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Does Teacher Behavior Change in Middle School Math Classes When Teachers Receive Instructional Coaching Using Bug-In-Ear Technology?

Ellen L. Browning
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DOES TEACHER BEHAVIOR CHANGE IN MIDDLE SCHOOL MATH CLASSES WHEN TEACHERS RECEIVE INSTRUCTIONAL COACHING USING BUG-IN-EAR TECHNOLOGY?

by

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A Dissertation Submitted to the Faculty of Old Dominion University in Partial Fulfillment of the Requirements for the Degree of

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Approved by:

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ABSTRACT

DOES TEACHER BEHAVIOR CHANGE IN MIDDLE SCHOOL MATH CLASSES WHEN TEACHERS RECEIVE INSTRUCTIONAL COACHING USING BUG-IN-EAR TECHNOLOGY

Ellen L. Browning
Old Dominion University, 2012
Director: Corrin Richels

The purpose of this study was to investigate if there is a relationship between the use of immediate feedback provided through instructional coaching and teacher behaviors shown to improve student achievement. Specifically this study used a time-series non-equivalent control group design to explore the relationship between instructional coaching using Bug-In-Ear (BIE) technology and teacher frequency of the following behaviors: (a) teacher use of technology-enhanced choral response as part of completed three-term contingency trials, (b) the high-access strategy of choral response versus the low-access strategy of call-outs and blurt-outs, (c) re-directs, reprimands, and behavior-specific praise statements. Measures of student engagement and achievement were collected by means of electronic student response systems. The findings of the study indicated that immediate feedback delivered by instructional coaching via BIE technology was not related to an increase in the frequency of completed teacher TTC trials. However, results indicated significant changes in teacher behaviors including use of choral response, re-directs and reprimands, and low-access strategies. A relationship between frequency and nature or coaching prompts and teacher prompts was also
demonstrated. This study contributes to the field of education by introducing technology-enhanced choral response as a high-access instructional practice that may increase composite student achievement.
This dissertation is dedicated to each and every person ever committed to the pursuit of knocking down the barriers that prevent each and every individual from achieving their fullest potential in life. In the words of Margaret Mead, “Never doubt that a small group of thoughtful, committed people can change the world. Indeed, it is the only thing that ever has.”

To my dad, whose love of science, weather, and nature shaped my love of the same from a very early age. Your work as a champion of science educators with challenging students served as an inspiration for my own career journey. Your enthusiasm and spark for teaching teachers how to reach students through interesting and relevant hands-on activities is un-paralleled.
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contest”. You were right dad! Thank you for instilling in me the resilience and determination to get through this. I love you all.
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CHAPTER 1. INTRODUCTION

Background and Need for the Study

“Our system of public education was founded on the proposition that children should have the opportunity to acquire an education, and this is a responsibility that it has performed well” (Van Acker, 2004, p. 40, as cited in Gable, Hester, & Hester, 2005). At first glance, the national report card (NCES, 2013) supports Van Acker’s (2004) contention that public education has succeeded in its mission to provide public school students a satisfactory education, even subgroups of “at-risk” students. In fact, an examination of eighth grade math test scores over the last 17 years demonstrates a clear upward trend (Figure 1.1). One could argue that it would be subjective to debate whether or not there has been adequate movement over time, and certainly that is a topic that warrants greater discussion. Regrettably, there is a more formidable and ominous topic that demands immediate attention.

Figure 1. Progress in math test scores for 8th grade students not “at-risk” and “at-risk” (NCES, 2013).

A closer look at the nation’s report card (NCES, 2013) highlights that among the major sub-groups of “at-risk” secondary school students, the closing of the achievement gap in
eighth grade math is nothing more than an illusion. In fact, we are not making adequate progress to close that achievement gap (Figure 1.2). Students with disabilities are especially at risk for poor performance and the gap between students with and without disabilities continues to increase.

Figure 2. Progress in closing the national achievement gap for 8th grade math (NCES, 2013).

Further compounding the issue of the persistent achievement gap among subgroups of “at-risk” secondary school students in 8th grade math is the latest report from the National Center for Education Statistics (NCES, 2013), which demonstrates that although the percentage of students at or above basic and proficiency levels in eighth grade math has improved since 2011, 26% of eighth graders continue to score below basic achievement
levels in math. According to NCES (2013), *basic* indicates only partial mastery of the fundamental skills required to be successful in grade level content. Similar to eighth grade math, the report for eighth grade reading shows that the percentage of students reading at or above basic proficiency levels has increased slightly, but 22% of eighth graders are scoring below *basic* reading levels. Eighth grade science has not fared any better. In 2011, NCES reported that 35% of eighth grade science students were achieving below *basic*. As one would expect, the achievement gap across core classes does not diminish as grade level advances. The latest report (NCES, 2013) indicates that the average score in twelfth grade mathematics has increased since the first assessment in 2005, but has remained unchanged since 2009. Similarly, average reading scores for twelfth graders have increased since the first assessment in 1992, but have also remained static since 2009. Specifically, 35% of twelfth grade math students are scoring below *basic* and 25% are scoring below *basic* in reading (Table 1).

Table 1

| Students Achieving Below Basic Competency in Core Classes |
|-----------------------------------------------|------------------|------------------|
| Core Class                                    | Grade 8          | Grade 12         |
| Math (NCES, 2013)                             | 26%              | 35%              |
| Science (NCES, 2011)                          | 35%              | N/A              |
| Reading (NCES, 2013)                          | 22%              | 25%              |

A plethora of research and dialog targeting educational reform has taken place during the last four decades (Blumberg, 2009; Kowalski, 2009; Polikoff, 2015), yet the achievement gap among subgroups of “at-risk” secondary school students persists. Notwithstanding the favorable achievement trends demonstrated across core content
areas for a percentage of the secondary school population (NCES, 2013), the enduring achievement gap among specific subgroups of students may be indicative of problems with instructional practice at large. Many experts believe that instructional practices congruent with the methodological literature base on evidence-based practices is a requisite for all students to achieve favorable educational outcomes (Cook & Cook, 2011; Detrich & Lewis, 2013). Evidenced-based practices (EBP) consist of instructional and classroom management practices that are grounded in research that is trustworthy and meets standards with regard to research design and effect sizes (Cook, Tankersley, Cook, & Landrum, 2008). Still, implementation of effective teaching practices in the classroom remains limited (Cook & Cook, 2011; Goodman, Brady, Duffy, Scott, & Pollard, 2008). Moreover, Cook and Cook (2011) ascertain that instructional practices not demonstrated as empirically reliable may actually negatively impact student outcomes. For these reasons, ethical responsibility dictates that action towards aligning practice with research must take place.

**Statement of the Problem**

Remediation of barriers that prevent the use of evidence-based practices in the classroom involves investigating and perhaps changing teacher behaviors. McLeskey and Billingsley (2008) assert that teacher behaviors can be shaped, developed, and maintained through instructional coaching. Moreover, a growing body of research posits that immediate, real-time feedback may have a more significant impact on teachers’ behavior than traditional delayed feedback (Coulter & Grossen, 1997, Rock et al., 2012; Scheeler, McKinnon, & Stout, 2012). Instructional coaching via Bug-in-Ear (BIE) technology is one method of delivering immediate feedback that has shown promising results for
increasing the use of specific teaching behaviors including those that are evidence-based. Indeed, research has demonstrated that instructional coaching via BIE technology has proved effective in increasing the high-access strategy of choral response (Rock et al., 2012; Rock et al., 2009) and completion of TTC trials (Goodman et al., 2008; Scheeler, Congdon, & Stansbery, 2010; Scheeler, Ruhl, & McAfee, 2004). In accordance, if instructional coaching via bug-in-ear technology can be used to change teacher behavior to increase the frequency of the high-access strategy of technology-enhanced choral response as part of completed three-term contingency trials, what follows may be progress towards narrowing the achievement gap.

**Research Gaps**

For the purposes of this study, the review will focus on three main areas where gaps in the existing literature are most apparent, (a) participant demographics limited to elementary school settings, (b) diverse measures of content, student engagement, and student achievement, and (c) the methodology used to investigate BIE as a coaching tool.

**Participant demographics.**

The last ten years has seen an increase in the number of studies examining the relationship between immediate feedback delivered during instructional coaching using bug-in-ear technology and various dependent variables including high-access instruction (Rock et al., 2012; Rock et al., 2009) and completion of TTC trials (Goodman et al., 2008; Scheeler et al., 2010; Scheeler, McAfee, Ruhl, & Lee, 2006). However, there remains a paucity of empirical research. Moreover, although results of BIE studies are promising, much of the research has been conducted within similar participant demographics (i.e., preservice teachers and elementary school students). Indeed, 53 out of
72 teachers participating in BIE research were serving in K-6 classrooms (Farrell & Chandler, 2008; Goodman et al., 2008; Kahan, 2002; Rock et al., 2012; Rock et al., 2009; Scheeler et al., 2012; Scheeler et al., 2010). Two teachers were reported as teaching in 7-12th grade and K-12 (Rock et al., 2012; Rock et al., 2009) but their actual grade level was not listed.

Related in kind to the narrow scope of participant demographics that is rife in existing BIE coaching research, the accumulated studies related to BIE coaching demonstrate that there are a greater number of participants with teaching experience than without experience. Across studies examining supervisory coaching via BIE as a professional development tool, all but 12 of the teacher participants involved in the research were seeking certification in a new discipline (i.e., special education) and were therefore classified as pre-service teachers. Additionally there were nine teacher participants working towards a degree in physical education and nine teacher participants acting in the capacity of a cooperating teacher supervising student teachers. These data are disconcerting in light of recently published statistics related to teacher demographics published by the NCES (2013). According to these statistics, 91% of teachers nationwide have greater than three years of teaching experience. Thus, although BIE research has increased, there remain insufficient studies that include in-service teachers.

**Content, student engagement, and student achievement.**

Despite an educational landscape that has been shifting for the last 20 years in order to accommodate district, state, and federal mandates (e.g., No Child Left Behind, adequate yearly progress, state end-of-course testing), the number of students experiencing dismal achievement rates in secondary math continues to be high,
particularly among “at-risk” subgroups (NCES, 2013). Surprisingly, out of the nine
studies on BIE coaching reviewed, only one was conducted in a middle school general
education math class (Scheeler et al., 2010) and the study was related to instructional
cochaching as part of peer coaching rather than as part of supervisory coaching. Further,
measures of student engagement were evaluated in two of the studies (Rock et al., 2012,
Rock et al., 2009) while a measure of student achievement (i.e., percentage of correct
student responses as part of TTC trials as related to change in teacher behavior due to
immediate feedback via BIE coaching) was investigated in just a single study (Scheeler et
al., 2006).

Methodology.

Kerlinger (1986) and Trochim (2006) posit that a frequent reason for the
preclusion of experimental research in situ may be the inability to control extraneous
variables during the research process. To illustrate this point, only four out of nine studies
reviewed were conducted in the actual classroom during the course of normal instruction
(Rock et al., 2012; Rock et al. 2009; Scheeler et al., 2010; Scheeler et al., 2006).
Moreover, one of those studies (Scheeler et al., 2010) was not related specifically to
supervisory coaching, rather it was investigating the efficacy of teacher dyads using BIE
as part of peer coaching. Yet, despite concerns of forgoing experimental control during
research, Black (1999) and Creswell (2005) assert that quasi-experimental designs are
similar enough to true experimental designs to make possible the investigation of cause
and effect relationships between one or more variables in a classroom.

