2008; Nocente, 2009; Penuel, Boscardin, Masyn, & Crawford, 2007; Raphael, Pressley, & Mohan, 2008; Sartori, 2008; Shirley, 2009). Studies that focus on teaching practices with ARS will broaden the limited research of ARS classroom use within the K-8 teaching and learning environment.

Five literature reviews have been completed on the use of ARS in education
Caldwell’s literature review (2007) generates best practice tips in areas such as planning, attendance, communication with students, peer learning, grades, and system frustration issues. Caldwell (2007) provides an extensive list of characteristics for ARS questions, and synthesizes research on how to write effective ARS questions. Fies and Marshall (2006) focused on pedagogical theories, methods and constructs associated with ARS. One common pedagogical approach used in higher education is Peer Instruction (Crouch & Mazur, 2001). University professors commonly use Peer Instruction along with ARS to increase engagement and interaction in large lecture halls (Crouch & Mazur, 2001; Knight & Wood, 2005; Nicol & Boyle, 2003). To date, only one study (Chen, Liu, Yu, Chang, Lu, & Chan, 2005) looked at Peer Instruction and ARS in K-8 classrooms. Chen et al. (2005) found that ARS used in conjunction with an “active and experimental learning pedagogical model” significantly raised students achievement levels (p. 6).

Caldwell (2007) summarized the current state of the field, and discussed the benefits and motivational factors for using ARS. He also reviewed typical ARS questioning strategies and question writing tips and noted common features of questioning strategies used in higher education. Typical questioning strategies include questioning that guides student thinking, assesses student knowledge for formative or summative evaluations, and to make lectures more fun and interactive. Caldwell (2007) offered a list of best practice tips and covered topics in the area of planning, increasing attendance, communicating with students the rationale behind
implementing ARS, peer instruction, grading and time management of ARS implementation.

Fies and Marshall (2006) reviewed implementation studies and categorized studies in terms of condition of use and data collected. The majority of ARS studies examine individual conditions of use (Burnstein & Lederman, 2003; Fies, 2005; Hall, Collier, Thomas, & Hilgers, 2005; Nicol & Boyle, 2003; Reay, Li, & Bao, 2008), increased engagement and participation (Graham, Tripp, Seawright, & Joeckel, 2007; Moredich & Moore, 2007; Premkumar & Coupal, 2008; Raphael et al., 2008), and pedagogical concerns (Fies, 2005). Little is known about teachers’ goals for using ARS in elementary and middle school classrooms and how classroom use reflects teachers’ goals.

One comprehensive study surveyed 498 elementary and middle school educators on their goals, attitudes, and profiles of practice for ARS use in the classroom (Penuel, Boscardin, Masyn, & Crawford, 2007). Penuel et al. (2007) found two main goals for teacher’s use of ARS. The first goal was formative and focuses on “improving learning and instruction”. The second goal related to assessing learning and improving teaching efficiency” (p. 328). In the same study, Penuel et al. (2007) found five general teaching constructs among K-8 teachers. The five teaching constructs included evaluating students’ understanding, presenting diagnostic questions to elicit students’ current level of thinking, the use of data displays, promoting discussion of student answers, and using data results to modify instruction (p. 329). Penuel et al.’s (2007) survey study provided a launching ground for future
research studies that focus on teachers’ goals and classroom uses with ARS.

Surveys comprise the primary methods of data collections about profiles of use for ARS (Fies & Marshall, 2006). However, self-reported measures are subjective and less accurate than direct observation. Direct observation of teachers using ARS in the classroom can add to the research of ARS use at middle school and elementary levels. To date, research using direct observation to verify teachers’ goals for using ARS, classroom use, and student engagement, is virtually non-existent.

Judson and Sawada (2002) capture the history, findings and recommendations of electronic response systems from the 1960’s to 1970’s. Although the Judson and Sawada (2002) review is dated, several conclusions still apply today. First, positive effects occur when students communicate and assist each other with understanding the material (Crouch & Mazur, 2001; Judson & Sawada, 2002; Knight & Wood, 2005; Nicol & Boyle, 2003). Secondly, when considering technology implementation, pedagogical considerations come first, and technology second (Banks, 2006; Beatty & Gerace, 2009; Beatty, 2005; Bruff, 2009; Duncan, 2005; Penuel et al., 2007; Simpson & Oliver, 2007). ARS supports an instructor’s pedagogical practice and serves as a tool for improving student comprehension (Judson & Sawada, 2002). Future studies that focus on ARS classroom use across subject areas and grade levels would support best-practice pedagogical models now emerging in higher education research (Banks, 2006; Caldwell, 2007; Duncan, 2005; Simpson & Oliver, 2007).

Kay and LeSage (2009) found twenty-six different labels for ARS including audience response systems (Caldwell, 2007), classroom response systems (Siau,
Sheng, & Nah, 2006), electronic voting systems (Simpson & Oliver, 2007) personal response system (Brewer, 2004), clickers (Bergstrom, 2009) and zappers (d’Inverno, Davis, & White, 2003). The most commonly used terms include audience response systems, personal response systems, electronic voting systems, and student response systems. The wide range of labels creates difficulty in accessing the latest research.

Kay and LeSage (2009) reviewed the benefits and challenges of using ARS based on 67 peer-reviewed papers spanning over a seven-year period from 2000 – 2007. Benefits of ARS use include positive student attitudes toward ARS, increased student attention, higher interest and engagement levels during lectures, increased quality of class discussions, increased interaction, and assessment benefits (Kay & LeSage, 2007). Challenges include additional time needed to develop ARS questions, remote devices not functioning, covering less content when using ARS, and that less experienced teachers had difficulty adjusting to the constant student feedback (Kay & LeSage, 2007). Kay and Knaack (2009) explored the benefits and challenges of ARS in secondary science classrooms and found similar results to those in higher education in the areas of student attitudes, increased engagement, and positive assessments benefits when teachers used ARS formatively as a tool to check for student understanding, or to review material for upcoming tests.

Simpson and Oliver (2007) compared the research developments and new direction of ARS from 2002 to 2006. Simpson and Oliver (2007) identified six themes for comparing the development and change in practice for using ARS: context in which voting systems are used; reasons for use; pedagogical practice; student perceptions; impact on staff; organizational issues. Simpson and Oliver (2007) found
that a shift in focus had occurred in ARS use. Earlier ARS case studies focused on solving educational tasks while the more recent focus of ARS was on pedagogical methods and instructional practices (Bruff, 2009; Duncan, 2005; Nicol & Boyle, 2003; Simpson & Oliver, 2007). Although ARS research in higher education has shifted to best practices, it is still worth noting that ARS can simplify teachers’ tasks of assessing students for formative and summative measures (Duncan, 2006; Shirley 2009). Penuel et al. (2007) found that teachers often use ARS for formal assessment purposes in elementary and secondary classrooms. Research in K-8 classrooms that expand the knowledge of teachers’ goals for using ARS will enhance the current scope of research across a wider range of educational levels.

Much of the research on ARS has focused on student and teacher attitudes toward using ARS in large university classrooms. Additional areas of research concentrated on the areas of peer interaction (Duncan, 2005), applications and case studies (Banks, 2006), best practices (Caldwell, 2007), pedagogy (Simpson & Oliver, 2007), engagement and questioning strategies (Bruff, 2009). A comprehensive review of research on ARS in higher education revealed positive attitudes toward ARS among students (Judson & Sawada, 2002).

Minimal research about ARS exists at the elementary, middle and high school levels. At the K-8 level, a gap in research exists for teachers’ goals for using ARS, and the classroom practices that teachers use in conjunction with their goals. The literature at the K-8 level fails to provide adequate information about how ARS impacts engagement and student achievement. Studies that focus on ARS classroom
use and student engagement can expand the current knowledge about effects that ARS has on engagement in higher education.

**Feedback and Technology**

The use of ARS in higher education has not come without controversy. Most of the problems associated with ARS are the breakdown of technology, lack of system and teacher support, and the desire for extensive professional development for implementation. Students and teachers reported frustrations when the system would just not work. The advantage of using technological tools in the classroom is that the use enables immediate feedback. Immediate feedback provides students with a means for measuring progress toward their desired learning goals. Immediate feedback allows students to monitor their learning and serves as encouragement to reinforce guidance toward a correct response. ARS offers teachers a means for gathering immediate feedback about student learning and sharing the results with students during the instructional process. ARS allows students to respond to multiple choice, true/false, numeric responses, and yes/no questions using a remote control device. Instructors can immediately display a histogram to the whole class once students click in their responses, or they can choose to view the results privately.

In the classroom, feedback generally occurs at the end of the lesson or culminating activity as a form of formative or summative assessments. According to Shute (2008), feedback used in an educational setting is key to developing knowledge and improving skills. When feedback is immediately visible, then students and teachers can use the information to guide, revise, and modify both student thinking
and classroom instruction (Bransford, Brown, & Cocking, 1999). Black and Wiliam (1998) found that continuous opportunity to obtain feedback increases students’ learning, comprehension, and the transfer of knowledge. Feedback guides students from their present state of understanding and performance to the desired standards and instructional goals of the lesson (Nicol & Macfarlane-Dick, 2006). ARS serves as a feedback tool because it supports teachers in providing continuous and immediate feedback throughout a lesson. Bransford et al. (1999) argue that feedback must occur continuously as a part of instructional process in which students attain the opportunity to use the information to revise their thinking. Teachers can use ARS to provide students with immediate results of their progress toward the desired learning goal. The continuous opportunity of obtaining feedback increases students’ learning, comprehension, and the transfer of knowledge (Black & Wiliam, 1998; Bransford et al., 1999). The feedback loop that ARS provides is a powerful tool that helps teachers and students monitor learning progress by keeping them engaged in the learning process.

**Engagement**

Engaged time, often referred to as “time on task”, is the portion of time students spend directly involved in learning opportunities (Johns, Crowley, & Guetzloe, 2008). In a larger sense, student engagement is the time and energy a student spends on activities that increase learning (Exeter, Ameratunga, Ratima, Morton, Dickson, & Hsu, 2010). Engaged learners are more involved intellectually, behaviorally and emotionally in learning activities than learners who are not fully
engaged (Bangert-Drowns & Pyke, 2002). Walker, Severson, Todis, Block-Pedego, Williams, Haring, and Barckley (1990) define active engagement time (AET) as the time when a “student is appropriately engaged in working on assigned academic material that is geared to her or his ability and skill levels.” During active engagement (a) the student is focused on the material and on a specific learning task, (b) the student engages in appropriate motor responses such as writing, or looking up information (c) the student requests assistance in an acceptable manner (Johns et al., 2008; Walker et al., 1990). Walker et al. (1990) include students interacting with the teacher or peers as a form of active engagement. Effective teachers know the importance of time on task and they understand that increased student engagement offers opportunities for increased success (Johns et al., 2008).

Kay (2009) has found that students who use ARS in large university classrooms report being more interested and engaged in concepts presented in the lectures. Hodges (2009) describes several strategies for increasing engagement with ARS: Giving quizzes on reading assignments, taking attendance, testing conceptual understanding from a peer-learning format, taking opinion polls to show various viewpoints, and posing controversial topics for discussion. Many studies argue that when students actively participate in lessons they tend to be more engaged (Preszler, Dawe, Shuster, & Shuster, 2007; Simpson & Oliver, n.d.). In the university setting, increased engagement is a reported benefit of ARS (Caldwell, 2007; Draper & Brown, 2004; Preszler et al., 2007; Siau, Sheng, & Nah, 2006; Simpson & Oliver, 2007). Most of the engagement data has been generated from self-reported surveys. Little is known about actual engagement levels in K-8 classrooms with the use of ARS.
technologies. Research that focuses on measuring student engagement through formalized measuring instruments can augment the current research on self-reported engagement levels.

**Engagement and Academic Achievement**

Engagement is considered a reliable predictor of learning and personal development (Carini, Kuh, & Klein, 2006). Student engagement time is one critical behavior associated with academic achievement (Vile Junod, DuPaul, Jitendra, Volpe, & Cleary, 2006). Research supports that increased active engagement time among students increases a student’s opportunity to participate in academic activities which ultimately increases the rate in which students learn and acquire desired skills (Greenwood, Horton, & Utley, 2002; Vile Junod et al., 2006). Similarly, the more students practice a skill and receive corrective feedback, the more proficient they become (Carini et al., 2006; Kuh, 2003). Various studies have shown a positive correlation between engagement and achievement in the areas of standardized tests and grades for K-8 students (Connell, 1990; Connell, Spencer, & Aber, 1994; Marks, 2000; Skinner, Wellborn, & Connell, 1990). Gamoran and Nystrand (1992) confirmed that student engagement during classroom instruction increased achievement scores on exams designed to measure student understanding and synthesis. Carini et al. (2006) examined the extent in which student engagement was associated with experimental and traditional measures of academic performance. Carini et al. (2006) found statistically significant positive correlations between student engagement, Graduate Record Exam (GRE) scores, and grade point averages (GPA). The results from Carini
et al. (2006) support previous research findings linking engagement with positive learning outcomes such as critical thinking and grades. Results demonstrated that lower achieving students, determined by SAT scores, had greater benefits from student engagement than higher achieving students (Carini et al., 2006). ARS research supports the finding that increased engagement and more interactive learning environments enhance student understanding and improves student achievement (Duncan, 2005; Mazur & Hilborn, 1997; Ward, Reeves, & Heath, 2003). In order to advance ARS research in the areas of increased engagement and achievement, classroom observations with systematic measures of student engagement is needed at all educational levels.

**Formative Assessment**

Formative and summative assessments are two forms of assessment practices used in the classroom. Formative assessments, gathered during the instructional process, are used to determine students' understandings, misconceptions, and serve as a guide to modify instruction. Summative assessments generally count toward a student’s final grade and include tests and assignments. Black and Wiliam (1998) claim that feedback is central to formative assessment and that ARS provides teachers with the ability to provide immediate timely feedback to support learning. Teachers use formative assessments to guide and modify instruction with the aim of increasing student knowledge, ability and understanding within a content area. Rushton (2005) describes formative assessment as information given to students that provides them with vital information for closing the gap between their current performance levels
and the desired learning goals. Effective formative assessment includes gathering information about the learner’s progress during instruction, so appropriate corrective instruction and modifications can be made during the lesson (Guskey, 2003). ARS helps teachers and students to learn more interactively through ongoing formative assessments. Research confirms that teachers use ARS as a formative assessment tool to modify instruction during the lesson and to adjust future lessons based on current student performance (Beatty & Gerace, 2009; Moredich & Moore 2007; Penuel et al., 2007). Additional research is needed to uncover if classroom uses of ARS in elementary and middle school reflect similar uses in higher education.
Chapter III Research Methodology

This study investigated the use of Audience Response Systems (ARS) in elementary and middle school classrooms and was designed to uncover teachers' goals, classroom uses, and perceived effects ARS had on student engagement. The lens of Activity Theory provided a conceptual framework for analyzing the inter-relationships within the teaching and learning processes and offered a structure for analyzing the activity of teaching and learning as a systematic whole. The constructs of activity theory informed the research questions and methods used to examine the teaching and learning activity within the classroom.