Based on the aforementioned gaps in the extant literature base on BIE coaching,
we can only surmise that it is imperative to conduct further research on immediate
feedback via BIE coaching with in-service teachers in secondary math classrooms using (at the very least) quasi-experimental research methods. In accordance, existing research must be both replicated and extended in order to validate immediate feedback via BIE as a method of increasing evidence-based instruction in secondary math classrooms and in turn, narrowing the achievement gap among secondary math students.

**Purpose of the Study**

The purpose of the present study is to extend previous research examining the use of immediate feedback delivered by instructional coaching using BIE technology to change teacher behaviors. This study merges the dependent variables of the high-access strategy of choral response and completion of TTC trials. These variables were selected due to their use in interventions examined in previous research studies (Goodman et al., 2008; Rock et al., 2009; Scheeler et al., 2006) that investigated the use of bug-in-ear coaching in situ with three in-service middle school math teachers. Additionally, in response to Sindlar, Bursuck, and Halle’s (1986) assertion that monitoring individual student responses may prove difficult when using choral response, a technology component has been added to traditional choral response. Students will chorally respond to teacher prompts by way of electronic student response systems (SRS). Specifically, this study will examine the relationship between immediate feedback delivered by instructional coaching using BIE technology and the frequency of the high-access strategy of technology-enhanced choral response as part of completed TTC trials. Further, to better capture the relationship between immediate feedback as part of instructional coaching, change in teacher behavior and subsequent change in student
achievement gains, added measures of student participation and formative assessment are analyzed using data collected in real time by student response systems.

Research Questions

This study considered the following six research questions:

1. Does immediate feedback delivered by BIE coaching change teachers’ use of the high access strategy of technology-enhanced student choral responding (i.e., using SRS) as part of a teacher TTC (e.g., question, student response, corrective feedback/teacher reinforcement) in middle school math classes?

2. Does immediate feedback delivered by BIE coaching change teachers’ use of the low-access strategy of call-outs and blurt-outs in middle school math classes?

3. Does the frequency of classroom management prompts (i.e., re-directs and reprimands) used by the teacher change related to delivery of classroom management prompts (e.g., re-directs, reprimands, and precise praise statements) by BIE coaching?

4. Does the frequency or nature of instructional prompts provided by the instructional coach change related to the teachers’ use of the high access strategy of technology-enhanced student choral responding (i.e., using SRS) as part of a completed teacher TTC trial (e.g., question, student response, corrective feedback/teacher reinforcement) in middle school math classes?

5. Does the frequency of classroom management prompts provided by the instructional coach change related to use of re-directs, reprimands, and praise statements by middle school math teachers?
6. To what degree does student achievement as measured by electronic student response systems to questions created in collaboration with teacher participants relate to the teachers' use of the high access strategy of technology-enhanced choral response during instruction?

The dependent variables for this study include three teacher variables: (a) frequency of technology-enhanced choral response as part of completed TTC trials, (b) frequency of the low-access strategy of call-out and blurt-outs, and (c) frequency of redirects and reprimands; two instructional coaching variables: (a) frequency of all coaching prompts provided, and (b) frequency of classroom management prompts provided (e.g., re-directs and reprimands); and one student variable: change in student achievement. The independent variable is immediate feedback delivered by bug-in-ear coaching. Social validity measures include responses from all three teacher participants on a Likert-type survey and a written response from one study participant.

**Research Hypotheses**

The extant literature base on BIE technology led the researcher to three hypotheses related to teacher and coaching behaviors during instruction and student achievement before and after teacher participation in instructional coaching using bug-in-ear technology:

1. Middle school math teachers who receive immediate feedback from an instructional coach via BIE coaching will (a) increase their use of the high access strategy of technology-enhanced student choral responding as part of a completed TTC trial (e.g., question, student response, corrective feedback/teacher reinforcement), (b) decrease their use of the low-access strategies of call-outs and
blurt-outs, and (c) decrease the use of re-directs and reprimands while increasing the use of praise statements.

2. Middle school math teachers who receive instructional coaching will (a) require fewer instructional prompts from the instructional coach to use the high access strategy of technology-enhanced student choral responding (i.e., using clickers) as part of a completed teacher TTC (e.g., question, student response, corrective feedback/teacher reinforcement), and (b) require fewer classroom management prompts from the instructional coach related to the use of re-directs, reprimands, and/or praise statements.

3. Students will show improved achievement as measured by electronic student responses to questions created in collaboration with teacher participants as the teachers' use of high access strategies also increases.

**Glossary of Terms**

This study used the following definitions to establish operational definitions.

"At-risk" students: “At-risk” students are individual students or groups of students who have a statistically higher risk of academic failure than their non-“at-risk” peers.

Blurt-outs: A low-access instructional strategy in which a teacher poses a question in a manner that supports one or more random students calling out the answer.

Call-outs: A low-access instructional strategy in which a teacher poses a question and before giving the entire class an opportunity to think about and subsequently respond chorally, calls on one student by name.
Choral response: A high-access instructional strategy in which a teacher poses a question to the entire class, gives think time, and then solicits a “choral” response from all students, usually upon an agreed upon signal.

High-access instruction: Instruction that actively engages every student, provides think time for every student, and offers the teacher an opportunity for immediate formative assessment of student knowledge (e.g., choral response and “thumbs up when you know” strategy).

Low-access instruction: Instruction that limits the engagement of all students, treats all students as having similar skill sets, does not provide think time, and prevents many students from interacting with the teacher (e.g., blurt-outs, call-outs, and hand-raising).

Technology-enhanced choral response: Choral response via electronic student response systems (e.g., clickers).

Three-term contingency trial: A learning unit consisting of the following three components: (1) antecedent (e.g., teacher poses question) (2) student(s) respond to teacher question, and (3) consequence (e.g., corrective or reinforcing feedback). Action on all three components is required to be a complete TTC trial.

Assumptions, Limitations, and Delimitations

Assumptions

The following assumptions were present in the study:

1. Evidence-based practice may increase favorable student outcomes.

2. Public school classrooms are comprised of a heterogeneous subset of learners including those with and without special needs and with and
without those that are considered “at-risk” for failure.

3. Increased student engagement is a strong predictor of increased student achievement outcomes.

4. Engaged students are less likely to engage in disruptive classroom behaviors and will subsequently require fewer teacher re-directs, reprimands, and classroom management prompts.

5. Teachers want to engage in instructional practices that will increase favorable outcomes for their students.

Limitations

The following limitations were present in the study:

1. Participant selection was a convenience sample of three teachers and one class each of their students. Therefore, the study results may not be generalizable to a larger population.

2. Unresolvable limitations in software availability prevented the teachers from providing student prompts via their classroom laptops and SMART boards. Therefore, student prompts were generated in real-time by the researcher on her personal Dell tablet. This removed the capability of the teacher participants to collect and respond to real-time data (e.g., number of student responses, percent correct of student responses) which was the manner originally intended by this study.

3. Despite researcher requests for 5 pre-planned questions to use in conjunction with the student response systems as part of technology-enhanced choral response, teacher participants did not consistently provide
5 questions or provide questions in advance.

4. Limitations to the amount of student achievement data collected during the study and insufficient student response data eliminated the ability of the researcher to answer research question six with any degree of reliability.

5. According to Jackson (2005), when conducting a study with more than 3 dependent variables, multivariate statistical analysis is required. While, the design of this study built-in the use of “appropriate” SPSS statistics including multivariate analysis of covariance (MANCOVA) using the control group as a covariate, too few data points and distributions that were not normal prevented the use of parametric data analysis using SPSS. For these reasons, non-parametric equivalents were used as part of the inferential statistical analysis.

Delimitations

The following delimitations were present in the study:

1. The population was limited to secondary school math students and may not be generalizable to students in primary school and/or other subjects.

2. Phase change rules were based on number of data points taken rather than stability of a set criterion and may limit results.

3. Praise statements were recorded for frequency whether they were behavior specific or not. In that behavior-specific praise is supported by empirical evidence as being more effective in changing student behavior, the following limitation is introduced into this study: student behavior and academic gains may have seen greater increase if praise statements had
been behavior specific.

**Chapter Summary**

The present study is organized into five chapters. Chapter 1 provided an introduction to the study and reviewed cogent background information followed by a statement of the problem, research questions, and a list of definitions used in the study. Chapter 2 reviews literature related to evidence-based practice, instructional coaching, instructional coaching via bug-in-ear technology, the high-access instructional practice of choral response, TTC trials, and use of student response systems during classroom instruction. Chapter 3 describes the research design and methodology of this study including participants, procedures, data collection methods, and reliability. Chapter Four presents an analysis of the data collected and a brief summary of the findings. Chapter Five summarizes the study and includes a detailed discussion of the findings. Implications, recommendations, and conclusions close the chapter. Finally, a list of references and appendices of materials used during the implementation of the study are provided.
CHAPTER 2. LITERATURE REVIEW

According to Quinn, Poirier, Faller, Gable, and Tonelson (2006), the struggle to understand why some students fail to succeed in traditional classrooms is long and storied. Some experts argue that educational programming contributes to the inability of students to flourish (Quinn et al., 2006; Will, 1986). Others contend that the absence or minimal use of evidence-based instruction as part of daily practice has thwarted efforts to improve student outcomes (Carnine, 1997, Cook, Landrum, Tankersley, & Kaufman, 2003; Greenwood, 2001). Many experts believe, as did Roeser, Eccles, and Sameroff (2000) that favorable student outcomes are predicated upon quality instructional interactions between students and teachers (Jamil, Sabol, Hamre, & Pianta, 2015; Roeser et al., 2000). Indeed, factors that impact teacher efficacy have been widely examined and discussed (Detrich & Lewis, 2013; Gable et al., 2005; Simonsen, Fairbanks, Briesch, Myers, & Sugai, 2008; Watson, Gable, & Greenwood, 2011). Consistent with the supposition that the relationship between teachers and students is one of reciprocity, (i.e., effective teacher practice nets effective student outcome), numerous research studies and articles have been documented that substantiate the claim that teacher behaviors are central to student experiences (Bracey, 1994; Sindlar et al., 1986; Skinner & Belmont, 1993). Therefore, and quite understandably, professional development opportunities demonstrated to increase teacher efficacy warrant further investigation.

Prior to the design of the present study, the researcher conducted a comprehensive review of the literature regarding the use of (BIE) technology to provide immediate feedback to teachers as part of professional development was conducted. The purpose of the review was to examine the relationship of instructional coaching via BIE technology
on changes in teacher behaviors. Relevant literature related to high-access instruction, TTC trials, and student response systems was also examined.

In what follows, the results of the literature search are organized into five categories of relevant literature presented in the context of the purpose of this study: (a) instructional coaching of teachers (b) bug-in-ear as an intervention variable in teacher development (c) TTC trials as part of instruction demonstrated to increase student engagement (d) high-access and low-access instruction as they pertain to student engagement, and (e) student response systems as part of opportunities to respond and formative assessment.

Literature Search

The process used to locate articles for this review included a systematic search of online databases including Education Research Complete, ERIC, PsychINFO, Dissertations and Theses Full Text from 2002-2014. Search terms included the following key word combinations: bug-in-ear, whisper-in-ear, preservice teacher training, in-service training, coaching, instructional coaching, professional development, student teaching/supervision, wireless communication, advanced online bug-in-ear, evidence-based practice, evidence-based instruction, high-access instruction, choral responding, choral response, TTC, learning units, and student response systems. The following journals were hand searched to locate the most recent studies (2010-2014): Exceptional Children, Teacher Education and Special Education, and Learning Disabilities Quarterly. References from included studies were examined to locate relevant articles. Finally, Google Scholar was used to type in phrases and authors related to the keywords. Web results were subsequently followed up by going to the related articles sites that were generated.
Instructional Coaching

McLeskey and Billingsley (2008) suggest that teacher training for both novice and experienced teachers may be one of the most important factors in increasing teachers' fidelity of implementation of EBP. However, research demonstrates that teacher training alone may not be enough to maximize or sustain fidelity (Kretlow, Wood, & Cooke, 2009). Kretlow et al. (2009) found that although the frequency of instruction using evidence-based strategies increases after initial training, levels that are high and stable do not exist until teachers have received at least one individualized coaching session. Coaching, which involves an expert providing support or feedback to teachers (Showers & Joyce, 1996), was initially implemented as a professional development activity. Research has shown instructional coaching to be an effective type of follow-up support to preservice training and continued professional development (Filcheck, McNeil, Greco, & Bernard, 2004; Kretlow et al., 2009; Stichter, Lewis, Richter, Johnson, & Bradley, 2006). The accumulated literature on coaching in professional development includes two dominant models: supervisory coaching (Showers & Joyce, 1996) and side-by-side coaching (Blakely, 2001). Peer coaching is a third category that can be either supervisory or side-by-side (Allen & Leblanc, 2004). Regardless of the type of coaching, the timing of the instructional feedback plays a significant role in determining effectiveness of the support (Scheeler et al., 2004).

Wiedmer (1995) points out that instructional feedback for novice teachers typically has been implemented in a three stage process. In order, the process includes: pre-observation conferencing, observation, and post-observation conferencing. In-service teachers receive feedback in much the same way minus the pre-observation conferencing.
A standard in-service teacher observation includes a short classroom visit by a supervisor or administrator followed by a performance evaluation at a later date (Dyke, Harding, & Liddon, 2008). This traditional method has long been based on the premise that delaying feedback avoids disruption of instructional flow (Rock et al., 2012; Rock et al., 2009; Scheeler et al., 2006). However, mounting evidence indicates that immediate feedback is more effective in changing behaviors than delayed feedback (Rock et al., 2012, Rock et al., 2009; Scheeler et al., 2006; Scheeler et al., 2010). Additionally, Heward (1997) asserts that if feedback is delayed, learners are allowed to practice errors which translate into the incorrect performance of teaching skills and strategies. Fortunately, coaching via bug-in-ear (BIE) technology has made the delivery of immediate feedback an easy, effective, and affordable option that teachers report high levels of satisfaction with (Goodman et al., 2008; Rock et al., 2012; Scheeler et al., 2010).

**Bug-in-Ear Coaching**

BIE technology was first used by Korner and Brown in 1952 and was referred to as a mechanical third ear. Initially consisting of two-way FM audio systems that were used by the coach and the individual being observed in the same location, BIE technology has undergone significant changes since the 1950s. Recent online advances utilizing Bluetooth™ a USB adapter, and interactive videoconferencing such as SKYPE (Rock et al., 2012; Rock et al., 2009) enable an instructional coach to observe and provide corrective feedback during real-time teaching sessions from remote locations.

Giebelhaus (1994) conducted the first study in which BIE technology was used to offer feedback to teachers. The use of BIE allowed for immediate feedback to teachers without disruption of instruction (Goodman et al., 2008; Kahan, 2002). Research
spanning the last decade indicates that BIE technology is effective in changing teacher behaviors (Farrell & Chandler, 2008; Kahan, 2002; Rock et al., 2012; Rock et al., 2009; Scheeler et al., 2010; Scheeler & Lee, 2002; Scheeler et al. 2010; Scheeler et al., 2012). The ability to offer immediate corrective feedback to teachers during actual teaching sessions can facilitate the use of classroom practices that are grounded in EBP. The simplicity with which BIE technology allows for delivery of immediate feedback by instructional coaches coupled with affordable options including fully remote capabilities (Rock et al., 2009, Scheeler et al., 2012) has significant implications for teacher preparation programs and in-service professional development. Additionally, students may reap the benefit of this advanced online coaching technology.

Impact of Bug-in-ear Technology for Instructional Coaching

In recent years, there has been an increase in research on the impact of instructional coaching as a means of professional development for teachers. Knight (2011) specifies that one of the key goals of an instructional coach is to help teachers identify and implement evidence-based practices through effective feedback. According to Scheeler et al. (2004), effective feedback is feedback that results in a change in student or teacher behavior. Further, Knight (2011) contends that effective coaches are proficient at recognizing teacher needs based on coach and teacher relationships that have been established from the beginning. McREL Staff (as cited in Miller, Harris, & Watanabe, 1991) affirms that instructional coaching is more effective than lecture or demonstration at equipping teachers with the knowledge and skills required to be effective in the classroom.
During the last decade there has been an increasing interest in professional coaching that provides immediate feedback to teachers (Rock et al., 2012; Rock et al., 2009; Scheeler et al., 2006, Scheeler et al., 2012). Scheeler and colleagues (2004) conducted a review of nine empirical studies examining the impact of various types of feedback to teachers. Similar to results found in a study by Greenwood and Maheady (1997), Scheeler et al. (2004) found that effective feedback is consistent, corrective, and positive. In addition, Scheeler et al. (2004) found that effective feedback has a component of immediacy. These results are supported by earlier research by Coulter and Grossen (1997) as well as current research (Rock et al., 2012; Rock et al., 2009; Scheeler et al., 2006, Scheeler et al., 2012). Because students experience an increase in the efficacy and efficiency of learning as supported by the principles of operant learning with regard to specific, immediate, corrective feedback (Van Houten, 1980; Wallace & Kauffman, 1973), the same behavioral principles can be applied to teachers. Indeed, recent advances in Bug-in Ear technology provide opportunities for immediate feedback to teachers in a discreet, affordable manner.

**Outcomes for Bug-In Ear Coaching**

A summary of studies conducted with BIE coaching is provided in Table 2. Participants across studies included preservice or novice teachers, in-service (i.e., experienced teachers), and 4 senior high school students. Varying research designs were employed across studies including six single-subject multiple-baseline across participant designs (Goodman et al., 2008; Scheeler et al., 2006, Scheeler et al., 2008; Scheeler et al., 2010; Scheeler et al., 2012; Scheeler & Lee, 2002), two mixed methods designs (Rock et
al., 2009; Rock et al., 2012), one case study with an A B1B2 A reversal design (Kahan, 2002), and one case study with a basic qualitative design (Farrell & Chandler, 2008).

Although all nine studies focused on outcome measures related to the use of BIE technology to provide immediate feedback, the dependent variables measured varied across studies. Dependent variables are separated into three main categories as follows: 1) those that were specific to evidence-based instructional strategies (Rock et al., 2012; Rock et al., 2009), 2) those that represented measures of student engagement or outcome (Rock et al., 2012; Rock et al., 2009; Scheeler et al., 2006), and 3) those representing social validity of the study (Rock et al., 2012; Rock et al., 2009; Scheeler et al., 2006; Scheeler et al., 2012). A fourth dependent variable, directly related to the type of equipment used in each study, was the location of the coach giving the immediate feedback on site or from a remote location.

Authors of two studies reported an increase in one specific teaching behavior, TTC trials (TTC trials) by preservice teachers (Scheeler et al., 2012; Scheeler & Lee, 2002). According to Skinner (1968) TTC trials are discrete learning units comprised of an antecedent, student response and teacher response; in that order. Likewise, Goodman et al. (2008) reported an increase in one similar specific learning behavior, learning units (LU), by preservice teachers in addition to an increase in the rate and accuracy of the delivery of LU’s. Expanding previous research, Goodman et al. (2008) examined the rate and accuracy measures after fading of the intervention and found that both the rate and delivery of learning units were sustained over time.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Study Design</th>
<th>Participants</th>
<th>Type of Participant</th>
<th>Grade Level/Content</th>
<th>Duration/Setting</th>
<th>Dependent Variable(s)</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td>Farrell &amp; Chandler (2008)</td>
<td>Qualitative case study approach</td>
<td>N = 16</td>
<td>8 PE teachers and 8 student teachers</td>
<td>Primary school Phy ed</td>
<td></td>
<td>1) Which feedback method do teachers prefer, traditional or WIME?</td>
<td>Results indicate that WIME was found to have several advantages over traditional fb methods.</td>
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<td>Goodman, Brady, Duffy, Scott, &amp; Pollard (2008)</td>
<td>Single-subject Multiple baseline across participants</td>
<td>N = 3</td>
<td>Novice teachers with Spec Ed degree and &lt; 3 years teaching experience</td>
<td>6-8 K-3 Reading/Math (Special ed students)</td>
<td>Interventions occurred during regular instruction in the teacher's own self-contained/resource classroom</td>
<td>1) Rate and accuracy of LU delivery</td>
<td>Rate and delivery of LU's increased.</td>
</tr>
<tr>
<td>Kahan (2002)</td>
<td>A81B2A reversal design-case study</td>
<td>N = 2</td>
<td>One PE teacher and 1 student teacher</td>
<td>High school phys ed class with 46 students</td>
<td></td>
<td>1) What are the characteristics of dyadic communication? 2) What effect does BIE have on role satisfaction? 3) Social validity</td>
<td>Results indicate that BIE was identified as an effective communication tool that promotes &quot;with-it-ness&quot;.</td>
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<td>Rock, Gregg, Gable, Zigmund, Blanks, Howard, &amp; Bullock (2012)</td>
<td>Mixed methods sequential explanatory strategy</td>
<td>N = 13</td>
<td>Masters students enrolled in a personnel prep program</td>
<td>K-6</td>
<td>Interventions occurred during regular instruction in the teacher's own gen/sped classroom</td>
<td>1) Changes in teaching behavior 2) Changes in classroom climate including student engagement 3) Social validity</td>
<td>BIE technology facilitated positive changes in teaching behavior including an increase in effective teacher practices and student engagement. Overall, teachers reported a high level of satisfaction with the technology.</td>
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<tr>
<td>Rock, Gregg, Thead, Acker, Gable, &amp; Zigmund (2009)</td>
<td>Mixed methods sequential explanatory strategy</td>
<td>N = 15</td>
<td>Teachers enrolled in a field-based graduate special ed program</td>
<td>K-12</td>
<td>Interventions occurred during regular instruction in the teacher's own gen/sped classroom</td>
<td>1) Changes in teaching behavior 2) Changes in classroom climate including student engagement 3) Level of benefit/disruption associated with BIE technology</td>
<td>BIE technology facilitated positive changes in teaching behavior including an increase in effective teacher practices and student engagement. Overall, teachers reported a high level of satisfaction with the technology.</td>
</tr>
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<td>Scheeler, Congdon, &amp; Stansbery (2010)</td>
<td>Single-subject Multiple baseline across participants</td>
<td>$N = 6$</td>
<td>3 teacher dyads each consisting of a general ed &amp; spec ed teacher</td>
<td>7th grade general math</td>
<td>Interventions occurred in the general ed teacher’s inclusion classroom</td>
<td>1) % of TTC trials completed by co-teachers 2) Ease of use of BIE to give and receive instructional feedback</td>
<td>The study indicated an increase in completion of TTC trials. Teachers found BIE acceptable and practical to use during classroom teaching.</td>
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<tr>
<td>Scheeler &amp; Lee (2002)</td>
<td>Single-subject Multiple baseline across participants</td>
<td>$N = 3$</td>
<td>Preservice teachers enrolled in a special ed practicum</td>
<td>Primary school</td>
<td></td>
<td>1) % of TTC trials completed by teacher 2) Social validity</td>
<td>Results indicate that immediate feedback increased completion of TTC trials. Social Validity was high.</td>
</tr>
<tr>
<td>Scheeler, McAfee, Ruhl, &amp; Lee (2006)</td>
<td>Single-subject Multiple baseline across participants</td>
<td>$N = 5$</td>
<td>Preservice special education teachers (field experience)</td>
<td>Pre-K-5 Reading/Math</td>
<td>Interventions occurred during regular instruction in the teacher’s own classroom</td>
<td>1) % of TTC trials completed by teacher 2) % correct of student responses per intervention session 3) Social validity of intervention</td>
<td>Results support that immediate feedback delivered via BIE technology increased the % of completed TTC trials with preservice teachers in addition to an increase in % of correct student responses. The social validity questionnaire generated high teacher approval of BIE technology.</td>
</tr>
<tr>
<td>Scheeler, Machuckie, &amp; Albright (2010)</td>
<td>Single-subject Multiple baseline across participants</td>
<td>$N = 4$</td>
<td>High school seniors diagnosed with LD. All were attending a vocational school</td>
<td>12</td>
<td>Interventions occurred during the student’s regular class periods and lasted approx. 10 minutes per peer</td>
<td>1) The change in a specific behavior related to an oral presentation 2) Social validity</td>
<td>Results indicated that peer coaching via BIE decreased undesirable target behaviors which in turn increased desired performance objectives. Social validity was high.</td>
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Table 2  Continued