Research Questions

1. What goals do teachers have for using Audience Response Systems in elementary and middle school classrooms?

2. How do teachers use Audience Response Systems?

3. How are ARS uses related to teachers' goals?

4. What do teachers perceive are the effects that ARS has on student engagement and how do such perceived effects relate to teachers’ goals and uses?

Methods

I conducted a mixed methods multiple case study to address my research questions. Using the lens of activity theory, I focused on teachers’ goals for using
ARS, the instructional methods they used to actualize their goals and the impact of ARS on student engagement. The unit of analysis was the teaching and learning activity. Activity theory offered a lens for gathering and analyzing data within the teaching and learning unit, while providing a framework for analyzing how tools were mediated between the participants in the teaching and learning environment (Engestrom, Miettinen & Punamäki-Gitai, 1999).

**Conceptual Framework: Activity Theory**

Research on classroom technologies and Audience Response Systems (ARS) often turns to socio-cultural theories for ideas about learning and development (Beatty & Gerace, 2009; Groves, Gear, Jones, Connolly, & Read, 2006; Penuel, Roschelle, & Abrahamson, 2005). The activity of teaching and learning is a unique interactive process. A socio-cultural lens can explain changes within the activity and offers researchers an approach for viewing the interactive process within teaching and learning (Banks, 2006). Students learn when given the opportunity to interact with meaningful classroom discourse and socio-cultural activities (Rogoff, 2003; Wink & Putney, 2002). ARS helps teachers and students to accomplish continuous interactive learning through ongoing feedback and formative assessment during the teaching and learning activity. ARS serves as a mediating tool between the teacher and the learner. ARS gathers information from data inputted by the student, and the teacher can share the information with the students to scaffold learning, and use the feedback to modify and change instruction.
Activity theory is a theoretical perspective that extends from Vygotsky’s (1978) social learning theory. Activity theory suggests that individuals interact with the environment and others through social activities. Activity theory, originating in the 1920’s and rooted back to German philosophers Kant and Hegel, provided a structure for the works of Vygotsky, Leont’ev, and Luria (Jonassen & Rohrer-Murphy, 1999; Nardi, 1996). Activity theory looks at an activity in terms of the subject, object, actions, and operations. The subject is the individual or group involved in the activity. The object, held by the subject, drives the activity toward the goal. Nardi (1996) considers the idea of object as the “object of the game” or an “object lesson” (p. 37). In activity theory, learning is directed by action within a social context and goals that are mediated through objects. The primary unit of analysis within the activity system model is the activity (Cole & Engeström, 1993). Activities are organized into activity systems and generally displayed as a triangle (Jonassen & Rohrer-Murphy, 1999). Activity theory offers a framework for analyzing the dynamic interactions within a classroom environment. Every dimension of the learning activity, the subjects, goals, tools, rules, and the division of labor, influence and guide the activity. A more detailed look at the interactions in the classroom is key to understanding the dynamics of how teachers, students, tools, and goals are all intertwined in the learning process.
Figure 1 illustrates an activity system model (Cole & Engeström, 1993). Within activity theory, the subject of the activity is the individual or the group. In this ARS research study, the subject of focus is both the teacher and the students. The object, or goal, is the instructional purpose for using ARS, which is actualized by the teacher’s use of instructional methods. The tools include the ARS devices, charts, histograms, and reports that the teacher generates using the ARS software. Community includes administration, teachers, students, and parents. School responsibilities for both the teacher and the students comprise the division of labor. In the current study, the rules consist of the grade level standards, benchmarks, and pacing guides. The unit of analysis is the teaching and learning process and a primary construct of activity theory.
is the outcome of the activity. The outcome for the teaching and learning environment is the individual teacher’s goals for using ARS in the classroom and how the uses relate to the teacher’s goals. As part of the analysis of the data presented below, it was necessary to view each teacher as separate unit actualizing individualized goals for using ARS in the classroom. Activity theory provided a strong framework for understanding how ARS influences the teaching and learning process.

**Participants and Setting**

The participants involved in the study were principals and teachers at four participating schools (two elementary schools and two middle schools) in a school district in southern California, which will be referred to as the East Valley School District (EVSD). Twenty teachers participated in an online survey and 14 participants completed interview and observation sections of the study. The 14 participants included one elementary and one middle school principal. The 12 teacher participants taught in grades three through eight.

All 12 teachers in the study participated in WestEd’s Teach for Success (T4S) program (WestEd, 2011). WestEd is a non-profit agency that develops research-based programs models and effective standardized assessments to inform instruction. WestEd’s work on student engagement is based on research from Jamentz (2002) and Marzano Marzano, and Pickering (2003). A district-wide goal for EVSD in 2010 included increasing student engagement time to a rate of 85% throughout the lesson. WestEd coaches assisted teachers in reaching the district’s goal. Every teacher in the EVSD received a two-day training on maximizing student engagement. WestEd
provided teachers with specific activities for increasing student engagement. Teachers learned to actively involve students in their lessons through the following activities: Note taking, completing advance graphic organizers, responding orally by discussing ideas with a partner, summarizing, sharing similarities and differences with a peer, or chorally responding as a whole group. Other activities suggested included demonstrating response through movement, drawing non-linguistic representations, or conversing with a peer (WestEd, 2011). Administrators and WestEd coaches assessed engagement by conducting a quick check of actively engaged students versus non-engaged students to determine an overall percent of student engagement. In a typical upper grade (grades 4 through 8) classroom of 34 students, 29 students must be actively engaged to meet the district’s 85% goal. Administrators check engagement percentages three times during a 15-minute walk-through observation. The district’s goal of 85% engagement is important to know for this study because teachers may believe that ARS might satisfy the 85% engagement goal because all students are engaged while they key in responses to ARS questions. In reality, ARS questions are not used throughout the entire lesson; therefore, it is important to verify how often students are engaged during a lesson while they are actively involved in ARS questioning and while students are not involved in ARS questioning.

Teachers who used ARS within the EVSD ranged in teaching experience from 2 through 30 years of service. Third grade teacher participants had 24 students and upper grade teachers (grades four through eight) all had the maximum of 34 students. Twenty teachers participated in the online survey portion of the study. Fourteen participants, 12 teachers and 2 administrators, contributed in the interview and
observation segments. The 12 teachers were a subset of the original 20 survey participants. The principals did not take the online survey. Of the 12 teachers, five of them were from elementary schools and the remaining seven from middle school. The five elementary teachers included two third grade teachers, a fourth grade teacher, and two fifth grade teachers. The remaining seven middle school teachers included three sixth grade teachers, two seventh grade teachers, and two eighth grade teachers. Teachers at the elementary level used ARS for Math, Science, and Language Arts and teachers at the middle school used ARS for Math, Language Arts, and History.

**Sampling**

Four schools participated in the study, two elementary schools and two middle schools. The four selected schools participated in the study because the district identified them as schools using ARS in the classroom. I contacted the lead technology person at each of the four schools and requested a list of all teachers using ARS in the classroom. Once teachers’ names were gathered, I recruited volunteer participants via mass email. I received three participants over the next week. I followed up with personal emails asking each teacher individually to participate in the study and with an offer to answer any preliminary questions they had regarding the study. When teachers volunteered to participate in the study, I asked them via email to recommend another teacher as a potential study candidate. If the recommended teacher was not on my list of volunteers, I sent out an email to that teacher and stated that a colleague had recommended them for the study. By the second week, I acquired seven teacher participants, five elementary participants, and two middle school
participants. During the third week of recruitment, I then focused my efforts on contacting principals and secured two principals to participate in the study. I recruited an elementary principal by meeting the principal in person and a second principal at the middle school level by contacting her via email. At the end of the third week, I had nine of my 14 participants. I decided to visit the school sites directly and present my study. I made an appointment with a principal at one of the participating middle school sites and presented my study to him. The principal agreed to allow me to present my study at the site’s upcoming staff meeting. I presented my research study to the staff and answered their questions about videorecording, study requirements, permission forms, and confidentiality. I had sample video clips of what teachers and students could expect if they participated in the study. I had several class sets of permission forms for teachers who volunteered to participate. I secured the remaining five participants during the staff meeting.

All teachers who volunteered for the study were included in the study. The grade levels and ratio of elementary and middle teachers were representative of all teachers using clickers within the district. Once the participants were recruited, I arranged to meet each teacher and set up a time to introduce myself to his/her students, answer questions, and distribute assent and permission forms. I created an online schedule for classroom observations and teacher interviews. Teacher participants provided a list of acceptable dates and observation times, which I used to create an online schedule for them to reference. I provided teachers with a participant ID number in order to identify them on the schedule. If teachers needed to change their
time slot, they could reference the online schedule and select an open time slot. Data collection continued over a four-week period.

**Positionality**

I have been using ARS in my classroom for the past four years. I acquired my initial ARS system four years ago when asked to pilot the system by a principal at one of the participating middle schools. I spent two years at the middle school level learning how to use ARS with a variety of instructional methods. I received extensive staff development over the two-year period. When I transferred to a fifth grade elementary classroom, the principal, who heard of my expertise, bought a set of ARS and I became the official trainer for the school. I began with fifth grade and trained approximately 14 teachers in grades two through five. The following year the principal bought a second ARS system for the school. Currently, six teachers in fourth and fifth grade share two sets of ARS systems. I am aware that my advocacy for the use of ARS and my expertise in pedagogical methods might have hindered teachers’ willingness to participate in the study because many teachers are novice users and they might have felt threatened by my expertise. Teachers were aware that I had far greater knowledge in pedagogical implementation strategies with ARS than the majority of the study participants. I continuously assured participants that my interest in their classroom use was purely investigational. I affirmed that the results from the study would support the lack of research in K-8 classrooms and were are not for evaluative measures. The rapport I developed with teachers at the participating sites might also have enable greater in-depth and frank responses during the interview phase. In
addition, as an insider, I am aware of both the teacher’s involvement in WestEd’s Teach for Success T4S program and the district’s goal of 85% engagement, which could offer some insight into the type of goals and pedagogical methods used by the teacher participants. My positionality allowed me the privilege of asking specific questions about the district’s 85% engagement goal and how teachers might view ARS as a tool to reaching their engagement goals.

Measures

Surveys, rubrics, direct observations, and interviews generated a variety of data that could be used to answer my research questions. Garet, Porter, Desimone, Birman, & Yoon (2001) found that when surveys are used to measure frequency of use and instructional strategies, the data is generally biased low while teacher self-reported data is biased high. For this reason, I used both survey data and self-reported interview data to support the findings. The survey used in this study was a slight modification of the original survey used by Penuel et al. (2007) in the study Teaching with Student Response Systems in Elementary and Secondary Education Settings: A Survey Study. The survey provided a means for measuring teacher’s goals for using ARS, and uncovered profiles of use among elementary and middle school teachers. Penuel et al. (2007) surveyed 498 elementary and middle school teachers on their use of ARS. William R. Penuel granted me permission to use his Student Response System Questionnaire in the current study on January 29, 2010. The Student Response System Questionnaire aligned with existing research, which was a primary factor in establishing content reliability of the survey (Penuel et al., 2007). Penuel et al. (2007)
piloted the survey from two teachers in order to establish that the responses given aligned with the questions’ intent. Before receiving Penuel’s permission to use the Student Response System Questionnaire, I created a survey intended to measure teachers’ goals and profiles of use for ARS. Once I received permission to use the Student Response System Questionnaire, I compared my survey questions with Penuel’s and found that all my questions with the exception of two appeared as similar questions within Penuel’s survey. To assure reliability in the survey, I used the Student Response System Questionnaire and added my two questions, one of which allows an open-ended response about goals, at the end of the survey. The Student Response System Questionnaire is found in Appendix D.

A second measure included classroom observations of teachers using ARS. During the observation, I developed and utilized a rubric to tally instructional practices used throughout the lesson. The rubric, titled the Profiles of Use Rubric (found in Appendix C), included all the instructional practices listed on the Questionnaire Survey and a section to record additional practices used by the teacher. Video captured the instructional methods used in conjunction with ARS during the lesson. Self-reported teacher survey data, coupled with observational data verified the range of instructional practices teachers used with ARS. I revisited the rubric to verify accuracy of my observation after each the lesson. I compared the observational rubrics to video recordings to assure accuracy of tallied practices. In addition to recording instructional practices, a second rubric, the Behavioral Observation of Students in Schools (BOSS), measured student engagement.
The BOSS rubric, developed by Shapiro (2004), systematically examines and defines academic engagement in a classroom setting. Shapiro’s (2004) terms Active Engagement Time (AET) and Passive Engagement Time (PET) differs slightly from other research on academic engagement (Greenwood et al., 2002; Vile Junod et al., 2006). Shapiro (2004) narrowed academic engagement and split engagement into two distinct types, namely, AET and PET. He included items such as silent reading of learning material as passive engagement while previous research considered silent reading as an active engagement activity (Greenwood & Terry, 1994; Vile Junod et al., 2006). The BOSS is a quantitative method for measuring student engagement commonly used among school psychologists for observing a variety of behaviors in the classroom (Nock & Kurtz, 2005). The rubric included two categories of engagement, and three categories of non-engagement all of which focused on a target student, a peer, and teacher-directed instruction. Shapiro (2004) defines AET when the student is actively participating in the assigned task and includes activities such as writing, reading aloud, raising a hand, and talking to the teacher or a peer about the task. PET consists of times when students are passively focused on assigned work such as listening to a lecture, looking at an academic worksheet, reading silently, and listening to a peer responding to a question. Non-engaged student behavior included three categories, Off-Task Motor (OFT-M), Off-Task Verbal (OFT-V), and Off-Task Passive (OFT-P). OFT-M behaviors are instances of motor activity that are not aligned with the assigned academic task and include out-of-seat behavior, aimlessly flipping pages in a book, twirling a pencil, or throwing paper. OFT-V behaviors included audible utterances that are not associated with the academic task such as
whistling, or making unauthorized comment or remarks. OFT-P behaviors are when a student is passively not involved in the academic task for a period of three consecutive minutes and includes looking around the room, starring out the window, or listening to peers talk about unrelated topics (Shapiro, 2004).

The final data collection tool included an interview with each teacher. The interview’s focus was to elicit a second measure for identifying the teacher’s goals for using ARS in the classroom and to establish typicality of ARS use. The interview involved asking the teacher to comment on typical teaching methods she/he employs while using ARS. Interviews also attempted to elicit comments about teachers’ goals for using ARS. The interview was a semi-structured interview beginning with some basic background information questions about the number of teaching years, years using ARS, and a few open ended questions such as:

1. In what ways do you feel that a lesson using clickers differs from a lesson without clickers?
2. If you could no longer use clickers, how and in what ways would your teaching be affected?
3. If an individual, without previous knowledge of clickers, watched a lesson using clickers, what type of things might stand out to the observer?
4. Teachers who have clickers do not always use them for every lesson. How do you decide when to use clickers for a lesson and when not to use them? (see Appendix B).
Data Collection

The study focused on gaining insight into teachers' goals for using ARS, to uncover the range of practices, to understand how practices related to teachers' goals, and to determine the impact of ARS on student engagement. Table 1 connects each research question to the corresponding data collection method.