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<tr>
<th>Authors</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Scheeler, McKinnon, &amp; Stout (2012)</td>
<td>Single-subject</td>
<td>N = 5</td>
<td>Preservice special education practicum students</td>
<td>Primary Reading/Math</td>
<td>Interventions lasted 15 minutes and were conducted in the hallway outside of the student participant's classrooms.</td>
<td>1) 1% of TTC trials completed by teacher  2) Social validity of intervention</td>
<td>Results support that immediate feedback delivered via BIE technology increased the % of completed TTC trials with preservice teachers. In addition, the social validity questionnaire generated high teacher approval of BIE technology.</td>
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</table>
Two studies examined outcome variables related to student teachers and their cooperating teacher (Farrell & Chandler, 2008; Kahan, 2002). Both case studies reported qualitative data on the role satisfaction of cooperating teachers and preservice teachers when using BIE technology to give or receive feedback. However, that is where the similarities between the studies end. Farrell and Chandler (2008) were the only researchers to refer to BIE technology as Whisper-In-My-Ear (WIME).

The main focus of their study was to determine whether cooperating teachers preferred traditional supervisory methods over the WIME method. The results were mixed. Three out of four teachers reported that they would prefer a combination of WIME and traditional methods to receive feedback. All of the cooperating teachers agreed that BIE helped facilitate stronger connections with the student teachers and enabled them to provide immediate feedback without disrupting the flow of instruction.

Using a different approach to the use of BIE, Kahan (2002) expanded prior research by intermixing BIE technology with a think-out-loud strategy in an attempt to look at and analyze the characteristics of intralesson dyadic communication. Differentiation of communication characteristics were not found to occur as a result of the BIE technology. However, participants found the technology to be a useful supervision tool. Scheeler et al. (2010) also looked at dyadic relationships, but these dyads consisted of co-teachers in inclusive classrooms. In contrast to the studies measuring completed TTC trials by preservice teachers, Scheeler et al. (2010) measured TTC trials completed by co-teachers. They found an increase in completed TTC trials in addition to a high level of participant satisfaction with the coaching method.
In a landmark study using peer tutoring in a high school vocational setting, Scheeler et al. (2008) examined the impact of immediate feedback on the decrease of a specific student behavior. The behaviors targeted by each of the high school seniors included pace, inflection, and movement during oral presentations. Peer coaching via BIE technology was found to effectively decrease the undesirable target behaviors of speaking too quickly and moving around too much when giving a presentation. Decreases in unwanted behaviors resulted in increased desired performance objectives (Scheeler et al., 2008).

The remaining three studies (Rock et al., 2009; Rock et al., 2012; Scheeler et al., 2006) were the only studies to include a measure of student outcome. In lieu of TTC trials or LUs, Rock et al. (2012, 2009) utilized a mixed-methods approach to measure the following: changes in rates of response (measured by low-and high-access instructional strategies), changes in classroom climate and student engagement, and self-report data for participant reflections. Scheeler et al. (2006) added a measure of student outcome that consisted of the percentage of correct student responses. Across the three studies, an increase in effective teacher practices (increase in high-access instructional strategies/completed TTC trials) was observed (Rock et al., 2012; Rock et al., 2009; Scheeler et al., 2006) An increase in positive praise statements delivered by the teachers-in training was also observed. Based on these findings, we can posit that immediate feedback delivered by BIE coaching is a professional development tool for preservice, novice, and in-service teachers that may increase desirable teaching behaviors including those that are evidence-based.
Three-Term Contingency Trials

Three-term contingency trials consist of individual units of instruction (learn units) comprised of the following: (a) antecedent (b) student response, and (c) teacher feedback that are based on Skinner’s principle of operant conditioning (1968). The principle of operant conditioning posits that desired behaviors (or successive approximations of those behaviors) are reinforced by reinforcing stimuli (Skinner, 1968). In early behavior analysis applied to education, Skinner (1968) used formulaic instruction that included three components: (a) antecedent, (b) response, and (c) consequence (Vargas & Vargas, 1991). He theorized that the three components functioning as one unit of instruction would correlate strongly to effective instruction including time on task and opportunities to respond (Axelrod & Hall, 1999). To illustrate this point, a study conducted by Keohane (1997) demonstrated that the use of learn units served effectively as both a measure of effective instruction (i.e., formative assessment) and an effective teacher training tool. Student responses were used to inform instruction (corrective feedback or praise statements) while changes in teacher behavior were facilitated by analysis of student responses (Keohane, 1997). In a study by Albers and Greer (1991), two experiments demonstrated an increase in both TTC trials and the rate of correct responses by student participants in two experimental conditions. Collectively, this research (Albers & Greer, 1991; Keohane, 1997) supports Skinner’s (1968) work suggesting that TTC trials may be strong predictors of effective instruction. Further, Greer and Mcdonough (1999) posit that learn units (three-term contingencies), when utilized as analysis of both teacher and student behavior, may be the strongest predictor yet of effective instruction.
There is limited research on the effects of immediate feedback on the completion of TTC trials by preservice teachers. Among the few studies Scheeler and Lee (2002) and Scheeler et al. (2012) found that increase in the percentage of completed TTC trials directly followed feedback delivered by BIE technology. Although both of these multiple baseline studies indicated an increase in completed TTC trials as a result of immediate feedback, no measure of correct responding by students was reported. In a similar study, Goodman and Duffy (2008) conducted research on learning units (LU) which, like TTC trials, consist of a teacher initiated antecedent, student behavior, and consequence (Goodman et al., 2008). Supporting earlier research (Scheeler & Lee, 2002), the rate and accuracy of learning units increased in relation to immediate feedback however, student achievement was not included in this study. In an extension of the 2002 study, Scheeler et al. (2006) completed a study of preservice teacher behavior that demonstrated an increase in teacher completed TTC trials in addition to an increase in the frequency of correct responding in students.

Despite the promising results of studies demonstrating a relationship between an increase in teacher completion of TTC trials and subsequent increases in the frequency of correct responding in students, there remains a paucity of research in this area. There is, however, a substantial body of research supporting active student responding as a means of increasing opportunities for correct student responding (Hall, Delquadri, Greenwood, & Thurston, 1982; Martyn, 2007; Sutherland, Alder, & Gunter, 2003).
High-Access Instruction

Heward (1994) found that a relationship existed between increased levels of active student responding and increased student academic performance. Active student responding can be defined as any process in which students ask and answer questions (Heward, 1997). In that students who are actively participating during classroom instruction are more likely to recall information and achieve increased content mastery (Heward, 1997), it is logical to give all students frequent opportunities to respond. High-access instruction utilizes empirically-validated strategies that may increase the opportunity for increased student responding (Feldman & Denti, 2004).

High-access instruction is instruction that is specifically designed to ensure the active participation of both teachers and students during instruction (Feldman & Denti, 2004). According to Kameenui and Carnine (1998), high-access instruction may lead to increases in the following: (a) active engagement of all students, (b) maximized student participation, and (c) key concepts becoming accessible to all students, including students with diverse learning needs. Examples of high-access instruction include: (a) choral responding, (b) thumbs up when you know, (c) classroom whip around, and (d) classwide peer tutoring (Feldman & Denti, 2004). In a study by Rock and colleagues (2009), an increase in the use of high-access instruction (choral response, non-verbal group response, partner strategies, and cloze) by teachers was correlated to an increase in student engagement (Rock et al., 2009). Another significant finding was the increase in percentage of correct student responses from 76% accurate to 81% accurate (Rock et al., 2009). In spite of an empirical literature base replete with evidence supporting high-access instruction (Fuchs & Fuchs, 2001; Mastropieri et al., 2005; Reinke, Lewis-Palmer,
& Merrell, 2008; Rock et al., 2009), low-access instruction that limits the opportunities for students to be active participants prevails in many classrooms (Feldman & Denti, 2004). For example, in a traditional classroom, it is not uncommon for the instructor to ask one question to the class and allow one student to respond to the question after hand raising. This method of active responding limits the opportunities for participation to one student at a time (Gardner, Heward, & Grossi, 1994). Additional examples of low-access strategies include: (a) allowing students to call out answers, (b) round-robin reading, and (c) undifferentiated teaching (Feldman & Denti, 2004). One alternative to using a low-access strategy that allows for one student response at a time is to use choral responding.

**Choral Responding**

Choral responding, which refers to students responding as a group upon a given signal, has a surprisingly small literature base considering that it dates back to the one room schoolhouses of the early 1900s (Heward, 1994). Often used as part of the evidence-based practice of direct instruction (Carnine, Silbert, Kameenui, & Tarver, 2003), choral responding has not been widely used (or researched; Heward, 1994). An easy strategy to implement, choral responding simply requires every student in class to respond simultaneously upon an agreed upon signal (Wolery, Ault, Gast, & Griffen, 1992). In an early study by Kamps, Dugan, Leonard, and Daoust (1994), the researchers found that choral responding to increase student opportunities to respond resulted in gains in student achievement on weekly posttests (Kamps et al., 1994). Wolery et al. (1992) compared choral responding to individual responding with students with moderate intellectual disabilities. They found that use of choral responses increased both opportunities to respond and percentage of correct responses (Wolery et al., 1992).
Recent research by Rock and colleagues found that the increased use of choral response in addition to other high-access strategies (Rock et al., 2012; Rock et al. 2009) resulted in an increase in student engagement. These data are significant in that Fredrick (as cited in Rock et al., 2009) determined that students who are engaged 75% of the time experience greater academic achievement than those students who are less engaged.

Choral responding, in a “pre-21st century technology” era, is defined as a group, verbally responding to a question in unison (Heward, 1994). Blackwell and McLaughlin (2005) suggest that the effectiveness of choral responding is enhanced by the addition of the following elements: (a) a thinking pause, (b) clear signal for response issuance, (c) feedback, and (d) occasionally calling on individual students. More recently, technologies such as Student Response Systems, allow teachers the ability to use the high-access instructional strategy of choral responding more efficiently.

**Student Response Systems**

Traditionally, student responses and teacher feedback have taken various forms including: individual response, paper response, raising hands, and choral responding. In recent years, technology has opened the door to response and feedback at the click of a button in the form of Student Response Systems (SRS). Typical SRS consist of hand-held devices that allow students to send responses to a receiver that collects the input, tabulates the input, and then displays the aggregated data on a screen (Karaman, 2011; Kolikant, Drane, & Calkins, 2010). The teacher is then able to adjust real-time instruction based on the pupil responses while the students are also able to see the results. SRS may also be referred to as: classroom response systems (CRS), audience response systems (ARS), electronic response systems (ERS), and others (Guse & Zobitz, 2011; Hunter,
Rulfs, Caron, & Buckholt, 2010). Clickers refer to the remote hand-held device with which students send a response to a question. Answers typically take the form of true/false, multiple choice, or one-word answers.

Research on the impact of student response systems on learning is relatively modest. A study by Synder (2003) suggests that SRS increase student engagement by eliminating passive learning environments which in turn facilitate active listeners and greater learning. Another study conducted by Piorer and Feldman (2007) compared the performance of students using clickers to peers in equivalent courses not using SRS and found the performance of the students utilizing clickers to be superior. Trees and Jackson (2007) found that clickers are useful in assessing student learning and providing students with immediate feedback. The leveraging of student response systems as part of choral responding allows teachers to gather feedback in ways other than verbal output, which can prove difficult in terms of measuring the verbal response from individual students (Sindlar et al., 1986). This technology-enhanced high-access strategy provides students with an opportunity to interact with teacher prompts in an enhanced, empirically supported way. The fidelity with which TTC trials and technology-enhanced choral responding is implemented in classrooms is contingent on teacher knowledge and understanding of how to implement each strategy during instruction. Instructional coaching via BIE technology is a promising way to provide teachers with the support they need to implement evidence-based instructional strategies with fidelity.

**Empirical Gaps in the Literature**

The findings of these studies are broad in their implications for educators and students alike. The accumulated literature supports the assertion that immediate
corrective feedback delivered via BIE technology can increase in the specific EBP of completed TTC trials and use of the technology-enhanced high-access strategy of choral responding with preservice, novice, and in-service teachers. Further, the accumulated research demonstrates that increased teacher use of these strategies improves student behavior and performance including: student engagement, opportunities to respond, percentage of correct responses, and achievement. Notwithstanding the promise of these strategies and the number of years that they have been in existence, the review of research highlighted several critical gaps in the literature. First, the research base supporting both choral responding and TTC trials is small and outdated. Similarly, there is little replication in the growing body of research supporting the technologies of BIE and SRS on instruction coaching of teachers. Second, research conducted with in-service teachers and in secondary school settings and secondary math settings is insufficient and lacking in methodological diversity. Moreover, much of the research that has been conducted in situ has focused more on teacher behavior and student engagement than on the impact of instructional coaching on student achievement outcomes (Farrell & Chandler, 2008; Goodman et al., 2008; Scheeler et al., 2012).

The present study sought to address the aforementioned gaps in the literature while adding to the existing research base on empirically supported instructional strategies including: (a) high-access instruction, (b) choral response, (c) completion of TTC trials, and (d) use of student response systems during instruction. Further, this study served to expand existing research related to the delivery of immediate feedback by BIE coaching to in-service middle school math teachers. This study also aimed to expand the existing research by merging the high-access strategy of technology-enhanced choral
response with TTC trials. Finally, this study chose a quasi-experimental time-series design to investigate the relationship between the dependent variables.

Chapter 2 Summary

Chapter 2 provides an overview of the literature relevant to the present study. Following a summary of studies and literature related to instructional coaching, BIE coaching, and the dependent variables of TTC trials, high-access instruction (including choral response), and student response systems, gaps in the extant literature base were discussed. The purpose of the present study to address those research gaps and extend the current literature base was presented. What follows in Chapter 3 is a description of the research methodology that was used for this study.
CHAPTER 3. METHODOLOGY

The purpose of this study was to investigate the relationship, if any, of immediate feedback delivered by an instructional coach using bug-in-ear technology on specific evidence-based teaching behaviors. The specific teaching behaviors examined included: frequency of high-access instruction (choral response, thumbs up strategy), frequency of low-access instruction (call-outs, blurt-outs, reprimands, and redirects), and frequency of behavior specific praise. This study also examined the frequency of completion of TTC trials as part of the high-access strategy of technology-enhanced choral response and the use of student response systems for choral response. Additionally, this study examined the social validity of instructional coaching and using bug-in ear technology to deliver immediate feedback to teachers.

Method

Research began following approval from the Old Dominion University Institutional Review Board (IRB) and from the participating school division (Appendix A). The researcher encountered several insurmountable challenges throughout this study that resulted in study changes that are summarized in Table 3.

Table 3

Changes from Proposed Method

<table>
<thead>
<tr>
<th>Proposed</th>
<th>Changed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of Bluetooth technology</td>
<td>Use of wireless two-way FM radios</td>
</tr>
<tr>
<td>Teacher driven use of SRS for student prompts</td>
<td>Coach driven use of SRS for student prompts</td>
</tr>
<tr>
<td>Real-time SRS data used by teacher as part of completed TTC trials</td>
<td>Coach delivered data to teacher via BIE to be used as part of completed TTC trials</td>
</tr>
<tr>
<td>5 pre-planned questions as part of teacher prompts</td>
<td>Absence of 5 pre-planned questions as part of teacher prompts</td>
</tr>
<tr>
<td>Begin and end data collecting and audio recording upon an agreed upon teacher signal</td>
<td>Begin recording at start of class and end upon evidence of seat work beginning</td>
</tr>
</tbody>
</table>
Table 3 continued

<table>
<thead>
<tr>
<th>Proposed</th>
<th>Changed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect data and record audio until instruction ends or after 30 minutes</td>
<td>Record audio until all instruction ends. Collect data for 30 minutes of instructional time</td>
</tr>
<tr>
<td>Student achievement measured by pre and post tests and SRS data</td>
<td>Absence of pre and post-tests</td>
</tr>
<tr>
<td>Proposed title stated “change in student achievement”</td>
<td>New title states “change in teacher behavior”</td>
</tr>
<tr>
<td>Use of MANCOVA with control group as covariate</td>
<td>Use of Kruskal-Wallis non-parametric analysis</td>
</tr>
</tbody>
</table>

**Experimental Design**

This study employed a multiple time series with non-equivalent control group design (Table 4) to evaluate the effects of instructional coaching via bug-in-ear technology on specific evidence-based teaching behaviors and student achievement in middle school math classes. Similar to a simple time-series design, a series of observations took place throughout a planned intervention (Gottman, McFall, & Barnett, 1969). Though a time-series design can function as a quasi-experimental design when a control group is not possible (Gottman et al., 1969), this study included the added value of a non-equivalent control group that was not receiving the intervention.

Breakwell (1969) contends that with non-equivalent control group designs it is possible to have multiple levels of treatment or combinations of treatment. Accordingly, this study utilized two levels of interventions (Gottman et al., 1969). During both the first and second levels of intervention, immediate feedback via BIE coaching was delivered to two of the teachers while the third teacher received delayed feedback only. The second level of intervention introduced the use of student response systems as part of TTC trials by all three teacher participants and their students coupled with immediate feedback by BIE coaching for the same two teachers who received immediate feedback during the first level of intervention. Each of the three participants were repeatedly measured across
the two intervention conditions to assess perturbations in teaching relative to the variable. Finally, two maintenance probes, one with student response systems and one without student response systems were conducted. An additional generalization probe was taken on the same day that the final maintenance probe was taken. No feedback, immediate or delayed was delivered during the maintenance or generalization probes.

Table 4

*Multiple time-series non-equivalent group design*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 1</td>
<td>Observation</td>
</tr>
<tr>
<td></td>
<td>------</td>
</tr>
<tr>
<td></td>
<td>------</td>
</tr>
<tr>
<td>Teacher 1</td>
<td>Maintenance</td>
</tr>
<tr>
<td>Teacher 2</td>
<td>Observation</td>
</tr>
<tr>
<td></td>
<td>Intervention 1</td>
</tr>
<tr>
<td></td>
<td>Intervention 2</td>
</tr>
<tr>
<td>Teacher 3</td>
<td>Observation</td>
</tr>
<tr>
<td></td>
<td>Intervention 1</td>
</tr>
<tr>
<td></td>
<td>Intervention 2</td>
</tr>
</tbody>
</table>

**Independent variable.** The independent variable in this study was the presence or absence of the use of instructional coaching using BIE to provide immediate feedback. The intervention was an extension of research conducted by Scheeler and colleagues and Rock and colleagues (Scheeler et al., 2006; Scheeler et al., 2012; Rock et al., 2012; Rock et al., 2009).

**Dependent variables.** Data on dependent measures were collected on each of the three teacher participants, students from one class each of the three teacher participants, and on the instructional coach. Data were collected by means of tally marks taken by pen or pencil on an instructional coaching observation form (ICOF, Appendix D) during observations and interventions, and by means of tally marks taken while listening to the
audio recordings of the observations and interventions. Recorded data included:

frequency of the following teacher behaviors: (a) high-access strategy of student choral responding (by clickers and verbal), (b) low access strategies of call-outs and blurt-outs, (c) incomplete and completed TTC trials (verbal and by SRS; e.g., question, student response, corrective feedback/teacher reinforcement), (d) re-directs, (e) reprimands, and (f) praise statements.

Recorded data also included the subsequent effects on student participation and number of students answering correctly using student response systems during instruction. Finally, data were taken on the frequency and nature of instructional coaching prompts (e.g., instructional versus classroom management) delivered by the instructional coach.

Recruitment and Setting

The dependent variables investigated in this study could best be answered by conducting research in situ. Although, research conducted in the natural setting provides the added value of enhanced ecological validity, the trade-off is a participant sample that is not randomly assigned. According to Marston (2001), it can be difficult to adhere to the strict postulates of inferential statistics (e.g., random assignment of subjects) when conducting school based research. Notwithstanding this limitation, a major advantage of utilizing the time-series non-equivalent control group design as part of quasi-experimental research is that each subject served as his or her own control.

The school district selected for this study was chosen purposefully due to low math achievement scores relative to the state (based on state assessment scores). After the school district was selected, the researcher sent a request to conduct research to the
County School Board’s Senior Coordinator of Research and Evaluation in the Department of Assessment, Accountability, and Evaluation. Upon receiving permission to conduct research from the Senior Coordinator (Appendix A), the researcher began searching for a school in the county that might truly benefit from the study. In determining which schools might benefit the most, a review of 2014 comprehensive assessment scores as published by the state was conducted across all middle schools in the county. The researcher calculated the mean math score for the entire county and then targeted schools with a score less than that of the mean obtained. Subsequently, the researcher sent out six emails to middle school principals requesting the opportunity to conduct research at their school. Two replies were received, one “yes”, and one “no”. The “yes” came from a middle-sized suburban school system located in the southeast part of the country. Total enrollment for this school for the 2014-2015 year is 908 students. Of those 908 students, 76% of the students are eligible for free or reduced lunch and the student population is comprised of a heterogeneous mix (Table 5).