Table 1: Research Questions and Data Collection Methods

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Data Collection Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. How do teachers use ARS?</td>
<td></td>
</tr>
<tr>
<td>3. How are ARS uses related to teachers' goals?</td>
<td></td>
</tr>
<tr>
<td>4. What do teachers perceive are the effects that ARS has on student engagement and how do such perceived effects relate to teachers’ goals and uses?</td>
<td></td>
</tr>
</tbody>
</table>

In order to answer each research question, my data collection methods occurred in three phases. The first phase included surveying teachers on their goals for using ARS and the instructional methods they used in the classroom. Teachers
completed phase one by participating in an online questionnaire, which took approximately 15 minutes to complete. The questionnaire focused on teacher demographics, ARS training, teachers’ goals, profiles of use, and perceived effects of ARS on the teaching and learning process. The questionnaire can be found in Appendix D.

Phase two involved observing and videorecording teachers using ARS in a single classroom lesson. Lesson times vary according to subject area and grade level, but the average range for a lesson at the elementary level ran 30-60 minutes, and 50-55 minutes at the middle school level. A pilot observation revealed the need to have two video cameras and two microphone systems capturing the lesson. Figure 2 illustrates how the cameras were positioned during the formal classroom observations. Camera #1 and audio microphone #1 focused on the overhead screen and captured the ARS questions, feedback reports or histograms, and the teacher’s voice during the lesson. Camera #2 and audio microphone #2 faced the students and had the same the point of view as the observer. Microphone #2 captured student responses during the lesson.
My goal for the observations was two-fold. First, I used the profiles of use rubric to identify the range of instructional practices used throughout the lesson. Second, I used the BOSS rubric to gather data on student academic engagement at times when students were participating in lesson using ARS.

Phase three of the data collection included an interview with the teacher. The audio-recorded interview lasted 60 minutes or less. Teacher and principal interviews took place before or after school at a time that was convenient for them. Interviews for middle school teachers took place during their prep time, or before school. Each interview took place in the teacher’s classroom or in the principal’s office.
**Data Reduction**

Data analysis included data from surveys, classroom observations, and interviews. I collected online survey results, entered the results into an electronic spreadsheet (Excel), and imported the data into the statistical program SPSS. I quantitatively analyzed the survey results for goals and profiles of use using descriptive statistics, frequency counts, and a principal component analysis. A principal component analysis for teachers' goals and teachers' uses revealed common components among participants. I compared the self-reported instructional goals from the survey with the stated instructional goals from the interviews for common trends and similarities.

Classroom observations included two separate rubrics, the profiles of use rubric to tally instructional practices and the BOSS rubric to measure student engagement. I entered the results from the profiles of use rubric into SPSS and compared those results to the means from the survey results. The BOSS rubric provided a way for calculating percentages of engagement time for the target student, a comparable peer, and the teacher’s amount of time spent in direct instruction. Engagement times and profiles of use were compared to determine if there are distinct instructional practices that yield higher engagement percentages than other practices.

Interviews were recorded and transcribed in InqScribe. InqScribe is a transcription software program that supports digital video or audio analysis (InqScribe, 2011). Interview transcripts were entered into a qualitative data analysis program (HyperResearch) and coded for goals expressed by the teacher. HyperResearch is a
computer program that allows researchers to code text, graphics, video and audio files for qualitative data analysis or research (Hesse-Biber, Dupuis, & Kinder, 1991). Stated goals from the interview were compared to the self-reported data from the survey. This mixed method design allowed me to determine if the frequencies of self-reported survey data supported stated and observational data from teachers and classroom lesson. The mixed method design allowed for a systematic measure of tracking student engagement with ASR across grade levels, subject areas, and a variety of instructional practices.

**Limitations and Implications**

The sample size of the study was one limitation. A second limitation was having only one classroom observation per teacher participant. In order to minimize limitations, and obtain a realistic overview of teachers’ goals and practices, I used the interviews to establish typicality, and gain insight into the broader view of how teachers use ARS within the classroom. The implications of this study shed light into the reasons teachers at the elementary and middle school levels utilize ARS during instruction. The findings offer a preliminary foundation to establish futures studies in teaching practices using ARS and add to the limited amount of ARS research at the elementary and middle school level. The research findings offer insight into the gaps between the current knowledge and pedagogical practices with ARS and the current usage of ARS in the K-8 classrooms.
Demographics of Survey Participants

Demographic information of the 20 survey participants showed teachers using Audience Response Systems ARS in grades three through eight. Figure 2 illustrates the percentage of subject area taught by these 20 participants using ARS. Math and Language Arts are highly tested subject areas on the California Basic Skills Test (CST), and more than half of the teacher participants (64%) used ARS in Language Arts and Math. The remaining 36% of teachers used ARS for Social Studies/History and Science.

![Figure 3: Subject Area Taught Using ARS.](image)

Teachers’ current experience using ARS ranged from 6 months to 3 years. Over half of the teachers (55%) had been using ARS for two years or more. Twenty
percent of the participants had been using ARS for at least a year, but not more than two years, and 25% considered themselves novices using ARS for less than one year.

Approximately 50% of the teachers received 1-4 hours of training. The remaining teachers did not receive any formal training, but stated that they were shown a quick demo by an IT staff member, or a partner teacher. How teachers acquired their systems varied. The majority of teachers were required to use ARS by their principal. Only two teachers stated they used ARS voluntary, and did not feel any expectations of use. Over half of teachers surveyed stated that the principal acquired ARS through grant monies and that all teachers were required to use them. The remaining participants said they were offered the opportunity to use the system and they opted in voluntarily.

**Demographics of Interview Participants**

There were 14 interview participants, 12 teachers and 2 administrators. Five of the teachers were elementary school teachers and seven were from middle school. The administrators included one elementary principal and one middle school principal. Table 2 provides a profile of each teacher participant.
Table 2: Teacher Participant Demographics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Grade</th>
<th>Subject</th>
<th>Years Teaching</th>
<th>Years Using ARS</th>
<th>Daily Use</th>
<th>Required Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alan</td>
<td>3</td>
<td>Language Arts</td>
<td>21</td>
<td>2 years</td>
<td>1-2 days/wk</td>
<td>No</td>
</tr>
<tr>
<td>Kazinski</td>
<td>3</td>
<td>Language Arts</td>
<td>10</td>
<td>Less than 1 year</td>
<td>Monthly</td>
<td>Yes</td>
</tr>
<tr>
<td>Balmann</td>
<td>4</td>
<td>Math</td>
<td>30</td>
<td>2 years</td>
<td>1-2 days/wk</td>
<td>No</td>
</tr>
<tr>
<td>Little</td>
<td>5</td>
<td>Math</td>
<td>8</td>
<td>Less than 1 year</td>
<td>4-5 days/wk</td>
<td>Yes</td>
</tr>
<tr>
<td>Plume</td>
<td>5</td>
<td>Math</td>
<td>13</td>
<td>Less than 1 year</td>
<td>3 days/wk</td>
<td>Yes</td>
</tr>
<tr>
<td>Donald</td>
<td>6</td>
<td>History</td>
<td>15</td>
<td>1 year</td>
<td>Monthly</td>
<td>Yes</td>
</tr>
<tr>
<td>Irvine</td>
<td>6</td>
<td>Language Arts</td>
<td>22</td>
<td>2 years</td>
<td>1-2 days/wk</td>
<td>Yes</td>
</tr>
<tr>
<td>Kendall</td>
<td>6</td>
<td>Math</td>
<td>12</td>
<td>2 years</td>
<td>Daily</td>
<td>Yes</td>
</tr>
<tr>
<td>Roberts</td>
<td>7</td>
<td>History</td>
<td>3</td>
<td>3 years</td>
<td>Daily</td>
<td>Yes</td>
</tr>
<tr>
<td>Clark</td>
<td>8</td>
<td>Math</td>
<td>26</td>
<td>3 years</td>
<td>3-5 days/wk</td>
<td>Yes</td>
</tr>
<tr>
<td>Dunlop</td>
<td>8</td>
<td>History</td>
<td>2</td>
<td>1 year</td>
<td>1 day/wk</td>
<td>Yes</td>
</tr>
<tr>
<td>Staar</td>
<td>8</td>
<td>History</td>
<td>4</td>
<td>3 years</td>
<td>1-2 days/wk</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Demographic information from teacher participants showed that selected teachers were representative of the population using ARS within the East Valley School District (EVUSD). At the time of the study, based on the information of teachers using ARS provided by school’s principal, IT contact person, or lead technology teachers, only four schools in the district were using ARS in the classroom.
Findings Related to Question 1

Research Question 1: What goals do teachers have for using ARS in elementary and middle school classrooms?

Teacher Goals from Survey Data

A principal component analysis of the survey data revealed teachers as having two distinct goals for using ARS in elementary and middle school classrooms. One group of teachers used ARS to improve and enhance assessment. A second group of teachers used ARS to improve and enhance learning. A teacher who used ARS to enhance assessment had a high importance rating for statements such as increase your own productivity, assess student learning for grades, save time needed for formal or informal assessment, and to promote effective student learning. A teacher who used ARS to enhance learning had a high importance rating for statements such as increase the effectiveness of overall instruction, make students more aware of their conceptual understanding, and to enhance feedback to students about their learning.

Table 3 shows the principal component analysis of the survey results for goals for using ARS in the classroom.
Table 3: Teacher Goals for Using ARS as Determined From Survey Data

<table>
<thead>
<tr>
<th>Goal</th>
<th>M</th>
<th>SD</th>
<th>Component Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Enhance and Improve Assessment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase your own productivity</td>
<td>6.15</td>
<td>1.18</td>
<td>.94</td>
</tr>
<tr>
<td>Assess student learning for grades</td>
<td>5.60</td>
<td>1.79</td>
<td>.89</td>
</tr>
<tr>
<td>Save time needed for formal or informal assessment</td>
<td>5.75</td>
<td>1.59</td>
<td>.87</td>
</tr>
<tr>
<td>Promote effective student learning</td>
<td>6.30</td>
<td>.92</td>
<td>.77</td>
</tr>
<tr>
<td>Get instant feedback from students</td>
<td>6.75</td>
<td>.55</td>
<td>.28</td>
</tr>
<tr>
<td><strong>Enhance and Improve Teaching and Learning</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase the effectiveness of instruction overall</td>
<td>6.35</td>
<td>.81</td>
<td>.21</td>
</tr>
<tr>
<td>Make students aware of their conceptual understanding</td>
<td>6.25</td>
<td>.85</td>
<td>.21</td>
</tr>
<tr>
<td>Enhance feedback to students about their understanding</td>
<td>6.25</td>
<td>.97</td>
<td>.40</td>
</tr>
<tr>
<td>Increase student attention and activity during lectures</td>
<td>6.05</td>
<td>1.50</td>
<td>-.34</td>
</tr>
<tr>
<td>Gain an understanding of what students do and do not understand</td>
<td>6.80</td>
<td>.41</td>
<td>.55</td>
</tr>
<tr>
<td>Differentiate or individualize instruction</td>
<td>5.20</td>
<td>1.40</td>
<td>.32</td>
</tr>
<tr>
<td>Stimulate class discussion</td>
<td>5.65</td>
<td>1.23</td>
<td>.36</td>
</tr>
</tbody>
</table>
Mean scores indicate an importance rating on a seven point Likert scale where a score of one means not important and a score of seven means very important.

**Teacher Goals from Interview Data**

Interview transcriptions were coded for teacher goals. Interview data includes 12 teachers and 2 administrators. Table 4 displays the frequency counts for stated goals across all 14 participants. Table 4 also shows the total percentage of participants who discussed each goal and aligns teachers' stated goals into both goal categories, enhancing assessment and goals for enhancing learning.

### Table 4: Goals as Determined From Interview Data

<table>
<thead>
<tr>
<th>Goals</th>
<th>Frequency</th>
<th>M</th>
<th>SD</th>
<th>Percent of participants stating goal</th>
<th>Enhance Assessment</th>
<th>Enhance Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>52</td>
<td>3.71</td>
<td>1.90</td>
<td>100</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Immediate Feedback</td>
<td>52</td>
<td>3.71</td>
<td>2.87</td>
<td>100</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Check for Understanding</td>
<td>39</td>
<td>2.79</td>
<td>2.8</td>
<td>100</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Increase Effectiveness of Instruction</td>
<td>37</td>
<td>2.64</td>
<td>1.82</td>
<td>79</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Accountability for participation</td>
<td>28</td>
<td>2</td>
<td>1.96</td>
<td>86</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Data use to adjust instruction</td>
<td>26</td>
<td>1.86</td>
<td>1.23</td>
<td>100</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Peer Discussion</td>
<td>13</td>
<td>.93</td>
<td>1.27</td>
<td>43</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Ease of Assessments for Grading</td>
<td>11</td>
<td>.79</td>
<td>1.12</td>
<td>43</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Attendance</td>
<td>1</td>
<td>.07</td>
<td>.27</td>
<td>7</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Table 5 categorizes teachers according their goals for using ARS in the classroom based on interview data. Five of the twelve teacher participants used ARS for both goal categories, enhancing assessment and enhancing learning, while the remaining teachers fall into using ARS either for enhancing assessment, or enhancing learning.

**Table 5: Individual Teachers ARS Goals From the Interview Data**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Grade</th>
<th>Subject</th>
<th>Enhance Assessment</th>
<th>Enhance Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alan</td>
<td>3</td>
<td>Language Arts</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Kazinski</td>
<td>3</td>
<td>Language Arts</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Balmann</td>
<td>4</td>
<td>Math</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Little</td>
<td>5</td>
<td>Math</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Plume</td>
<td>5</td>
<td>Math</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Donald</td>
<td>6</td>
<td>History</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Irvine</td>
<td>6</td>
<td>Language Arts</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Kendall</td>
<td>6</td>
<td>Math</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Roberts</td>
<td>7</td>
<td>History</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Clark</td>
<td>8</td>
<td>Math</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Dunlop</td>
<td>8</td>
<td>History</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Staar</td>
<td>8</td>
<td>History</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Findings Related to Question 2**

Research Question 2: How do teachers use Audience Response Systems?
Survey Results – Classroom Uses

I conducted a principal component analysis in SPSS of the survey data and three distinct components for classroom use emerged.

Component 1: Classroom uses that promoted classroom discussion and thinking.

Component 2: Classroom uses that utilized feedback to adjust instruction.