Table 5

<table>
<thead>
<tr>
<th>Ethnicity of Student Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>43.1%</td>
</tr>
</tbody>
</table>

Prior to the recruitment of teacher participants, the researcher emailed the Principal the inclusionary criteria for participants. The Principal replied that there were three math teachers who fit the criteria and were willing to participate in the study. An email was subsequently sent to the teachers by the researcher requesting a 15 minute introductory meeting to stop by and give a brief summary of the study.
Participants

Participants consisted of three teachers and their students (from one class each) from a public school district located in the southeastern United States. The study was conducted at the beginning of the second semester of the school year. All three teachers expressed a willingness to participate in the study and were therefore considered volunteers. Each of the teachers reported that they had never used SRS systems as part of their instruction and were excited to learn how to use the technology. Teacher 1 (T1) was thrilled about learning to use student response systems as part of instruction as it was a requirement for a portfolio that she was putting together as part of alternative licensure that was due in late spring. Teacher 2 (T2) was excited about the possibility of embedding the use of SRS into her classroom because she was struggling with classroom management problems (e.g., student engagement) and thought this might help. Teacher 3 (T3) was the only male participant and was pleased about this study because he had been to a professional development class on using SRS in classrooms but not had a chance to implement it in the classroom yet.

Teacher participant characteristics.

Teacher 1. T1 was a female with a bachelor’s degree in Anthropology. She was a 5th year teacher but had been teaching with a temporary teaching certification due to financial hardship. She was currently working on alternative licensure (ACE) and due to complete her certification in spring of 2015.

Teacher 2. T2 was a female with a bachelor’s degree in Child and Adolescent Psychology and an expired teaching certification in middle grades math. She had 3 years of teaching experience but had been out for the last 13 years raising her kids. She had just
come back into the classroom mid-year and just six weeks prior to the beginning of this study. She was taking coursework as part of re-certification.

Teacher 3. T3, an army veteran, had 2.8 years of teaching experience. He had a degree in Criminal Justice Administration and dual certification in Integrated Middle Grade Math and Integrated Middle Grade Social Science.

Prior to beginning the study, consent forms were given to the teacher participants and, since data were collected during the course of typical instruction practices, a letter alerting parents and students that a researcher would be present in the classroom was sent out.

Student participant characteristics.

Student participants included students with and without disabilities, and with diverse backgrounds who were currently enrolled in middle school math. The age of the students ranged from 12-14 years of age with an average age of 13.5 years. Two classes of students were 7th grader pre-algebra students and one class of students consisted of 8th grade pre-algebra students. T1’s class consisted of 20 seventh grade pre-algebra students and met first period. There was one student with exceptionalities in this class. T2’s class consisted of 20 eighth grade pre-algebra students learning the same curriculum as the 7th grade algebra students and met period 2. This class had 6 students with exceptionalities, 2 students that were English Language Learners (ELL) and spoke no English, and 1 ELL student who spoke very little English. The ELL students had no instructional support (i.e., interpreter) and did no work in class. The class had one special education teaching assistant who was providing services to one student. The teaching assistant was only present 4 out of the 13 days of the study and typically had little interaction with the
students. T3’s class, comprised of 20 seventh graders was also learning the same curriculum as both T1 and T2’s classes (geometry) but was called 7th grade advanced math as opposed to “pre-algebra”. Teacher 3 had 14 students with exceptionalities. A para-professional with unknown duties was in attendance for 6 out of the total 12 days of the study but had no interaction whatsoever with the students.

**Instructional coach characteristics.**

The researcher, who served in the capacity of the instructional coach, was a teacher with 11 years of classroom experience. Three of those years were served in urban schools as a high school Earth Science teacher. Six of those years were spent as a high school Earth Science co-teacher in both an urban and suburban setting. Two years were spend as a Special Education teacher in a suburban school and included co-teaching and teaching self-contained students in Algebra, Earth Science and Biology. The instructional coach held an undergraduate degree in Science and Education, a master’s degree in Special Education, and had completed the coursework required for a PhD in Special Education. The instructional coach also had prior experience as the Education Administrator for an alternative school in which she developed curriculum and instructional activities for staff and students. During her tenure as a teacher, the instructional coach conducted staff development on teaching science to increase student engagement and achievement, how to embed formative assessment into instruction, and how to collaborate effectively in co-taught classrooms. Additionally, the instructional coach served as a mentor teacher to preservice teachers who were enrolled in a teacher preparation program. Finally, as part of graduate training, the instructional coach
presented at collegiate conferences on how to use formative assessment during instruction and how to engage students with novel and creative teaching.

Teacher training, materials, procedures, inter-observer agreement, procedural fidelity, and social validity will be detailed below.

**Materials**

The bug-in ear technology used in this study consisted of a Motorola Talkabout two-way radio with a small earbud. The instructional coach used the two-way radio to deliver immediate feedback, while the teacher participants used the two-way radio to receive immediate feedback. The instructional coaching sessions were audio recorded with the Language Environment Analysis System digital language processor (LENA dlp), a small audio recording device. Each of the three participants and the coach had a dedicated LENA dlp device of their own throughout the study. Both the instructional coach and teacher participants wore a pocket lanyard around their necks that contained the LENA dlp device in a pocket and the FM listening system attached to the outside of the pocket with a belt clip. The student response system used in this study was the SMART Response XE system hooked up to a Dell tablet. The students recorded their answers using Smart response XE clickers. The instructional coach sat in the far back or extreme side of the classroom at a distance ranging from 3 to 7 meters from the teacher.

A researcher generated Instructional Coach Observation Form (ICOF; See Appendix D) was used to record the frequency of the following teacher behaviors: (a) high-access strategy of student choral responding (by clickers and verbal) (b) low-access strategies of call-outs and blurt-outs, (c) incomplete and completed TTC trials (e.g., question, student response, corrective feedback/teacher reinforcement), (d) re-directs, (e)
reprimands, and (f) praise statements. A second observation form, similar in design to the first, was created to record the frequency of coaching prompts in addition to treatment fidelity steps.

Finally, a social validity survey designed by the researcher to gauge teacher satisfaction of instructional coaching and instructional coaching via BIE technology was given to the teacher participants (Appendix E).

Participant Training

Teacher training.

After a short introductory meeting with the teachers to give a brief summary of the study and present teacher participants with consent forms (Appendix F) and parent notification forms (Appendix G), each teacher was emailed a copy of Feldman and Denti’s (2004) article (Appendix J) on the use of high-access versus low-access instructional practices. The teacher participants were asked to read the article prior to a scheduled training. After a prebaseline during which no data collection occurred but prior to baseline observations and data collection, a 30-minute training session was scheduled and held after lunch on a teacher work day. Each teacher was given a scripted checklist (Appendix I) giving a brief description of the study in addition to information and step-by-step procedures related to the individual components of the study. The checklist included step-by-step protocols for use of each of the following: (a) LENA dlp to record audio, (b) bug-in-ear technology to receive instructional feedback from the coach, (c) high-access instruction, (d) learning units (TTC trials), and (e) student response systems. At the end of each section of the checklist was a box for the teacher participants to check if they understood the component or technology.
After reading a brief description of the study, the researcher modeled how to turn the LENA dlp device on, press record, and insert the device into the lanyard pocket. Next, the researcher demonstrated use of the bug-in-ear technology to deliver and receive feedback. The researcher then practiced with each teacher individually. During individual practice, examples of the nature and type of feedback that might be delivered were modeled by the coach (Appendix B). Examples of high-access and low-access instruction were modeled, followed by examples of complete and incomplete TTC trials. Finally, the researcher demonstrated use of the smart response system using a Dell tablet and pre­scripted math examples. Teachers were shown examples of student-tailored content questions and given time to practice with the SRS. Once the teachers demonstrated 100% proficiency (as measured by 100% on five questions) they were informed that they would have to conduct a similar training with the students in the class participating in the study. A directions sheet for the SMART Response XE technology, downloaded from the SMART website was provided, along with relevant instructional links related to the technology. After training and modeling occurred for each section of the checklist, the researcher gave teacher participants an opportunity to ask clarifying questions. None of the teachers asked any questions, the teachers signed a checklist indicating completion of training and the training was concluded.

**Student training.**

One day after teacher participants completed their training on how to use the SRS, they instructed their students on how to use the SRS to respond to teacher questions. Prior to teachers training the students how to log-in and respond to questions using student response clickers, the instructional coach provided each of the three teachers with student
ID's unique to use with the SRS. Students were identifiable to the teacher by number so as to match responses to individual demographics, but no personally identifying information was available to the instructional coach. A number of students were familiar with the technology while others were not. After failed attempts to have the teacher's laptops set up with the SMART software required to work with the SMART Response XE response systems, the students were given practice questions with the help and collaboration of the teacher and instructional coach. Students were able to demonstrate 100% proficiency with the SRS technology (as measured by 100% on five sample questions).

Training fidelity was measured by a second researcher listening to an audio recording of teacher and student training and checking off each step in training as it was articulated by the instructional coach into the LENA dlp.

**Instructional coach training.**

Knight (2011) asserts that instructional coaching is a skill that is complex and requires circumspection. Accordingly, careful thought and planning preceded the study. Prior to the study, the researcher/coach had received extensive training in instructional methodologies and use of evidence-based strategies in the classroom from both the school systems that she had worked for as a teacher and from the university that she was attending as part of her graduate work. Still, to increase the efficacy of instructional coaching for this study, the researcher/coach began preparing for the study by evaluating both the frequency and nature of coaching prompts delivered as well as the situations in which they were delivered in similar studies (Scheeler et al., 2006, Scheeler et al., 2012; Rock et al., 2012; Rock et al., 2009). Further, the researcher/coach read a highly regarded
book, *Coaching Whole School Change, Lessons in Practice from a Small High School* (2008) in order to better understand the complexities of school coaching. Additionally, the researcher/coach examined peer-reviewed literature related to skill sets that are reported to facilitate effective coaching relationships. Among the skill sets reported in the literature were: interpersonal relationship skills, problem solving skills, and content expertise (Curtis, Castillo, & Cohen, 2008; Gutkin & Curtis, 2008). Notwithstanding the recommendations ascertained in the literature, Borman, Ferger, and Kawakami (2006) who conducted a synthesis of literature related to instructional coaching, maintain that although there are certain qualities, characteristics, and training that lead to effective instructional coaching, the setting of the coaching intervention varies perhaps as much as the coach.

**Procedure**

A time series non-equivalent control group design utilizing two levels of intervention was used in this study. This study had four phases (not including a prebaseline observation to wear off any novelty effect with teacher and student participants): Phase 1 (baseline), Phase 2 (Intervention 1), Phase 3 (Intervention 2), and Phase 4 (maintenance and generalization). The intervention consisted of an instructional coach delivering immediate feedback to teachers during regular classroom instruction via bug-in-ear technology. The instructional coach, seated in the far back or far sides of the classroom, provided instructional prompts, classroom management prompts, or praise that were all behavior specific. The nature of feedback delivered was both corrective and reinforcing.
**Prebaseline.** A prebaseline observation period of 3 days was conducted prior to training and prior to the beginning of baseline data collection. This prebaseline observation was conducted in order to wear off any novelty effect with the teachers and/or the students (Leedy & Ormond, 2010). During the prebaseline observation period, the three teachers delivered their usual instruction without any of the materials used during the baseline and intervention phases. The instructional coach sat in the position that they would be in when taking data, the far back or far side of the classroom, and did nothing but observe. No data were recorded and zero feedback, delayed or immediate, was given. It is important to note that traditional instruction was delivered by all three teachers in all phases throughout the study. All teachers delivered instructional content as mandated by district and state standards, however, content was not synchronous across classes. Similarly, instructional delivery, technology utilized during instruction (including the questions asked while using the SRS), and time spent on actual “instruction” varied across each of the three classes.