Component 3: Classroom uses that checked for student understanding about current or previously learned material without assigning grades from the results.

Teachers who used ARS to promote classroom discussion and thinking incorporated a range of teaching strategies such as asking students to discuss, think, and rethink responses. They also used the feedback from ARS to facilitate whole class discussions of students’ ideas after displaying a distribution of student responses, to have students vote again after an explanation of concepts, to facilitate peer conversations before and after initial voting, and to ask questions about topics not related to the subject being taught, or to ask questions at the beginning of class to generate conversation.

Teachers who used ARS feedback to adjust and modify their instruction during class and to prepare for future lessons used ARS feedback to evaluate the effectiveness of their teaching, modify instruction in the midst of a lesson, and to plan ahead for the next upcoming lessons. The majority of the teacher participants used ARS to modify instruction.

Teachers who used ARS to check for student understanding about current or previously learned material without assigning grades from the results had lessons that
reviewed previously learned material. The only purpose of the lesson’s ARS feedback was to show the current level of understanding among students. Table 6 lists the component loadings for classroom uses.
### Table 6: Component Loadings From Survey Data for ARS Classroom Use

<table>
<thead>
<tr>
<th>Classroom uses</th>
<th>Promote Class Discussion and Student Thinking</th>
<th>Use Feedback to Adjust and Modify Instruction</th>
<th>Check for Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discuss answers with peer before and initial answer/vote.</td>
<td>.922</td>
<td>.138</td>
<td>.056</td>
</tr>
<tr>
<td>Discuss their answers with a peer after an initial answer/vote.</td>
<td>.887</td>
<td>.224</td>
<td>.129</td>
</tr>
<tr>
<td>Facilitate a whole-class discussion of students’ ideas after displaying a distribution of student’s responses.</td>
<td>.770</td>
<td>.010</td>
<td>.237</td>
</tr>
<tr>
<td>Vote again after discussing an answer with a peer.</td>
<td>.738</td>
<td>.277</td>
<td>-.101</td>
</tr>
<tr>
<td>Answer a multiple-choice question in the middle of class.</td>
<td>.661</td>
<td>-.366</td>
<td>-.021</td>
</tr>
<tr>
<td>Display distribution for all to see.</td>
<td>.644</td>
<td>.026</td>
<td>.110</td>
</tr>
<tr>
<td>Answer questions other than subject matter.</td>
<td>.625</td>
<td>.124</td>
<td>-.202</td>
</tr>
<tr>
<td>Answer a multiple-choice question at the beginning of class.</td>
<td>.610</td>
<td>.107</td>
<td>.140</td>
</tr>
<tr>
<td>Evaluate the effectiveness of your teaching.</td>
<td>.090</td>
<td>.893</td>
<td>-.028</td>
</tr>
<tr>
<td>Decide to adjust lesson plan for the next class on the basis of how students responded.</td>
<td>.195</td>
<td>.845</td>
<td>.295</td>
</tr>
<tr>
<td>Use feedback to make changes in you instruction during class.</td>
<td>.206</td>
<td>.830</td>
<td>-.033</td>
</tr>
<tr>
<td>Identify themselves to the whole class as answering in a particular way.</td>
<td>.438</td>
<td>-.702</td>
<td>-.212</td>
</tr>
<tr>
<td>Answer questions about subject matter.</td>
<td>.178</td>
<td>.282</td>
<td>.813</td>
</tr>
<tr>
<td>Prepare ahead of time the question.</td>
<td>.189</td>
<td>-.038</td>
<td>.762</td>
</tr>
</tbody>
</table>
### Table 6: Component Loadings From Survey Data for ARS Classroom Use, Continued

<table>
<thead>
<tr>
<th>Classroom uses</th>
<th>Promote Class Discussion and Student Thinking</th>
<th>Use Feedback to Adjust and Modify Instruction</th>
<th>Check for Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hide distribution from students.</td>
<td>-.427</td>
<td>.024</td>
<td>.457</td>
</tr>
<tr>
<td>Use for test and quizzes.</td>
<td>-.327</td>
<td>-.045</td>
<td>-.358</td>
</tr>
<tr>
<td>Identify students’ misconceptions.</td>
<td>.272</td>
<td>.203</td>
<td>-.346</td>
</tr>
</tbody>
</table>

### Observation Results – Classroom Uses

Classroom observations revealed that teachers’ uses fell into more than one category component of ARS classroom use. Seven of the teachers fell into at least two components, two teachers fell into all three components of use, and all 12 teachers participants fell into Component 3. Table 7 identifies participants according to observed classroom use.
Table 7: ARS Use in the Classroom by Teacher From the Observation Data

<table>
<thead>
<tr>
<th>Participant</th>
<th>Grade</th>
<th>Subject</th>
<th>Promote Class Discussion and Student Thinking</th>
<th>Use Feedback to Modify Instruction</th>
<th>Check for Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alan</td>
<td>3</td>
<td>Language Arts</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Kazinski</td>
<td>3</td>
<td>Language Arts</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Balmann</td>
<td>4</td>
<td>Math</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Little</td>
<td>5</td>
<td>Math</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Plume</td>
<td>5</td>
<td>Math</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Donald</td>
<td>6</td>
<td>History</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Irvine</td>
<td>6</td>
<td>Language Arts</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Kendall</td>
<td>6</td>
<td>Math</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Roberts</td>
<td>7</td>
<td>History</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Clark</td>
<td>8</td>
<td>Math</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dunlop</td>
<td>8</td>
<td>History</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Staar</td>
<td>8</td>
<td>History</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

The following vignette demonstrates a typical lesson of teachers using ARS to promote classroom discussion.

Eighth grade history lesson:

As students walked in to Ms. Dunlop’s eighth grade history class the objective was displayed on the screen. The objective read, “Today I am going to review the events of World War II, the Holocaust, and the Diary of Anne Frank by having class discussions and answering questions through the clicker response.” Mrs. Dunlop
began the lesson with true/false questions “The Holocaust is defined as the systematic
annihilation of Jews in Europe by the Nazi.” Ms. Dunlop stated, “Based on the
knowledge you have so far, do you think that is a true statement, or a false statement.
It’s our first question to get the discussion going, so don’t worry if you get it wrong.”
Ms. Dunlop read the question aloud and the students respond. The teacher talked about
the statement, showed the response histogram, and confirmed to students that this is a
true statement. Ms. Dunlop instructed students to rewrite the statement in their notes
in a manner that was meaningful to them. She then asked students to take a moment to
think about the next question now projected on the screen. She stated, “In what ways
were the Jewish people persecuted, that is, what laws or regulations were passed
during World War II that hurt Jewish people?” Ms. Dunlop asked students to think
about the laws Hitler passed that hurt Jews and she opened up a full class discussion
on the laws that hurt Jews. She asked the students to write down their responses on
their note taking form and then instructed students to turn to their partner and compare
their lists. She told students to discuss what they wrote and then add all the facts that
the other partner had that the student did not have their own list. Students turn to their
peers and begin a conversation about the items they wrote in their notes. Students
then shared out some of the laws and regulations that hurt Jews during World War II.
The teacher then facilitated a class discussion about each topic mentioned. Ms. Dunlop
ended the discussion with an opinion question about the persecution imposed on the
Jewish population during World War II. She asked students to vote on the severity of
the imposed rules on a scale of one through five. A one indicated that the rules
imposed on the Jewish population were mild and not harmful and a five indicated that
they were severe and repressive. Students agreed that the laws imposed by Hitler were severe and repressive.

Teacher who used ARS to adjust and modify instruction used ARS to both modify the current lesson in the midst of teaching and to modify future lessons. The following vignette illustrates the use of ARS as a teaching modification tool.

A fourth grade probability lesson:

Mrs. Balmann began the lesson with a quick review and asked students to take a moment to think about what they learned in probability. The entire class read question one together. “How many possible outcomes are there for a spinner with red, blue, brown, green and yellow sections and a coin flip.” Mrs. Balmann said, “Now stop. Before you do anything think about it with me. First of all, how many colors are there? Show me with your fingers.” Students held up their fingers to show the answer. “How many different sides to a coin?” Students held up two fingers. “Now what are you going to choose?” Mrs. Balmann read all the answer choices, paused to allow students some thinking time, and then asked the students to click in their response. Mrs. Balmann displayed the histogram of results. The responses were evenly distributed among answers A, B, C, and D. Mrs. Balmann made note of the responses and stated to the class, “Wow, look at that. Our answers are all over the place.” Mrs. Balmann stopped and conducted a mini review lesson for finding outcomes using multiplication. She then went through each answer and discussed the misconceptions students may have had if they selected any of the answers besides “B” which was the correct answer. The next question tested the identical concept. The
class read the question out loud, “How many possible outcomes are there for rolling a six-sided number cube and a coin?” Students submitted their response and the histogram showed that 80% of the students selected the correct answer. Students gave a silent cheer by waving their hands back and forth.

The following vignette illustrates how teachers used ARS to check for understanding without assigning grades to the task.

Fifth grade California Standards Test (CST) review lesson:

Mrs. Plume used the released CST questions as her review. She displayed questions on the screen and randomly selected questions for students to answer. Students performed well on the first couple of questions, so she searched for a harder question and stopped at a geometry problem. Mrs. Plume read the question aloud, “Gabrielle wants to cover a square garden with mulch to protect the plants. Which bag of mulch will Gabrielle need to exactly cover the entire garden?” The illustration showed a square garden with one side labeled 12 feet. Mrs. Plume waited for the students’ responses, and stated, “Still nobody needs a whiteboard; this stuff is way too easy. Go ahead and click in your answer.” Answers showed confusion among a handful of students. Mrs. Plume asked students to shout out the formula for area. The entire class chanted the answer, “Area equals length times width.” Mrs. Plume then selected question 72, which was another area problem. Mrs. Plume said to the class, “As I look around the room, I only see about three students solving this problem on their whiteboards. Personally, there is no way I could solve this without doing the work. This is not one I would do in my head. This is one I would use a whiteboard.”
Students solved the problem and inputted their answers. Mrs. Plume displayed the histogram and 90% of the students selected the correct answer. Mrs. Plume stated, “Good, you needed to solve to find out that both had the same area, 15 times 4 is the same as 20 times 3.” The teacher moved on to another randomly selected question.

Third grade language arts lesson:

Mrs. Kaminski created a review lesson on grammar. The first question asked students to identify the proper noun in the sentence. The sentence read, “My cat is named Frisky.” Students selected their answers and the ARS system displayed the word *Frisky* as the correct response. Mrs. Kendall stated, “I know you guys like to see the graph, so I’ll show you the graph.” Mrs. Kendall did not talk about the results, but the majority of the students answered correctly. The next question also asked students to identify the proper noun within the sentence, “Julie is my cousin.” Students clicked in their answer and Mrs. Kazinski displayed the histogram. “Oh, five of you got it wrong and the rest of you (12) got it right.” Mrs. Kendall moved on the next question.

In addition to discovering how teacher use ARS in the classroom, participants were asked how often they use ARS in the classroom. The results are shown in Figure 4. The majority of the teachers (60%) use ARS once a week or more.
Findings Related to Research Question 3

Research Question Three: How are ARS uses related to teachers’ goals?

Survey data of the 20 participants was imported into SPSS from Excel and a bivariate correlation was run between teachers’ goals and uses. Statistically significant correlations existed between teachers’ goals for using ARS and specific classroom uses. Table 8 outlines the correlations between goals for enhancing instruction and classroom uses of ARS.
### Table 8: Correlations of Teacher Goals and Classroom Uses From the Survey Data

<table>
<thead>
<tr>
<th>Goals for Enhancing Instruction</th>
<th>Classroom Uses</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase student attention and activity during class.</td>
<td>Answer a multiple-choice question in the middle of class.</td>
<td>( r(18) = .48, p &lt; .05 )</td>
</tr>
<tr>
<td>Gain an understanding of what students do and do not know.</td>
<td>Hide distribution from students.</td>
<td>( r(18) = -.68, p = .001 )</td>
</tr>
<tr>
<td>Make students more aware of their conceptual understanding.</td>
<td>Facilitate whole class discussion after displaying distribution of student responses.</td>
<td>( r(18) = .56, p &lt; .05 )</td>
</tr>
<tr>
<td>Increase Effectiveness of instructions overall.</td>
<td>Evaluate the effectiveness of your teaching.</td>
<td>( r(18) = .46, p &lt; .05 )</td>
</tr>
<tr>
<td>Make students more aware of their conceptual understanding.</td>
<td>Identify students’ misconceptions.</td>
<td>( r(18) = .62, p &lt; .05 )</td>
</tr>
<tr>
<td>Enhance feedback to students about their understanding.</td>
<td>Identify students’ misconceptions.</td>
<td>( r(18) = .48, p &lt; .05 )</td>
</tr>
<tr>
<td>Increase effectiveness of overall instruction</td>
<td>Identify students’ misconceptions.</td>
<td>( r(18) = .74, p &lt; .001 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Goals for Enhancing Assessment</th>
<th>Classroom Uses</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess student learning for grades.</td>
<td>Use for tests and quizzes.</td>
<td>( r(18) = .63, p &lt; .05 )</td>
</tr>
<tr>
<td>Save time needed for formal or informal assessment.</td>
<td>Use for tests and quizzes</td>
<td>( r(18) = .65, p &lt; .05 )</td>
</tr>
<tr>
<td>Increase your own productivity</td>
<td>Use for tests and quizzes</td>
<td>( r(18) = .54, p &lt; .05 )</td>
</tr>
</tbody>
</table>

Classroom observations allowed me the opportunity to link individual classroom uses to teachers’ stated goals, which supported self-reported data from the survey. For
example, Mr. Clark used ARS for tests and quizzes. Mr. Clark used the grading and reporting features of ARS to increase his own productivity and save time needed for evaluating formal and informal assessments. Mr. Clark saved time by creating a printout of all the questions missed by each student. Mr. Clarks kept the printouts in a binder and allowed students to look-up their ID number on the printout, in order to make a list of the questions they missed. Students then went back to their desks to rework the problems they missed on the test. The grading and reporting feature of ARS saved Mr. Clark hours of work by providing him with a detailed analysis of the class’ performance in one printed report. The example with Mr. Clark demonstrated how statistically significant correlations are seen in the classroom setting.

**Finding Related to Research Question 4**

Research Question Four: What do teachers perceive are the effects that ARS has on student engagement and how do such perceived effects relate to teachers' goals, and uses?

Teachers were asked in the survey about the perceived effects of ARS on student engagement based on a five point Likert scale where a score of one means not at all and a score of five means tremendously. Table 9 provides the means and standard deviation for each question on perceived effects on student engagement. In general, survey results revealed that teachers perceived students as being more actively engaged, more motivated, and more interested in learning in classroom when using ARS during learning.
Participant interviews also revealed that teachers and principals felt students were more engaged when using ARS during a learning activity. Elementary principal Catherine Knotts felt ARS use enhanced engagement, motivated students and made them more excited about learning. She stated:

I believe it greatly enhances engagement in that students have to respond to the questions in front of them. It’s obvious if they are not participating in the program. Students are paying attention to what is happening in the classroom, they are more involved. They are excited about the technology and that they have some control of the lesson and the direction that the lesson is going. Students are not just being engaged in the overall process, they are actually being engaged in the learning and they understanding after they participate that their answer does make a difference. It does matter what they do.

Middle school principal Kelly Skinner believed that carefully designed questions are the key to enhancing engagement with ARS. Mrs. Skinner stated:
You never see less than 100% engagement. The teachers that yield high student engagement actually have thoughtful questions that are worthy of discussing and arguing about. They aren’t just clicking at a rote random recall question. I was observing a class right before lunch, and on the way to lunch students were still arguing about distracters and which answers made more sense. That’s what we want to generate in students. It’s extremely motivating.

Teachers also expressed that students are more motivated and engaged when using ARS during lessons. Mrs. Alan, a third grade teacher, believed ARS use is “extremely exciting for kids, and engaging, and students are more enthusiastic to learn.” Mrs. Balmann, a fourth grade teacher, noted that it is the “overall engagement that stands out.” Mrs. Kendall, a third grade teacher, stated, “students really enjoy using them.” Mrs. Plume, a fifth grade teacher, noticed a change in engagement and mentioned, “Students are very animated and excited about what they are doing, and I think it’s because they really enjoy using the clickers.” Mrs. Plume added:

Students are excited about using ARS. It really gets them engaged in thinking through the lesson and trying hard to answer the questions. They are excited because they have technology in their hands that they can manipulate. The principal came in and watched me and every child was engaged. I had 100% engagement. Our goal is engagement and the expectation is that clickers will help increase engagement. For me, engagement and immediate feedback are the two most important things that stand out with clickers.

Ms. Dunlop, an eighth grade teacher, stated, “I just sense that there’s more engagement because they’re using something in their hands. They appear more excited waiting to see the histogram and to see what their results are. It is the engagement and the interaction between the student and the lesson that stands out.” Mrs. Kendall, a sixth grade teacher, commented about students working harder on the questions
because she made a game of the lesson and used the immediate feedback as a quick measure of success. Mrs. Kendall shared her strategy behind getting students to work hard and stated, “I give them points for their total percent correct. With the immediate feedback students know right away if they got 100%, or 90%, or 80% and they’ll work hard to get the points.” Even though evidence supported teachers’ beliefs that ARS positively impacts engagement, not every teacher felt that ARS was the sole cause of increased engagement. Nine of the 14 participants (64%) reported on the survey that teaching strategies contributed to engagement levels within the classroom.

**Perceived Effects on Engagement Related to Goals and Uses**

Statistical analysis revealed a positive correlation between teachers’ perceived effects on student engagement and teacher goals. Table 10 lists statistically significant correlations between perceived effects on student engagement and the goal for enhancing instruction from the survey data. There were no statistically significant results for perceived effects on student engagement and the goal for enhancing assessment.
Table 10: Correlations of Perceived Beliefs and Goals Categories From Survey Data

<table>
<thead>
<tr>
<th>Perceived Effects on Student Engagement</th>
<th>Goal: Enhance Learning</th>
<th>Goal: Enhance Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students are more active participants.</td>
<td>$r(18) = .60, p &lt; .01$</td>
<td>Not significant</td>
</tr>
<tr>
<td>Students are more motivated.</td>
<td>$r(18) = .55, p &lt; .05$</td>
<td>Not significant</td>
</tr>
<tr>
<td>The class is more interested in learning.</td>
<td>$r(18) = .60, p &lt; .01$</td>
<td>Not significant</td>
</tr>
<tr>
<td>Equally on task as non-clicker classes</td>
<td>$r(18) = -.50, p &lt; .05$</td>
<td>Not significant</td>
</tr>
<tr>
<td>Makes no difference in students' efforts in answering questions.</td>
<td>$r(18) = -.49, p &lt; .05$</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

Table 11 lists correlations between teachers' perceived effects on student engagement and individual goals.

Table 11: Correlations of Perceived Effects on Student Engagement and Individual Goals

<table>
<thead>
<tr>
<th>Perceived Effects on Student Engagement</th>
<th>Goals</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students are more actively engaged.</td>
<td>Make students more aware of their conceptual understanding.</td>
<td>$r(18) = .60, p &lt; .01$</td>
</tr>
<tr>
<td>Students are more actively engaged.</td>
<td>Gain an understanding of what students do and do not understand.</td>
<td>$r(18) = .46, p &lt; .05$</td>
</tr>
<tr>
<td>Students are more actively engaged.</td>
<td>Enhance feedback to students about their understanding.</td>
<td>$r(18) = .50, p &lt; .05$</td>
</tr>
</tbody>
</table>
Table 11: Correlations of Perceived Effects on Student Engagement and Individual Goals, Continued

<table>
<thead>
<tr>
<th>Perceived Effects on Student Engagement.</th>
<th>Goals</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some questions made students work harder to answer.</td>
<td>Stimulate class discussion.</td>
<td>$r(18) = .60, p &lt; .01$</td>
</tr>
<tr>
<td>Some questions made students work harder to answer.</td>
<td>Make students more aware of their conceptual understanding.</td>
<td>$r(18) = .64, p &lt; .01$</td>
</tr>
<tr>
<td>Equally on task as non-clicker classes.</td>
<td>Enhance feedback to students about their understanding.</td>
<td>$r(18) = -.45, p &lt; .05$</td>
</tr>
<tr>
<td>Makes no difference in students’ efforts in answering questions.</td>
<td>Stimulate class discussion.</td>
<td>$r(18) = -.49, p &lt; .05$</td>
</tr>
<tr>
<td>Makes no difference in students’ efforts in answering questions.</td>
<td>Make students more aware of their conceptual understanding.</td>
<td>$r(18) = -.70, p &lt; .01$</td>
</tr>
<tr>
<td>Students are more active participants.</td>
<td>Promote effective student learning</td>
<td>$r(18) = .47, p &lt; .05$</td>
</tr>
<tr>
<td>Students are more active participants.</td>
<td>Make students more aware of their conceptual understanding.</td>
<td>$r(18) = .52, p &lt; .05$</td>
</tr>
<tr>
<td>Students are more motivated.</td>
<td>Make students more aware of their conceptual understanding.</td>
<td>$r(18) = .64, p &lt; .01$</td>
</tr>
<tr>
<td>The class is more interested in learning.</td>
<td>Make students more aware of their conceptual understanding.</td>
<td>$r(18) = .66, p &lt; .01$</td>
</tr>
</tbody>
</table>

Statistical analysis results also revealed a positive correlation between teachers' perceived effects on student engagement and the type of use promoting class discussion and student thinking. Teachers who perceived that the class was more interested in learning while using ARS had the tendency to be teachers who used ARS for promoting classroom discussion and student thinking $r(18) = .46, p < .05$. Table
12 lists statistically significant correlations between perceived effects on student engagement and the individual classroom use. There were no statistically significant correlations for perceived effects on student engagement and the type of use categories for modifying instruction, or checking for understanding.
Table 12: Correlations of Perceived Effects on Student Engagement and Classroom Use From Survey Data

<table>
<thead>
<tr>
<th>Perceived Effects on Student Engagement</th>
<th>ARS Uses</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students are more actively engaged.</td>
<td>Display distribution for all to see.</td>
<td>( r(18) = .45, p &lt; .05 )</td>
</tr>
<tr>
<td>Students are more actively engaged.</td>
<td>Identify students’ misconceptions</td>
<td>( r(18) = .62, p &lt; .05 )</td>
</tr>
<tr>
<td>Some questions made students work harder to answer.</td>
<td>Identify themselves to the whole class as answering in a particular way.</td>
<td>( r(18) = .48, p &lt; .05 )</td>
</tr>
<tr>
<td>Some questions made students work harder to answer.</td>
<td>Facilitate whole-class discussion of students’ ideas after displaying a distribution of student responses.</td>
<td>( r(18) = .50, p &lt; .05 )</td>
</tr>
<tr>
<td>Equally on task as non-clicker classes.</td>
<td>Identify students’ misconceptions.</td>
<td>( r(18) = .50, p &lt; .05 )</td>
</tr>
<tr>
<td>Makes no difference in students’ efforts in answering questions.</td>
<td>Discuss answers with a peer after an initial answer/vote.</td>
<td>( r(18) = -.51, p &lt; .05 )</td>
</tr>
<tr>
<td>Makes no difference in students’ efforts in answering questions.</td>
<td>Facilitate whole-class discussion of students’ ideas after displaying a distribution of student responses.</td>
<td>( r(18) = .50, p &lt; .05 )</td>
</tr>
<tr>
<td>Makes no difference in students’ efforts in answering questions.</td>
<td>Identify students’ misconceptions.</td>
<td>( r(18) = -.48, p &lt; .05 )</td>
</tr>
<tr>
<td>Students are more active participants.</td>
<td>Display distribution for all to see.</td>
<td>( r(18) = .51, p &lt; .05 )</td>
</tr>
<tr>
<td>Students are more active participants.</td>
<td>Identify students’ misconceptions.</td>
<td>( r(18) = -.68, p = .001 )</td>
</tr>
<tr>
<td>Students are more motivated.</td>
<td>Display distribution for all to see.</td>
<td>( r(18) = .46, p &lt; .05 )</td>
</tr>
<tr>
<td>Students are more motivated.</td>
<td>Identify students’ misconceptions.</td>
<td>( r(18) = .67, p = .001 )</td>
</tr>
</tbody>
</table>
Table 12: Correlations of Perceived Effects on Student Engagement, Continued

<table>
<thead>
<tr>
<th>Perceived Effects on Student Engagement</th>
<th>ARS Uses</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The class is more interested in learning.</td>
<td>Display distribution for all to see</td>
<td>$r(18) = .55, p &lt; .05$</td>
</tr>
<tr>
<td>The class is more interested in learning.</td>
<td>Discuss answers with a peer before an initial answer/vote.</td>
<td>$r(18) = .49, p &lt; .05$</td>
</tr>
<tr>
<td>The class is more interested in learning.</td>
<td>Discuss answers with a peer after an initial answer/vote.</td>
<td>$r(18) = .47, p &lt; .05$</td>
</tr>
<tr>
<td>The class is more interested in learning.</td>
<td>Plan ahead of time two different lessons in order to have both ready to use.</td>
<td>$r(18) = .48, p &lt; .05$</td>
</tr>
<tr>
<td>The class is more interested in learning.</td>
<td>Identify students’ misconceptions.</td>
<td>$r(18) = .69, p = .001$</td>
</tr>
</tbody>
</table>

All teachers in the study mentioned that student engagement is a large part of the rationale behind implementing ARS. Eighty-three percent of the teachers in the study were required to use ARS as part of meeting the district’s 85% engagement goal. Many of the teachers believed that the district’s engagement goal drove the implementation of ARS. Mrs. Plume, a fifth grade teacher, mentions, “The expectation is that it is going to increase engagement, and our goal is engagement.” Mrs. Dunlop, an eighth grade teacher, supports the idea with her comment, “We use them for the engagement.” The majority of the teachers have the ideas of increasing engagement in the forefront of their minds with every lesson. A systematic tool for measuring student engagement was used during each classroom observation. The tool provided a means for measuring and comparing student engagement based on teachers’ perceived effects.
of how ARS effects engagement and the actual engagement time of students. The Behavioral Observation of Students in Schools (BOSS) provided a systematic approach for measuring of student engagement percentages during a 30-minute period. Engagement percentages were gathered, totaled and compared against the district’s 85% engagement goal. Total AET and PET were also tallied and analyzed.

Table 13 breaks down total observed engagement percentages into AET and PET totals. (Shapiro, 2004).

<table>
<thead>
<tr>
<th>Grade</th>
<th>Teacher</th>
<th>Subject</th>
<th>AET</th>
<th>PET</th>
<th>Total Engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Clark</td>
<td>Math</td>
<td>66</td>
<td>16</td>
<td>82</td>
</tr>
<tr>
<td>6</td>
<td>Kendall</td>
<td>Math</td>
<td>57</td>
<td>31</td>
<td>88</td>
</tr>
<tr>
<td>3</td>
<td>Alan</td>
<td>Lang. Arts</td>
<td>56</td>
<td>31</td>
<td>87</td>
</tr>
<tr>
<td>7</td>
<td>Roberts</td>
<td>History</td>
<td>44</td>
<td>54</td>
<td>98</td>
</tr>
<tr>
<td>5</td>
<td>Little</td>
<td>Math</td>
<td>38</td>
<td>44</td>
<td>82</td>
</tr>
<tr>
<td>5</td>
<td>Plume</td>
<td>Math</td>
<td>31</td>
<td>63</td>
<td>94</td>
</tr>
<tr>
<td>8</td>
<td>Dunlop</td>
<td>History</td>
<td>29</td>
<td>60</td>
<td>89</td>
</tr>
<tr>
<td>6</td>
<td>Irvine</td>
<td>Lang. Arts</td>
<td>26</td>
<td>41</td>
<td>67</td>
</tr>
<tr>
<td>3</td>
<td>Kazinski</td>
<td>Lang. Arts</td>
<td>24</td>
<td>60</td>
<td>84</td>
</tr>
<tr>
<td>4</td>
<td>Balmann</td>
<td>Math</td>
<td>21</td>
<td>52</td>
<td>73</td>
</tr>
<tr>
<td>8</td>
<td>Staar</td>
<td>History</td>
<td>21</td>
<td>22</td>
<td>43</td>
</tr>
<tr>
<td>6</td>
<td>Donald</td>
<td>History</td>
<td>17</td>
<td>71</td>
<td>88</td>
</tr>
</tbody>
</table>

Grades three through five are elementary school levels and grades six through eight are middle school levels. Although 50% of the teachers reached the district’s goal of 85% engagement goal, only three (25%) had higher active engagement percents versus passive engagement percentages. Table 13 highlights in bold higher active engagement totals. Although two of the three teachers with higher active engagement
percents used ARS in math, there was no statistically significant difference between engagement scores, subject area, or grade level. A bivariate correlation revealed no statistically significant difference between engagement percentages and classroom uses or teachers’ goals.

It is worth noting that each of the three teachers with higher active engagement totals had different styles of teaching. Mr. Clark, an eighth grade math teacher, had the highest AET percents and used ARS to enhance both assessment and learning. Mr. Clark used ARS as formative assessment measure during the observation. The following vignette provides insight into how Mr. Clark used ARS in his lessons.