**Phase 1 baseline.** Time series designs utilize successive observations across interventions to assess change and fluctuations during the entire process (Blackwell, 1969), therefore, the criterion set for change from one phase to another in this study was based on number of data points rather than stability of performance at a certain level. After prebaseline, the three teacher participants remained in the baseline phase for three days. During baseline, all three teacher participants wore the LENA dlp device (turned on and recording) and the bug-in-ear equipment (turned off) around their neck. Baseline data were recorded by tally on an Instructional Coach Observation Form (Appendix D). Frequency data included on the form included: (a) the high-access strategy of student
choral responding (b) low-access strategies of call-outs, blurt outs, and no-responses (c) completed TTC trials (d) re-directs, (e) reprimands, and (f) praise statements. Tally marks were used to record each component of a TTC trial including: (a) teacher question (b) student response, and (c) teacher feedback. Using Albers and Greer's (1991) observation format as a model for recording completed TTC trials, if a checkmark was placed in the antecedent and response columns, a trial was indicated. If a mark was also included in the feedback column, a completed TTC was recorded. None of the teachers utilized student response systems as part of their traditional instruction, so choral response via SRS was not included in baseline data recording. The observation and instructional coaching sessions ended when the teachers gave students independent or group seat work. Prior to exiting class, the instructional coach collected the pocket lanyard carrying the BIE and LENA dlp.

Delayed feedback was delivered to each of the three teacher participants by the instructional coach on the same day that baseline data were recorded. Delayed feedback consisted of feedback that was both corrective and reinforcing and was delivered immediately after class, during a period 3 planning (which they all shared), or in an email sent within one hour of the end of the instructional school day. Delayed corrective feedback always followed behavior specific praise and was typically related to one or more of the following: (1) use of high-access instruction, (2) feedback as part of completed TTC trials, or (3) classroom management suggestions. Verbal descriptions and modeling of how to engage in high versus low-access instruction and/or complete TTC trials often accompanied both corrective and reinforcing feedback. Corrective feedback for classroom management was behavior specific and included recommendations for
evidence-based strategies including those highlighted by Gable, Hester, Rock, and Hughes (2009) which included: (a) establishing classroom rules, (b) enforcing rules, (c) teacher use of behavior-specific praise, (d) planned ignoring, and (e) effective use of reprimands.

**Phase 2 intervention 1.** During intervention 1, two out of the three teacher participants received immediate feedback via bug-in-ear technology during the course of their normal instructional delivery. Immediate feedback was delivered from the coach who was located in the either the back or far side of the classroom (depending on the class). In addition to delivering immediate feedback, the researcher/coach audio-taped the sessions, and collected frequency data via tally marks on the ICOF during content instruction for three days. Frequency data included on the form included: (a) the high-access strategy of student choral responding (i.e., using clickers), (b) low-access strategies of call-outs and blurt-outs (c) completed TTC trials (e.g., question, student response, corrective feedback/teacher reinforcement), (d) re-directs, (e) reprimands, and (f) praise statements. Frequency of coaching prompts were also recorded. Conditions requiring immediate feedback and samples of instructional coaching prompts are summarized in Appendix B. Content instruction, material covered, and instructional delivery were not uniform across classes. Further, the amount of time spent on instruction also varied from teacher to teacher and ranged from 20 minutes to 55 minutes but data were only collected for 30 minutes of instruction. The observation and instructional coaching sessions ended when the teachers gave students independent or group seat work. At the end of each observation session, the instructional coach collected the pocket lanyard holding the BIE and LENA dlp prior to exiting the class.
One of the three teacher participants, Teacher 1 (control) engaged in traditional instruction similar to that of Teacher 2 and Teacher 3 but did not receive any immediate feedback. Once again, the instructional coach was positioned in the back of the classroom seated away from students and recorded frequency data identical to the data taken for the two teachers receiving the intervention. Delayed feedback, similar in nature to that delivered during baseline, was provided at the end of class, during period 3 planning, or by email within 1 hour of the end of the instructional day.

**Phase 3 intervention 2.** During intervention 2, treatment conditions remained identical to those in intervention 1 except that student response systems were embedded into content instruction and utilized as part of technology-enhanced choral response as part of completed TTC trials for all three of the teacher participants and their students. T2 and T3 continued to receive immediate feedback while T1 received delayed feedback only. Frequency data were collected by the instructional coach in the same manner as it was collected during intervention 1.

Student response systems (clickers) were handed out or collected by students upon entry into class. Upon the teacher’s verbal signal, students logged in to their student response systems using their unique ID. The researcher/coach plugged in student prompts that were given to her just prior to the start of class (or during class) and when the teacher indicated (usually with a nod), the researcher/coach electronically sent the question (via the SRS) to the students. While students were answering the prompts, the instructional coach provided live data to the teacher via BIE including: (a) the number of students that had answered the question, and (b) the ratio of correct to incorrect student responses. Using these data, the teacher provided corrective or reinforcing feedback to the students.
Intervention 2 lasted 3 days for Teacher 1 (control teacher), 5 days for Teacher 2, and 4 days for Teacher 3. Differences in the number of data points collected during intervention 2 were due to teacher absences due to personal reasons.

**Maintenance.** Two follow-up probes used to evaluate the maintenance of using choral response as part of completed TTC trials were collected. The first maintenance probe was collected one week following the end of intervention. The instructional coach was still cooperating with the teachers with the student response systems during this maintenance probe. The second maintenance probe collected four-weeks post intervention did not include coach utilization of the SRS because the researcher wanted to see if the teachers would incorporate SRS on their own.

**Generalization.** One generalization probe was collected for each teacher four-weeks post intervention to see if they incorporated the high-access practice of choral responding as part of completed TTC trials with and without student response systems. The generalization probe was taken during a class of each teacher participant’s other than the one used for study data points.

**Observation and data collection procedures.** The instructional coach collected data for 30 minutes each instructional session by pen and paper frequency tally in real time on the ICOF (Appendix D) and by audio recording each session. The sessions were recorded on a LENA dlp worn by the teacher and the instructional coach. Frequency data collected included (a) the high-access strategy of student choral responding (verbal and using clickers), (b) low-access strategies of call-outs and blurt-outs (c) completed TTC trials (e.g., question, student response, corrective feedback/teacher reinforcement) with and without use of student response systems, (d) re-directs, (e) reprimands, and (f) praise
statements. Data were later coded for number of completed TTC trials, number of incomplete TTC trials, frequency of choral response using the SRS, frequency of verbal choral response, frequency of teacher reprimands, redirects, and praise statements. Coaching feedback was recorded by the LENA device during each treatment session and subsequently coded for the following: frequency of instructional prompts, frequency of classroom management prompts, and frequency of praise statements.

Training for reliability on dependent variables. A research assistant with a bachelor's degree in Accounting and a minor in Computer Sciences who collected data for agreement purposes was trained by the researcher/coach to identify and code the following: (a) the high-access strategy of student choral responding (i.e., using clickers), (b) low-access strategies of call-outs and blurt-outs, (c) completed TTC trials (e.g., question, student response, corrective feedback/teacher reinforcement) with and without student response systems, (d) re-directs, (e) reprimands, and (f) praise statements. Both the researcher and assistant researcher listened to audio recordings of the teachers during two separate training sessions and tallied teacher performance on the target behaviors. Training consisted of operationally defining terms, written and verbal instructions on how to code data, modeled examples and non-examples of variables, practice, and corrective feedback. Training was complete when the research assistant obtained 90% agreement with the researcher over three consecutive trials.
Inter-rater agreement, procedural fidelity and social validity

Inter-rater reliability was established throughout all phases of the study using both the ICOF and audio recordings. The instructional coach took live data during the instructional observation and coaching sessions and then re-coded the data using the audio recordings obtained during the observations. A second researcher was trained on coding procedures using the ICOF form after all the audio sessions had been collected. The second researcher was trained on how to code behaviors including: (a) high-access strategy of student choral responding (by clickers and verbal) (b) low-access strategies of call-outs and blurt-outs, (c) incomplete and completed TTC trials (e.g., question, student response, corrective feedback/teacher reinforcement (d) re-directs, (e) reprimands, and (f) praise statements. The second researcher was also trained to code the frequency and nature of instructional coaching prompts (e.g., instructional versus classroom management).

The two researchers engaged in practice coding sessions using point-by-point analysis of recorded “teacher” audio until they reached 90% agreement. A second practice coding session included practice coding of the recorded “coach’s” audio. Practice continued until they reached 90% agreement. Audio recordings from each phase were then randomly selected for inter-rater reliability using www.random.org. After training and practice, the first and second researcher listened to the same audio recordings independently, at different times, and in different locations.

The second trained researcher listened to and coded 33% of baseline audio for all participants, 40% of intervention 1 audio for all participants, and 55% of intervention 2 audio for all three teacher participants. Once the audio coding was completed, inter-rater
reliability was obtained by taking the number of agreements for the observation periods and dividing them by the number of agreements plus the number of disagreements. An inter-rater reliability of 93% was obtained by multiplying that number by 100 (Kazdin, 1982).

**Treatment fidelity**

Treatment fidelity was completed on 100% of all intervention sessions to ensure that the intervention was implemented as described in the procedural protocol (Appendix I). In that school district approval for this study permitted only one researcher to be in the classroom collecting data, the instructional coach articulated a verbal confirmation of each of the procedural steps into the LENA dlp at the start of every observation or instructional coaching session. Treatment fidelity was then calculated from the recordings by dividing the total number of steps in the treatment protocol by the total number of steps followed plus the number of steps not followed and multiplying that number by 100 (Bryan & Gast, 2000). Treatment fidelity was 100% for both phases of interventions.

**Social validity**

The perceived social validity of a study intervention is an important piece of the research. Because this study presented an intervention aimed at enhancing teacher performance and student outcome measures, a researcher generated social validity measure was given. The social validity survey consisted of a Likert type survey consisting of 8 items. The eight items focused on both satisfaction of instructional coaching and on satisfaction of instructional coaching by BIE technology. Two questions related to student outcomes were also included.
Data Collection and Analysis

Measurement Instruments

The researcher and a second researcher recorded the frequency of the following teacher behaviors on an Instructional Coaching Observation Form (ICOF) generated by the researcher. The ICOF included frequency measures for: (a) high-access strategy of student choral responding (verbal and via SRS), (b) low-access strategies of call-outs and blurt-outs (c) completed TTC trials (e.g., question, student response, corrective feedback/teacher reinforcement) with and without student response systems, (d) redirects, (e) reprimands, and (f) praise statements. In addition, a separate ICOF, was used to document both the frequency and nature of instructional feedback provided to teachers during instructional coaching and treatment fidelity. SRS software recorded the quantity and nature of student responses during choral responding during each intervention. The percentage of correct responses to incorrect responses served as a formative measure of student engagement and achievement. Finally, a social validity questionnaire was used to measure levels of satisfaction with the intervention.

Data Analysis

Data were analyzed in two ways based on the type of data collected and the relationship that the research question was assessing. Research questions one through five were examined with graphed data generated by way of the Microsoft applications of Excel and Powerpoint. The graphs were then examined for visual patterns and trends. Questions one through three were analyzed using a combination of visual data inspection and non-parametric statistical data. Statistical analysis was used to look for statistically significant relationships. Social validity data were descriptively analyzed.
Visual analysis of data.

Visual examination of graphed data is recommended by Kratochwill and colleagues (2010) when trying to ascertain the strength of a cause and effect relationship. After inputting data into Microsoft Excel, mean frequencies and range of frequencies were calculated. Next, data were used to generate line graphs. The X-axis was used to represent observation sessions and the Y-axis represented frequency of behaviors. The percentage of non-overlapping data were analyzed along with variability and trend between intervention phases.

Statistical analysis of data.