Eighth grade algebra lesson:

As students entered Mr. Clark’s 8th grade Algebra class they picked up their clickers housed in a pocket chart on the wall. Students were aware of the routine, and everyone quickly settled down and began the morning warm-up problems. Students were given four minutes to complete the warm-up, and students were held accountable for inputting an answer. Mr. Clark always gave students the ability to choose I don’t know as an answer choice to prevent random guessing. Mr. Clark monitored answers on his computer as students inputted their math warm-up answers into their clickers. Mr. Clark insisted that students show their work for the warm-up, and reminded several students to actively work out the problem on their paper. The timer went off and Mr. Clark verbally shared the warm-up results with students. He stated, “About 60% of you got all three questions correct. Twenty-percent got two out of three correct, and the final 20% of you need some review.” Mr. Clark instructed all students
to work out the final problem with him, which contained irrational numbers. Mr. Clark used the scores to quickly reteach concepts using irrational numbers, and students were required to re-work the problem with him. Mr. Clark gave students a second problem similar to the previous problem using irrational numbers, reminded students of the procedures, and had them work out the problem as he walked around and monitored their work.

Mrs. Kendall, who also used ARS in her sixth grade math class, had the second highest active engagement total, (57%). Mrs. Kendall motivated students with performance points, which enhanced their participation and willingness to work hard on difficult problems. Mrs. Kendall’s use of ARS was evident in the following vignette.

Sixth grade math lesson:

Mrs. Kendall was conducting a math review for California Standards Test (CST). Students had a review handout and Mrs. Kendall guided the students through the lesson reminding students of problem solving procedures. Students worked each problem out as Mrs. Kendall guided them through the review problem by problem. Mrs. Kendall used ARS to hold all students accountable for inputting an answer and to monitor student progress as she progressed through the math review. Mrs. Kendall had the ARS system display the percent of correct answers so students were able to monitor their progress as they move through the lesson. Mrs. Kendall reminded students that many of them could make the 100% club if they continued to work hard on solving the problems. Students cheered when high correct responses were reached.
and the teacher gave class points every time the class scored 80% or higher. Mrs. Kendall took notes on questions that the class continued to struggle with and informed the class of the concepts and skills they would review in the upcoming lesson. At the end of the review Mrs. Kendall looked at the class report and called out name of students who scored 100%. She reminded students to get their stickers for the 100% chart on the wall. The students appeared excited about the point and sticker system Mrs. Kendall had created for them.

Mrs. Alan, a third grade teacher, who scored about 56% on active engagement, included peer and classroom discussion throughout her lesson. The following vignette provides a glimpse of Mrs. Alan’s classroom lesson.

Third grade language arts lesson:

Mrs. Alan began her third grade class with an opinion question asking students if they enjoy using clickers to answer questions during class. Students answered either yes or no. Mrs. Alan waited for everyone to respond assuring accountability that all students participate. All student responses were positive, so Mrs. Alan used the opportunity to promote further discussion among students. Mrs. Alan asked each student to tell their partner one specific reason why they liked using clickers to answer questions. She then asked students to share their responses as she generated a written list on the board. The list included items such as “I like to know if I got the answer.” “I like talking about the answers.” “I like to see what other kids put.” “I like when you ask us fun questions.” Mrs. Alan then proceeded with her lesson and while students were selecting their answers Mrs. Alan stated, “Be ready to discuss your
answer with your partner. Be ready to share why you chose what you did.” When the results were shown, the histogram displayed a variety of answers. Mrs. Alan said, “The correct answer is B. If you marked something else think about why you marked that answer and share with your neighbor why you marked your answer.” Students turned to their neighbor and began a conversation behind the rationale of their answer choice.

All three teachers, Mr. Clark, Mrs. Kendall, and Mrs. Alan, integrated the feedback from ARS into their lessons. How each teacher utilized the feedback varied. Mr. Clark used the ARS feedback to monitor student progress, make adjustments during the lesson based on student results, and to save time for formal and informal assessments. Mrs. Kendall used ARS feedback to motivate students during the lesson and to plan future lessons. Mrs. Alan used the feedback to promote peer and classroom discussions. Although other teachers had similar classroom uses with ARS, the manner in which each teacher used the feedback to keep students engaged contributed to the higher levels of active engagement scores. Students saw that the teacher monitored their lessons based on their responses. The manner in which the teacher used the feedback kept students on task and enhanced engagement.

Goals, Classroom Uses, and Perceptions of ARS on Student Engagement

Teachers’ goals, classroom uses, and perceptions of ARS on student engagement are all intertwined among each other. Table 14 shows the connections between teachers’ goals, classroom uses, and teachers’ perceptions of ARS on student engagement.
Table 14: Connections – Goals, Classroom Uses, & Perceptions of ARS on Engagement

<table>
<thead>
<tr>
<th>Goals</th>
<th>Classroom Uses</th>
<th>Perceptions of Effects of ARS on Student Engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make students more aware of their conceptual understanding</td>
<td>Display distribution</td>
<td>Students are more active participants.</td>
</tr>
<tr>
<td>Make students more aware of their conceptual understanding</td>
<td>Identify students’ misconceptions</td>
<td>Students are more motivated.</td>
</tr>
<tr>
<td>Make students more aware of their conceptual understanding</td>
<td>Facilitate whole class discussion after displaying distribution of student responses</td>
<td>The class is more interested in learning.</td>
</tr>
<tr>
<td>Enhance feedback to students about their understanding</td>
<td>Identify students’ misconceptions</td>
<td>Students are more actively engaged.</td>
</tr>
<tr>
<td>Make students more aware of their conceptual understanding</td>
<td>Identify students’ misconceptions</td>
<td>Some questions make students work harder to answer.</td>
</tr>
</tbody>
</table>

Table 14 aligns the correlations from table 8, 11 and 12 in order to highlight the connections among goals, classroom uses, and teachers’ perceived effects of ARS on student engagement. Based on correlations, teachers who have the goal for making students more aware of their conceptual understanding display the distribution of answers during lessons and also have the perceptions that students are more active participants within the lesson. Teachers who use ARS to enhance feedback to students
about their understanding also use ARS to identify student misconceptions and generally believe that students are more actively engaged in class.

In contrast to the connections and correlations among teachers’ goals, classroom uses, and perceptions of the effects that ARS has on student engagement, it is important to mention how the classroom activity system changes when ARS classroom uses are not present. For example, not all teachers use ARS to promote classroom discussion. Teachers who do not use ARS to promote classroom discussion, or to identify student’s misconceptions, do not have the goal of increasing students’ misconceptions. One third grade teacher stated, “I generally only use ARS to review previously learned material. The feedback helps students see how well they might perform on an upcoming quiz, and it helps me see how much they’ve learned. The clickers work best for review, I don’t really see how I can use it for teaching a lesson.” The comment by this third grade teacher shows that classroom uses are uniquely different with the absence using ARS to promote discussion. The teacher in this example falls under the third type of use in which she uses ARS to check for understanding without assigning grades.

A second example is the absence of using ARS for tests or quizzes. Teachers who do not have the goal for enhancing assessment, or using ARS to increase their own productivity and save time needed for formal or informal assessments generally do not use ARS for tests or quizzes. An 8th grade history teacher said, “I do not use ARS for tests and quizzes because they are too unreliable. The system often does not work, and the students get frustrated.” In this case, the teacher’s attitude about ARS
reliability influences her willingness to use the system for tests and quizzes. From an activity theory perspective, for this teacher, ARS hinders the potential of increasing overall teacher productivity and saving valuable time for grading formal and informal assessments.
Chapter V: Discussion

This study extended research on Audience Response System (ARS) use to elementary and middle school classrooms settings. The study was designed to identify teachers’ goals for using ARS, classroom uses of ARS, and teachers’ perceptions of the effects that ARS has on student engagement. Four main questions guided the research:

1. What goals do teachers have for using Audience Response Systems in elementary and middle school classrooms?

2. How do teachers use Audience Response Systems?

3. How are ARS uses related to teachers' goals?

4. What do teachers perceive are the effects that ARS has on student engagement and how do such perceived effects relate to teachers’ goals and uses?

The first section of this chapter includes a summary of major qualitative and quantitative findings. The second section elaborates on the findings and discusses the patterns and trends found among teachers’ goals for using ARS, classroom uses of ARS, and teachers’ perceptions of the effects that ARS has on student engagement. The findings from the study show that teachers have two goals for using ARS in the classroom and three profiles of use. Statistically significant positive and negative correlations existed between teachers’ goals and classroom uses. Positive correlations
emerged between teachers’ perceived effects of ARS on student engagement and the goal for enhancing instruction.

**Teachers’ Goals for Using ARS**

The findings revealed two main goals for using ARS in elementary and middle school classrooms. The first goal teachers had for using ARS was to enhance assessment and the second goal was to enhance learning. Interview and observation data showed that 84% of teachers had goals for enhancing learning, 58% of teachers had goals for enhancing assessment, and 42% had goals for both enhancing learning and enhancing assessment. Teachers’ goals tended to limited by the professional development they received with the system. For example, one teacher, Mrs. Donald, only knew how to use the “fast grade” feature in ARS, which allows teachers to give tests and quizzes to students while having the results immediately aggregated. She used ARS to enhance assessment because using the “fast-grade” feature was the only feature she felt comfortable using. Because of this, she only used ARS for testing purposes.

Mrs. Balmann, a fourth grade teacher, had the goal of enhancing learning. She used ARS to ask questions to check for understanding as she taught her lesson. Questions were posed on the fly and never created in advance. Mrs. Balmann used the immediate feedback feature from ARS to monitor and modify instruction both during instruction and for future lessons. Teachers such as Mrs. Donald, a sixth grade teacher, and Mrs. Balmann, fourth grade, tended to use ARS in a manner that supported their goal for the system yet their uses were limited and shaped by the type
of training they received in using ARS. Mr. Clark, an eighth grade teacher, mentioned that he was one of the last teachers to get “onboard with clickers.” He said he fought them for a long time, but he couldn’t put off learning how to use the system any longer. Mr. Clark started out using ARS only for tests and quizzes because learning to use the “fast grade” feature was the first method he learned with ARS. As Mr. Clark began to see the benefits of ARS, he slowly learned to incorporate new uses. Mr. Clark had the goals of using ARS to enhance both learning and assessments. The teachers who had goals of using ARS to enhance both assessment and learning tended to have a broader range of uses than teachers whose only goal was only either enhancing assessment or enhancing learning.

Teachers’ goals for using ARS varied depending on a variety of factors. Teachers’ goals tended to support the type of training and professional development teachers’ received for ARS. Teachers’ willingness to expand their goals was influenced by the time available to teachers to learn new ways to incorporate ARS into their lessons. Without time to invest in learning how to use ARS, teachers tended to have the goal that matched the type of training they received. If teachers were trained to use ARS to ask questions on the fly, then they tended to have the goal for enhancing learning. If teachers were only trained to use the “fast-grade” feature of ARS then they generally had the goal for enhancing assessment because using ARS for tests and quizzes supported the goal for enhancing assessment. Teachers that sought out additional support and training on their own tended to have broader uses of ARS in the classroom. These teachers, similar to Mr. Clark, generally saw the greater potential that ARS has on the activity of teaching and learning.
Classroom Uses for ARS

Three distinct profiles of use emerged from the study. The first type of use included classroom activities that promoted class discussion and student thinking. The second type of use described ARS activities that utilized feedback to adjust and modify instruction. The third type of use described ARS activities to check for understanding without assigning grades. Teachers often fell into more than one type of use category. One hundred percent of the teachers used ARS to check for understanding. It is not surprising to see all teachers use ARS to check for understanding because determining how well students grasp the material is a teacher’s job. Knowing what students understand is key to helping students progress toward meeting standards. Teachers' ARS uses often matched their teaching style. If a teacher generally promotes classroom discussion to enhance learning, then they would more likely to use ARS to promote classroom discussion. When asked, several teachers stated their teaching style would not change much if they lost the ability to use ARS. Mrs. Balmann, a fourth grade teacher, stated, “You can do anything with clickers as you can without.” Mrs. Alan, a third grade teacher, mentioned, “My teaching wouldn’t change much. I could still get the results with whiteboards, or the response cards.” Mrs. Donlop, an eighth grade teacher, said, “I mainly use ARS in my PowerPoint lessons, which I do anyway. I can review what they have learned as I move along.” Ms. Litoff, a fifth grade teacher, mentioned, “I can still get the feedback with whiteboards.” The teachers’ comments support the idea that ARS use in the classroom is also influenced by pedagogical practices and teaching style. ARS
is not the only factor within the teaching and learning environment that transforms the dynamics of learning in the classroom.

**Teacher Goals and Classroom Uses**

Results from the survey revealed statistically significant positive and negative correlations between teachers’ goals for using ARS and classroom uses. Teachers’ classroom uses generally mirrored the type of professional development the teacher received for using the ARS system, the teachers' teaching style, and the job duties teachers needed to perform. For example, Mrs. Donald, a sixth grade teacher, received minimal training on using ARS. She was taught how to use the “fast-grade” feature for giving tests and quizzes, but nothing more. Mrs. Donald said, “Teachers need to be trained. There is some value in them if you are trained. I don’t know they would ever give them (ARS) to teachers if they aren’t trained.” Like many others, she was mandated to use ARS at her school site, so she used the system in the only manner she was trained to satisfy the mandate of use. Mrs. Kazinski, a third grade teacher, had a similar story -- she was also mandated to use ARS, but she was trained Feeling overwhelmed by the ARS mandate and her other teaching duties, she chose to use the feature that allowed her to create premade questions for review purposes. Mrs. Kazinski knew that there were other methods for using ARS, but due to time constraints, and her belief that the system was too unreliable, she was not interested in learning new ways to use ARS in the classroom. Mrs. Balmann, a fourth grade teacher, was not mandated to use ARS in her classroom, but her classroom use still mirrored the training she received. She received training on using the system to ask
questions on the fly throughout the lesson without having to create premade questions in advance. Mrs. Balmann could take any lesson worksheet and use the questions on the handout within ARS. She could also teach a regular lesson and ask ARS questions as part of the guided practice portion of her lesson without any advance prep time. Although Mrs. Balmann was aware of the ability to use ARS for assessment and access reports she was not using any of the added features. This was her second year using ARS, and she still only used the system in the manner in which she was trained. Due to the lack of training, teachers found themselves sticking with the few uses of ARS they were comfortable with using.

**Teachers’ Perceived Effects of ARS on Student Engagement**

The results from the study showed that teachers and administrators generally believed that ARS enhanced engagement, motivated students, made students more active participants and interested in learning. Some teachers perceived that some ARS questions made students work harder to answer them. The data from the study showed statistically significant positive and negative correlations between teachers’ perceived effects on student engagement and teachers’ goals for enhancing learning. The data also revealed a statistically significant positive correlation between teachers’ perceived effects on student engagement and the type of use for promoting class discussion and student thinking. Mrs. Alan, a third grade teacher, believed that ARS enhances engagement and stated, “I think clickers immensely helps with engagement because if you wait for everybody to respond, everybody has to be accountable, everybody has to answer.” This teacher had one of the highest active engagement scores and used ARS
to promote classroom discussion and student thinking. If a teacher tends to believe ARS will enhance engagement, then the teachers is more likely to notice times when students are engaged. Perceived beliefs about how ARS effects engagement does play a role in the teaching and learning dynamics, yet it did not appear to influence teachers enough for them to learn new methods of using ARS when the constraints of time were an issue.

**Implications for Theory**

Activity theory helped interpret the findings in relation to the influences that shaped teachers’ goals and classroom uses of ARS. The presence of ARS as a communication tool facilitated the potential of use, but did not guarantee certain kinds of uses, or goals. Teachers who were leery about the reliability of ARS due to system errors, and those who felt that their professional development was inadequate, tended to have a limited set of classroom uses of ARS in comparison to those teachers who did not have issues with ARS reliability or professional development. Teachers who expressed that time constraints limited their ability to learn more about the diverse features of ARS tended to stick with the one or two uses that were demonstrated in their professional development training. Although these teachers were aware of additional classroom uses of ARS, they did not pursue further training.

The framework of activity theory offers a lens to see the tensions between the reliability of the ARS, the rules and mandates to use ARS, and the lack of adequate professional development. The rules add new tensions to teachers' daily workload, and time pulls the teachers away from seeking further professional development or
additional support for the ARS implementation. Two teachers said that they only used ARS because they were mandated to do so. Of these two teachers, one teacher used ARS for summative assessments because she felt it was the most effective use of her time, while the second teacher used ARS to check for understanding without using the results as a summative assessment tool because she felt the system was too unreliable and she was not trained in using ARS for tests or quizzes. Teachers who used ARS only to satisfy a mandate may or may not have used ARS if it were presented to them voluntarily and they had a choice to implement its use. These findings suggest that the presence of a technology tool enables and facilitates the potential of certain kinds of uses, but it does not assure them. Teachers commented continuously that they were aware of other uses of ARS, but due to reasons such as time constraints, lack of professional development, or lack of ongoing support, they did not utilize the full potential of ARS. The activity theory framework allows researchers to see the activity of teaching and learning in broader terms. The framework shows how rules, the mandate to use ARS, division of labor, ARS professional development, tools, and the time needed to prepare for ARS implementation, all play a key role in influencing the teachers’ goals and classroom uses of ARS. Teachers voiced their frustrations about the overwhelming demands of daily teaching responsibilities. Their frustrations included lack of time and ongoing support with new mandates and technology requirements. The tension caused friction between the mandate rules, and their daily teaching responsibilities. All teachers knew about other ways to use ARS in the classroom, which they did not employ or seek to learn. The result was that teachers’
uses were limited by the professional development or lack of professional development that they received.

Figure 5 and Figure 6 show the influences of ARS use as viewed through an activity theory lens.

Figure 5: ARS in the Teaching and Learning Activity Setting – Teacher Focus

Figure 5 illustrates the teaching and learning environment with the teacher as the main focus. The organizational structure of the school system influences the teachers’ goals and classroom uses for ARS. Teachers use the reporting features of ARS to optimize their daily workload. The teachers’ day-to-day responsibilities such as monitoring student progress, ensuring participation, grading, and following pacing guides drive the teachers’ goals and outcomes.
In contrast to Figure 5, Figure 6 shows the teaching and learning activity setting from the focus of the student. When the student is the subject, influences of tools, division of labor, community, and rules shift according to the students’ daily responsibilities within the teaching and learning activity setting. Although both the teacher and student may have improved academic learning goals, the student in contrast may have the goal of pleasing the teacher through participation and task completion. The student may also feel the influence of the teachers’ mandates to participate and achieve academic improvements. Students may feel a greater family influence because their parents monitor their adherence to following the rules of the system on a daily basis. Students began feeling the pressure of mandates when teachers began holding them responsible for participation. Teachers passed along the 85% engagement
mandate to students and with the ease of the ARS feedback began holding students accountable for participation. The immediate feedback and reporting feature of ARS allowed teachers to hold students accountable for their own learning during instruction by providing them with real-time results of their learning progress. Both elementary and middle school teachers developed monitoring systems that tracked students toward their learning goals. Teachers used the reporting feature of ARS to reward and acknowledge students who were progressing toward standard. Individualized student ARS reports also equipped teachers with the data needed to provide students with specific information about their current state of learning in relation to the desired learning goals. Activity theory provides a framework for viewing the influential factors from a variety of subjects that play key roles in molding the teaching and learning environment.
Chapter VI: Conclusion and Implications

Conclusion

This study looked at Audience Response Systems (ARS) and examined teachers’ goals, classroom uses, and teachers’ perceptions of the impact that ARS had on student engagement. The research questions that guided this investigation were:

1. What goals do teachers have for using Audience Response Systems in elementary and middle school classrooms?

2. How do teachers use Audience Response Systems?

3. How are ARS uses related to teachers’ goals?

4. What do teachers perceive are the effects that ARS has on student engagement and how do such perceived effects relate to teachers’ goals and uses?

I examined these questions through an online survey, classroom observations, and interviews among elementary and middle school teachers and principals. The study limitations included the sample size, and only one classroom observation per teacher participant. Interviews and were used to minimize the limitations by establishing typicality among ARS classroom use.

Results from the study revealed that teachers had two distinct goals for using ARS in the classroom. Both goals relate to the teachers’ division of labor and are embedded in their daily tasks and responsibilities. The first goal involved using ARS in the classroom to improve and enhance assessment. Teachers with the goal of using
ARS to improve and enhance assessment expressed high ratings in the survey for statements such as increase teacher productivity, assess student learning for grades, save time needed for formal and informal assessments, and to promote effective student learning. The second goal for using ARS in the classroom entailed using ARS to improve and enhance learning. Teacher having the goal of improving and enhancing instruction revealed high importance ratings for survey statements such as increase the effectiveness of overall instruction, make students aware of their conceptual understanding, enhance feedback to students about their learning, and increase student attention and activity during lectures. From the interview data, more than 80% of teachers expressed using ARS in the classroom to improve and enhance learning. Approximately 58% indicated using ARS in the classroom to improve and enhance assessment, and 42% expressed having both goals for ARS use in the classroom, improving assessment and improving learning.

A principal component analysis of the survey data revealed three distinct components for ARS use in the classroom.

Component 1: ARS use that promoted classroom discussion and student thinking.

Component 2: ARS use that utilized feedback to adjust instruction.

Component 3: ARS use that checked for student understanding about current or previously learned materials without assigning grades from the results.

Teachers who used ARS to promote discussion and student thinking included teaching strategies that asked students to discuss, think, and rethink responses while using also incorporating strategies that facilitated peer conversations. This component of
classroom facilitated reaching the district’s 85% engagement goal, by actively involving students in the learning process. Teachers who used ARS to adjust instruction utilized feedback from ARS to evaluate the effectiveness of their teaching, modify their instruction in the midst of a lesson, and plan future lessons based on the student’s current performance. The use of ARS to modify instruction falls into the division of labor. Teachers who used this component of classroom practice enhanced the efficiency of their daily teaching responsibilities. Teachers who used ARS in the classroom to check for understanding about current or previously learned material generally had lessons that focused on review work, test prep, or checking the students' current level of performance to that desired standards. This last type of classroom use helps teachers monitor how the students are progressing towards the standards. Teachers do not need to invest time-consuming data management when an immediate feedback tool such as ARS was available to them. In an instant they could know how well their students are performing in relation to the desired standard. In general, teachers employed a mix of classroom uses and their teaching practices overlapped in one or more of the classroom use categories.

Several classroom uses correlated with the teacher’s goals of using ARS to enhance assessment and learning. Classroom uses that positively correlated with enhancing learning included such items as facilitating a whole class discussion, using ARS to identify students’ misconceptions, and having students respond to multiple-choice question in the middle of the lesson. The use of ARS for tests and quizzes positively correlated with the teachers’ goals of using ARS to enhance assessment.
Teachers goals and classroom uses are intricately influenced by the rules and mandates governed by both the state and the district. Teachers used ARS to facilitate their roles as teachers and the day-to-day duties that teachers have in a classroom setting. Teachers continuously assess students both formatively and informatively in order to assist students’ growth toward reaching the standards. ARS had the ability to facilitate the speed at which teachers could assess and provide feedback to students. Using the lens of Activity theory provided a clear view between the teachers’ goals and uses of ARS and the daily factors that influence and govern teaching and learning in the classroom. Teachers attempt to streamline their duties and ARS provided a timesaving method for many teachers. The speed at which teachers could assess and provide feedback with ARS was nearly instantaneous. The results show that teachers’ goals and uses for ARS were influenced by the rules and duties of their jobs.

The study found that teachers perceived students to be more engaged, more motivated, and more actively involved in the lesson while using ARS in the classroom. Statistically significant positive correlations emerged between teachers’ perceptions that ARS increased engagement and the classroom use of promoting class discussion and student thinking. Teachers' perceptions that ARS increased student engagement were positively correlated with teachers’ goals for enhancing instruction. Teachers' beliefs that ARS encourages students to work harder on some questions were positively correlated with the classroom use of having students identify themselves as answering a question in a particular way and facilitating a whole class discussion after displaying a histogram for student to view. Overall, teachers’ perceptions of the effects of ARS on student engagement were positively correlated with the goal of
using ARS to enhance learning and a variety of classroom uses that promote interaction, effort and engagement.

**Implications of this Study**

The implications of this study shed light on teachers' goals for using ARS in elementary and middle school classrooms and offer insight into how classroom uses are related to teachers’ goals. The findings offer a preliminary foundation to establish future studies examining teaching practices for ARS in K-8 classrooms. With these measures of teaching practices, researchers can now look at how classroom practices relate to achievement levels. In addition, researchers can look at implementing continuous professional development (PD) for teacher using ARS and how ongoing professional development influences classroom practices.

A second implication is to explore research that can establish best-practice methods for ARS within elementary and middle school classrooms. If documented classroom practices show an improvement in achievement, then future research studies can study the implementations of best practices and how those practices influence achievement levels.

A third implication is to use engagement measures to establish engagement comparisons between classrooms that use ARS and those that do not. Research can attempt to find classroom uses of ARS that promote the optimal amount of active engagement. If high amounts of active engagement are measured using ARS, how do such strategies relate to achievement? Research can focus on implementing high engagement strategies to see if similar results are achieved. The results from the
classroom profiles of use can provide a base for future research studies that attempt to identify ARS uses that increase active participation, and student achievement. For example, “peer instruction” is a strategy for increasing student interaction, participation, and mastery of concepts in higher education supported by previous research (Mazur, 1997). Further research can look at implementing such strategies in K-8 classrooms to verify if similar results are attainable. Further research can also study how various classroom uses such as using ARS to modify instruction, or to check for understanding influence learning outcomes goals. One striking difference between the results of this study and that of Penuel et al. (2007) was that Penuel found that K-8 teachers generally do not use ARS to promote classroom discussion. Promoting classroom discussion with ARS in higher education is widely documented as a productive teaching method. The key component that perhaps makes the outcome of this study different from Penuel et al.’s (2007) results was the WestEd T4S training mandated by the district. The teachers implemented specific strategies for increasing engagement levels during instruction, and one strategy was increasing discussion among students and between student partners. Similar to findings in higher education research, writing ARS questions that promote discussion and help uncover students’ misconceptions is time consuming and difficult for many teachers. Higher education is far more advanced in providing teachers with resources for writing good ARS questions and providing tips for implementation. The fact that students in elementary and middle schools are rarely given the opportunity to revote after discussing an answer with a peer might suggest that teachers at the K-8 level also experience difficulty in writing good ARS questions that promote discussion and
student thinking. Similar to higher education research, teachers at the elementary and middle would benefit from training in writing good ARS questions.

A unique similarity in the results from both the survey and the classroom observations showed that teachers rarely ask students to revote their answers after discussing the topic with a peer. In higher education, Peer Instruction is one method that asks students to vote again after discussing and debating their answers with a peer (Crouch & Mazur, 2001). In the elementary and middle school classrooms, voting again after discussing an answer rarely occurred. In contrast, teachers generally asked students a similar question testing the same concept, but students rarely had the opportunity to change their initial answer after clarifying explanations were given. The reason for this discrepancy might be that teachers lack training in developing good ARS questions. Most teachers in the study had no training in pedagogical and content strategies for using ARS. Higher education research has found that providing teachers with more content-based instruction and implementation strategies was key for successful implementation. The lack of content training at the elementary and middle school levels confirms that content training at the K-8 levels is also needed to assure successful implementation of ARS.

The teaching and learning environment is one that is intricately intertwined within a larger system of influences. Activity theory provided a lens for closely examining the teaching and learning environment within a classroom setting. The activity theory framework offered a structure for observing how desired outcomes, goals and classroom uses are influenced and mediated by tools, district rules, and the
roles of both the students and the teachers. Activity theory sheds light on the influences that played a part in the overall goals and outcomes. Future studies can look at the influences within activity theory and apply them to classrooms with varies forms on interactive technologies.

With the growing trend of interactivity among new technologies, the findings of this study can be used as a launching ground for further research with more interactive technologies beyond ARS. With the expansion of interactivity in the teaching and learning environment, future research can look at the expansion of classroom uses and teachers’ goals with more sophisticated forms of interactivity and emerging technologies.
Appendices

Appendix A – Administrative Questionnaire
Appendix B – Teacher Questionnaire
Appendix C – Type of Use Rubric
Appendix D – Survey Questionnaire
Appendix A - Administrator Questionnaire

1. What was your initial opinion/impression/attitude about clickers, and how did your site acquire the clickers? (Example: Single decision, team/staff/school site council decision, decision of previous administrator?).

2. How did the staff respond to the idea of using clickers in their lessons? How and in what ways did you need to create buy-in, or deal with opposition?

3. How do you want teachers to use clickers in their lessons?

4. If you were to offer advice to teachers on how to use the reporting features of the clicker program and expand their classroom use of clickers, what type of suggestions might you give them?

5. Are there any classroom practices using clickers that stand out to you more than others? If so, which ones, and why do you feel they stand out? Do you see any differences in clicker use among subject areas or grade levels?

6. How and in what ways do you feel classroom instruction changes with the implementation of clickers?

7. Think about the upcoming new school year, how do you hope to move forward or change the current use of clickers at your site? What would remain the same about the current practice and what do you hope will change?

8. How and in what ways do you think the formal reports in the clicker program help teachers meet the academic needs of their students while targeting the standards and benchmark achievement goals?

9. What effects do you feel that clickers have on student engagement?

10. What effects do you feel that clickers have on student achievement?

11. In what ways do you feel clickers help or hinder a teacher’s ability to deliver instruction?

12. Think of some of your teachers who stand out in their ability to successfully incorporate all the features of clicker program into their practice. (Histogram displays, reports, questioning methods, games, etc.) What is unique about these teachers that makes them more successful then others?

13. I know that East Valley teachers are using Teach for Success (T4S) strategies and some of the goals include 85% engagement and targeting a daily objective. How and in what ways do you feel that clickers help or hinder a teacher’s ability to meet the T4S goals?

14. How and in what ways did you or your teachers inform parents about the use of clickers in the classroom?

15. Is there anything else you feel that teachers or researchers should know about the use of clickers in an elementary or middle school classroom?
Appendix B - Teacher Questionnaire

1. How long have you been teaching?
2. How did you acquire your set of clickers?
   a. How long have you been using clickers?
   b. How many days a week do you use them?
3. Were clickers introduced to all of the teaching staff, or just a select group of teachers?
   a. How and in what ways were they introduced?
   b. Do you feel there are specific expectations of use? If so, what are they?
4. Can you describe a typical clicker lesson?
5. Think of all the considerations a teacher makes when planning a lesson. When you plan a lesson using clickers, what types of things do you consider?
6. In what ways do you feel that a lesson using clickers differs from a lesson without clickers?
7. If I came and watched you teach the same lesson again without clickers what aspects of the lesson will remain the same and what aspects would change?
8. If you could no longer use clickers how and in what ways would your teaching be affected?
9. If an individual, without previous knowledge of clickers, watched a lesson using clickers, watched a lesson using clickers, what types things might stand out to the observer?
10. Teachers who have clickers don’t always use them for every lesson. How do you decide when to use clickers for a lesson and when not to use them?
11. In what ways does clicker use help or hinder a lesson?
12. How and in what ways do you feel that using clickers helps or hinders your ability to manage the demands of benchmark testing, pacing, and district achievement expectations?
13. If I were to say, “I’ve been offered the opportunity to get a set of clickers. Do you think I should invest my time in them? What reasons would you give me to accept or reject the opportunity?
14. How often and in what ways do you use the formal report features of ARS?
15. In what ways do you think clicker use affect students?
16. In what ways do you think clicker use affect student learning?
17. What was your objective for the lesson in the videotape?
18. Do you feel that your objective was met?
19. If you did the same lesson again without clickers, how would you judge if you met the objective?
20. I know that East Valley teachers are using Teach for Success (T4S) strategies and some of the goals include 85% engagement and targeting a daily objective. How and in what ways do you feel that clickers help or hinder you ability to meet the T4S goals?
21. I noticed in the lesson that you (did/did not) share the histogram feature with students. Is this typical for you?
22. I selected several clips of your lesson using clickers. If another teacher were to watch this clip, what would you want the teacher to know about the lesson and what is happening in this particular segment. Are these clips typical of your clicker lessons?

23. This question is modified for each teacher based on the observation.
   a. I notice you used the clickers to take an “opinion poll” about how the students felt in regards to the upcoming test. Are there other ways you use clickers that I did not get a chance to see?

24. Is there anything else you feel that teachers or researchers should know about the use of clickers in an elementary/middle school classroom?

25. Many teachers told me that “they only use clickers for homework check, or for a warm-up, or for tests and quizzes, and they felt that they would not be a good candidate to observe. Why do you think they said this?

26. Outside the use of clickers, what is the most demanding, frustrating, or biggest challenge you face as a teacher?
Appendix C – Type of Use Rubric

Teacher ID Number __________________________
School ID Number __________________________
Grade ID Number __________________________

Date ___________________ Time ___________________

Check all that apply.

1. ____ Questions were prepared ahead of time.

2. ____ Students use the system to answer a multiple-choice question at the beginning of class, before beginning the day’s lesson.

3. ____ Students use the system to answer a multiple-choice question in the middle of class, midst of the day’s lesson.

4. ____ Students use the system to answer a multiple-choice question about the subject matter content being taught throughout the lesson.

5. ____ Students use the system to answer a multiple-choice question about something other than subject matter content (e.g. their level of engagement or understanding at the moment).

6. ____ Teacher displays a distribution of student responses to a question for all to see.

7. ____ Teacher hides the distribution of student responses to a question for all to see.

8. ____ Teacher asks students to identify themselves to the whole class as answering in a particular way. Student comment: “I answered “B” because…”

9. ____ Teacher asks students to discuss their answers with a neighbor or peer before registering an initial answer/vote.

10. ____ Teacher asks students to discuss their answers with a neighbor or peer after registering an initial answer/vote.

11. ____ Teacher asks students to answer/vote again after discussing an answer with a peer.

12. ____ Teacher asks students to answer/vote again after presenting an explanation of the idea or concept you are testing.
13. ___Teacher facilitates a whole class discussion of students’ ideas after displaying a distribution (histogram) of student responses.

14. ___Teacher comments that the next class session will change based on how students responded, or performed to the current lesson.

15. ___Teacher had alternate lessons ideas planned in order to have both ready to use (depending on how students respond to a question you pose). Teacher is explicit about having two versions of lessons or questioning patterns.

16. ___Teacher uses feedback from the clickers to make instructional changes during class.

17. ___Teacher uses feedback from ARS to help evaluate the effectiveness of their teaching. Statements include: “I can see that I am not making myself clear.” “I can see that I need to explain this concept in a different manner.” “I can see that many of are still confused.”

18. ___Teacher uses ARS for tests and quizzes.

19. ___Teacher uses ARS to identify students’ misconceptions.

20. ___Attendance

21. ___Teacher has students input homework answers.

22. ___Other

23. ___Other

24. ___Other

25. ___Other
Appendix D – Student Response System Questionnaire

The Use of Audience Response Systems in Elementary and Middle Schools

A. YOUR BACKGROUND

A1. How many years have you been teaching. Type in number of years.

A2. What grade level do you teach? (Mark all that apply for your school level)
   - ☐ 1
   - ☐ 2
   - ☐ 3
   - ☐ 4
   - ☐ 5
   - ☐ 6
   - ☐ 7
   - ☐ 8

A3. Elementary Only - In which subjects do you use the clickers?
   - ☐ Math
   - ☐ Science
   - ☐ Social Studies
   - ☐ Language Arts

A4. Middle School Only - In which subjects do you use clickers?
   - ☐ Math
   - ☐ Life Science
   - ☐ Earth Science/Physical Science
   - ☐ Chemistry
   - ☐ Physics
   - ☐ Social Studies/History
• ☐ Language Arts
• ☐ Other

A5. How long have you used clickers? (Enter number of years.)
  • ☐ Less than a year.
  • ☐ One year
  • ☐ 2 years
  • ☐ 3 years
  • ☐ 4 years
  • ☐ 5 years
  • ☐ More than 5 years

A6. How much training did you receive related to the technical aspects of using clickers?
  • ☐ None
  • ☐ Less than 1 hour
  • ☐ 1-4 hours
  • ☐ 5-8 hours
  • ☐ >8 hours

A7. How much professional development did you receive on instructional strategies to use in conjunction with clickers?
  • ☐ None
  • ☐ Less than 1 hour
  • ☐ 1-4 hours
  • ☐ 5-8 hours
  • ☐ >8 hours

A8. How often do you use other kinds of computer technology in your teaching?
  • ☐ Hardly ever
  • ☐ 1-2 times a semester
  • ☐ 1-2 times a month
  • ☐ 1-2 times a week
  • ☐ Almost every day
A9. How did you get your clickers?

- [ ] I purchased it on my own.
- [ ] I asked for it, and my school bought it.
- [ ] I was offered the opportunity to use it.
- [ ] I was directed to use it by an administrator
- [ ] Other:
B. YOUR USE OF CLICKERS

The following questions ask about your use of clickers—how often you use clickers and how you use them.

B1. Do you have clickers in your class at all times? (Mark one box only for each question.)

- [ ] Yes
- [ ] No

B1.1 If no, how often do you have access to it?

- [ ] Less than once a month
- [ ] Once or twice a month
- [ ] Once a week
- [ ] Several days a week

B2. How often do you use clickers for any purpose?

- [ ] Less than once a month
- [ ] Once or twice a month
- [ ] Once a week
- [ ] 2 or 3 days a week
- [ ] Every day or usually every day

B3. When using clickers, how often do you do the following? (Mark one box for each question.)

<table>
<thead>
<tr>
<th>Task</th>
<th>Hardly ever/never</th>
<th>Sometimes</th>
<th>Most of the time</th>
<th>Nearly every time</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Prepare ahead of time the questions you will ask students using clickers.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Ask students to use the system to answer a multiple-choice question at the beginning of class, before beginning the day's lesson.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
c. Ask students to use the system to answer a multiple-choice question in the middle of class, in the midst of the day's lesson.

<table>
<thead>
<tr>
<th>Hardly ever/never</th>
<th>Sometimes</th>
<th>Most of the time</th>
<th>Nearly every time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d. Ask students use the system to answer a multiple-choice question about the subject matter content you are teaching.

<table>
<thead>
<tr>
<th>Hardly ever/never</th>
<th>Sometimes</th>
<th>Most of the time</th>
<th>Nearly every time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

e. Ask students to use the system to answer a multiple-choice question about something other than subject matter content (e.g., their level of engagement or understanding at the moment).

<table>
<thead>
<tr>
<th>Hardly ever/never</th>
<th>Sometimes</th>
<th>Most of the time</th>
<th>Nearly every time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

f. Display a distribution of students' responses to a question for all to see.

<table>
<thead>
<tr>
<th>Hardly ever/never</th>
<th>Sometimes</th>
<th>Most of the time</th>
<th>Nearly every time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

g. Hide the distribution of student responses from students.

<table>
<thead>
<tr>
<th>Hardly ever/never</th>
<th>Sometimes</th>
<th>Most of the time</th>
<th>Nearly every time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

h. Ask students to identify themselves to the whole class as answering in a particular way.

<table>
<thead>
<tr>
<th>Hardly ever/never</th>
<th>Sometimes</th>
<th>Most of the time</th>
<th>Nearly every time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

i. Ask students to discuss their answers with a neighbor or peer before registering an initial answer/vote

<table>
<thead>
<tr>
<th>Hardly ever/never</th>
<th>Sometimes</th>
<th>Most of the time</th>
<th>Nearly every time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>j. Ask students to discuss their answers after a vote</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k. Ask students to answer/vote again after discussing an answer with a peer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>l. Ask students to vote/answer again after presenting an explanation of the idea or concept you are testing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m. Facilitate a whole-class discussion of students' ideas after displaying a distribution of student responses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n. Decide to adjust your lesson plan for the next class session on the basis of how students responded to a question</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o. Plan ahead of time and prepare two different lessons, or components of lessons, in order to have both ready to use (depending on how students respond to a question you pose)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p. Use the feedback from the clickers to make changes in your instruction during class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hardly ever/never</td>
<td>Sometimes</td>
<td>Most of the time</td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>-----------</td>
<td>------------------</td>
</tr>
<tr>
<td>q. Use the feedback from the clickers to help you evaluate the effectiveness of your teaching.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r. Use for test and quizzes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>s. Use to identify students' misconceptions.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
C. YOUR PURPOSES FOR USING THE SYSTEM

C1. How important are the following goals or benefits to you for using clickers? (Mark one box for each statement to indicate the degree of importance of each goal.) 1 = Very Unimportant; 7 = Very Important

E2. Please indicate the degree to which in your opinion, clickers confer the following benefits: (Mark (X) one box for each statement.)

[d. Students are better able to judge their understanding of class material.]

1 2 3 4 5 6 7

Very Unimportant Very Important

b. To stimulate class discussion about an idea or concept.

1 2 3 4 5 6 7

Very Unimportant Very Important

c. To make students more aware of their conceptual understanding.

1 2 3 4 5 6 7

Very Unimportant Very Important

d. To increase student attention and activity during lectures.

1 2 3 4 5 6 7

Very Unimportant Very Important
e. To gain a better understanding of what students do and do not understand.

Very Unimportant  ◯  ◯  ◯  ◯  ◯  ◯  ◯  Very Important

f. To enhance feedback to students about their understanding of target concepts or ideas.

Very Unimportant  ◯  ◯  ◯  ◯  ◯  ◯  ◯  Very Important

g. To assess student learning (where the assessment counts toward grades)

Very Unimportant  ◯  ◯  ◯  ◯  ◯  ◯  ◯  Very Important

h. To save time needed for the process of formal or informal assessment

Very Unimportant  ◯  ◯  ◯  ◯  ◯  ◯  ◯  Very Important

i. To increase your own productivity overall

Very Unimportant  ◯  ◯  ◯  ◯  ◯  ◯  ◯  Very Important
j. To get instant feedback from students

1 2 3 4 5 6 7

Very Unimportant  ○ ○ ○ ○ ○ ○ ○ Very Important

k. To differentiate or individualize instruction

1 2 3 4 5 6 7

Very Unimportant  ○ ○ ○ ○ ○ ○ ○ Very Important

l. To increase the effectiveness of instruction overall

1 2 3 4 5 6 7

Very Unimportant  ○ ○ ○ ○ ○ ○ ○ Very Important
E1. Please indicate the degree to which you agree or disagree with the following statements by marking the appropriate box. (Mark one box for each statement.) [a. Students are more actively engaged in a clicker class than in others.]

## E. EFFECTS OF CLICKER USE

E1. Please indicate the degree to which you agree or disagree with the following statements by marking the appropriate box. (Mark one box for each statement.)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Students are more actively engaged in a clicker class than in others.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>b. Class dynamics are not affected by the use of the clickers.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>c. The clickers help me tell if the students understand a concept.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>d. Class interactions resulting from using clickers helps student learning.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>e. There is no advantage in using the clickers to help students build on their previous knowledge.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>f. Some clicker questions make students try really hard to answer them.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neither agree nor disagree</td>
<td>Agree</td>
<td>Strongly agree</td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>----------</td>
<td>---------------------------</td>
<td>-------</td>
<td>---------------</td>
</tr>
<tr>
<td>h.  Students are equally on task in classes that use clickers and those that do not use clickers.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.  Using clickers, students can quickly tell whether they are right or wrong.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k.  I know as much about students understanding without clickers as with them.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>l.  There is a greater sense of community in a clicker class than in other classes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m.  Using clickers does not help improve understanding.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n.  Doing activities with clickers helps students get a better understanding of concepts.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o.  Clickers make no difference in students' effort in answering questions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
p. Doing activities in class with clickers helps students relate new material to things they know.

q. I have better-quality information about students' understanding through the use of clickers.

r. By using clickers I have more timely information about what students know.

s. I have been able to adapt instruction better to specific students needs or misconceptions by using clickers.
E2. Please indicate the degree to which in your opinion, clickers confer the following benefits: (Mark one box for each statement.)

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Not at all</th>
<th>Slightly</th>
<th>Moderately</th>
<th>Substantially</th>
<th>Tremendously</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Students are more active participants in class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Students are more motivated.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Students learn the material I teach better.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Students are better able to judge their understanding of class material.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. The class as a whole is more interested in learning.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. The students are more eager to help each other understand the material.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. The students feel as though I'm on their side to a greater extent.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
References


decision making, the 106th yearbook of the National Society for the Study of Education (pp. 74-104). Chicago: National Society for the Study of Education.