According to Jackson (2005), multivariate statistics must be used to analyze data that has more than one dependent variable. However, although the original intent of this study was to run MANCOVA via SPSS using the control teacher as the covariate, insufficient data and measurement variables in violation of the normality assumptions of parametric statistics (McDonald, 2014) prevented such an analysis. Therefore, the Kruskal-Wallis test, a non-parametric equivalent of ANOVA with capabilities of analyzing data with more than two values (McDonald, 2014), was used.

Frequency data were entered into SPSS software by categories (e.g., call-outs and blurt-outs, re-directs and reprimands) and sessions. Data were further broken down into intervention levels (i.e., intervention 1 and intervention 2). Next, homogeneity of variance tests were conducted for all variables across the teacher grouping variable to ensure normal distributions. Finally, the Kruskal-Wallis test was performed in SPSS using the following sequence: (1) Analyze, (2) Non-parametric tests, (3) Legacy dialog, and (4) K-independent samples. The teacher participants, coded with the values of: “3”
(control), "2" (Teacher 2) and "1" (Teacher 3), were entered as the “Grouping Variable” and the target behaviors of: completed TTC trials (with and without SRS), call-outs and blurt-outs, re-directs, reprimands and praise statements, coaching prompts, and classroom management coaching prompts were entered into the “Test Variable List”. For each significant result obtained (p < .05), two matched pairs tests were run using the aforementioned Kruskal-Wallis procedure only these times the “Grouping Variable” consisted of the following pairs: (1) T1(control) and T2, and T1(control and T3). Finally, statistical significance was reported using the Chi square value and the Asymp.Sig. value.

Chapter Summary

This chapter described the research design and methodology utilized in this study. An overview of participant demographics, materials, procedures and data collection methods were discussed. In addition, a detailed description of the data analyses conducted during this study were provided. The next chapter will discuss the results of the data analyses.
CHAPTER 4. RESULTS

This study examined the impact of immediate feedback delivered by BIE coaching on specific teaching behaviors and student outcome measures. This chapter is organized in sequence by the six research questions presented in Chapter 1. The six questions are: (1) Does immediate feedback delivered by BIE coaching change teachers’ use of the high-access strategy of technology-enhanced student choral responding (i.e., using SRS) as part of a teacher TTC (e.g., question, student response, corrective feedback/teacher reinforcement) in middle school math classes? (2) Does immediate feedback delivered by BIE coaching change teachers’ use of the low-access strategy of call-outs and blurt-outs in middle school math classes? (3) Does the frequency of classroom management prompts (i.e., re-directs and reprimands) used by the teacher change related to delivery of classroom management prompts (e.g., re-directs, reprimands, and precise praise statements) by BIE coaching? (4) Does the frequency or nature of instructional prompts provided by the instructional coach change related to the teachers’ use of the high-access strategy of technology-enhanced student choral responding (i.e., using SRS) as part of a completed teacher TTC trial (e.g., question, student response, corrective feedback/teacher reinforcement) in middle school math classes? (5) Does the frequency of classroom management prompts provided by the instructional coach change related to use of re-directs, reprimands, and praise statements by middle school math teachers?, and (6) To what degree does student achievement as measured by electronic student responses to questions created in collaboration with teacher participants relate to the teachers’ use of the high-access strategy of technology-enhanced choral response during instruction?
Research Question 1
Does immediate feedback delivered by BIE coaching change teachers' use of the high-access strategy of technology-enhanced student choral responding (i.e., using SRS) as part of a teacher three-term contingency (e.g., question, student response, corrective feedback/teacher reinforcement) in middle school math classes?

Visual analysis.

*Phase 1 baseline.* During baseline conditions, there was no evidence of use of any high-access instructional practices (e.g., choral response, thumbs up) by any of the three teacher participants during instructional delivery. Furthermore, none of the teachers utilized student response systems or formative assessment during instruction. Figure 4.1 presents the mean and range of teacher use of any high-access strategies during instruction across all phases of the study. Although use of high-access instruction was absent, all three teacher participants demonstrated frequent and consistent rates of completed TTC trials as part of the low-access strategy of call-outs and blurts outs.

The percentage of TTC trials completed by teachers during baseline ranged from 67% to 100%. Although stability of baseline was not a requirement for phase change in this study, all three teachers exhibited a stable baseline within 2 (T3) or 3 (T1 and T2) observation sessions. Teacher 3 was the first teacher to demonstrate a stable baseline with a mean completion rate of TTC trials of 75% over two consecutive days. Teacher 2 had the highest percentage of completed TTC trials during baseline ($M = 82.33$, range = 67-80) while Teacher 1 (control) had slightly smaller percentage completion rates ($M = 77$, range = 67-88) than Teacher 2 and Teacher 3 but was only 2 points lower in range than Teacher 3.
Figure 3. Frequency of high-access strategies used by teachers.

**Phase 2 intervention 1.** Student response systems were not utilized during instruction during the first intervention phase (Phase Two) of the study by any of the teacher participants, therefore, technology-enhanced choral response was not present during this phase. With the implementation of immediate feedback as part of instructional coaching via BIE technology during Intervention 1, the frequency of low-access
instructional prompts (i.e., call-outs and blurt-outs) as part of completed TTC trials from the two teacher participants receiving coaching increased. Teacher 2 had a mean increase in number of student prompts of 100% while Teacher 3 increased by 91%. Teacher 1, who was not receiving immediate feedback increased her mean percentage of student prompts by only 9%. Accompanying the increase in low-access prompts by Teacher 2 and Teacher 3 was an increase in the percentage of completed TTC trials (T2, $M = 96$, range = 88-100; T3, $M = 79$, range = 71-87). Teacher 1 had a small decline in the mean percentage of completed TTC trials ($M = 2.6$, range = 66-91).

Teacher use of high-access practices other than technology-enhanced choral response first appeared during intervention 1. Teacher 1 (control) engaged in the most frequent use of high-access strategies including one instance each of verbal choral response and "thumbs-up if you know". Further, T1 engaged in three instances of a high-access strategy she referred to as "bubbles-in-hands" in which students would make a bubble with their hands near their mouths as part of showing attention prior to an activity. Teacher 2 used verbal choral response twice over 3 days and the "thumbs-up" strategy five times over 3 days. Finally, Teacher 3 used the "thumbs-up" strategy 4 times over three days. In sum, T2 had the highest frequency of use of other high-access practices ($M = 2.3$, range = 0-5) while T1 (control) had the second highest frequency of use ($M = 1.7$, range = 0-3) and T3 was third with a mean percentage of 1.33.

**Phase 3 intervention 2.** During Intervention 2, coach driven use of student response systems as part of the high-access strategy of choral response for all three teacher participants accompanied immediate feedback by the instructional coach for
Teacher 2 and Teacher 3. During this phase, all three teachers utilized technolog-

enhanced choral response as part of their instruction.

Table 6 represents the mean frequency and range for teacher prompts using both

high-access (i.e., choral response via SRS) and low-access (i.e., call-outs and blurt-outs)

strategies as part of completed TTC trials across all phases of the study. Further, the

mean percentage and range of completed TTC trials as part of the low-access strategy of

call-outs and blurt-outs and the high-access strategy of technology-enhanced student

choral responding (i.e., using SRS) are included.

The percentage of teacher use of technology-enhanced choral response as part of

completed TTC trials during Phase 3 (Intervention 2) varied for two teachers (Control, $M$

= 27%, range = 0-82%; Teacher 2, $M$ = 96%, range = 88-100). Teacher 3 had a 100% rate

of completion of TTC trials while using technology-enhanced choral response. Further,

while the use of technology-enhanced-choral responding as part of completed TTC trials

increased for the two teachers receiving instructional coaching, so did the frequency of

the low-access strategy of call-outs and blurt-outs decrease (T2, $M$ = 40, range 1-9; T3, $M$

= 32, range = 2-9). Conversely, the mean percentage for frequency of low-access call-

outs and blurt-outs increased for T1 (control) by 33%.

Further analysis of descriptive data for Phase 3 (intervention 2) demonstrated that

T1 (control) and T3 increased their use of “other” high-access strategies by 260% and

75% respectively (T1, $M$ = 6, range = 1-5; T3, $M$= 1.75, range = 0-3), but Teacher 2’s use

of “other” high-access strategies deteriorated to 2 instances of verbal choral response on

the first day of intervention 2.
Table 6

Mean and Range Frequencies and Percentages for Teacher Prompts and Completed Three-Term Contingency Trials in Baseline and Intervention Phases

<table>
<thead>
<tr>
<th>Participants</th>
<th>Condition</th>
<th>Teacher Prompts</th>
<th>Percentage Three Term Contingencies Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Range</td>
</tr>
<tr>
<td>Control</td>
<td>Baseline</td>
<td>11.0</td>
<td>8-13</td>
</tr>
<tr>
<td></td>
<td>Intervention 1</td>
<td>12.0</td>
<td>7-18</td>
</tr>
<tr>
<td></td>
<td>Intervention 2 w/o SRS</td>
<td>16.0</td>
<td>15-17</td>
</tr>
<tr>
<td></td>
<td>Intervention 2 w/SRS</td>
<td>3.0</td>
<td>2-11</td>
</tr>
<tr>
<td>Teacher 2</td>
<td>Baseline</td>
<td>4.0</td>
<td>3-5</td>
</tr>
<tr>
<td></td>
<td>Intervention 1</td>
<td>8.0</td>
<td>5-11</td>
</tr>
<tr>
<td></td>
<td>Intervention 2 w/o SRS</td>
<td>4.8</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>Intervention 2 w/SRS</td>
<td>4.8</td>
<td>3-8</td>
</tr>
<tr>
<td>Teacher 3</td>
<td>Baseline</td>
<td>3.3</td>
<td>2-4</td>
</tr>
<tr>
<td></td>
<td>Intervention 1</td>
<td>6.3</td>
<td>5-7</td>
</tr>
<tr>
<td></td>
<td>Intervention 2 w/o SRS</td>
<td>4.3</td>
<td>2-9</td>
</tr>
<tr>
<td></td>
<td>Intervention 2 w/SRS</td>
<td>4.3</td>
<td>3-6</td>
</tr>
</tbody>
</table>

Two maintenance probes and 1 generalization probe were taken for all three teachers to evaluate any lasting changes related to the coaching intervention. T1 (control) did not use the SRS as part of technology-enhanced choral response for either maintenance probe or the generalization probe. T2 and T3 both used technology-enhanced choral response as part of completed TTC trials for 5 questions each during the first maintenance probe. Similarly, neither T2 nor T3 used technology-enhanced choral response as part of completed TTC trials during the second maintenance probe or the generalization probe.

With respect to teacher use of other high-access instructional strategies (e.g., "thumbs up", bubbles-in-hands, and “other”), T1 used the high-access strategy of “thumbs-up” on two occasions during the first maintenance prompt, one use of bubbles-in-hands during the second prompt, and one instance of verbal choral response during the generalization prompt. T2 did not use any high-access strategies other than technology-enhanced choral response for either of the two maintenance prompts or the generalization prompt. Finally,
T3 engaged in “other” high-access practices during each of the follow-up probes. During the first maintenance probe, he used “thumbs-up” two times and “other” high-access strategies four times. During the second maintenance probe he used “other” high-access strategies on two occasions. Additionally, he engaged in “other” high-access strategies on four occasions during the generalization probe.

**Statistical analysis.** In addition to descriptive statistics, a Kruskal-Wallis test across the three teacher participants was conducted to evaluate any differences among the three teacher participants (T1 control, Teacher 2, and Teacher 3) on median change in frequency of teacher use of technology-enhanced choral response as part of completed TTC trials due to immediate feedback delivered by instructional coaching via BIE technology. The results were not significant \( x^2(2, N = 12) = .745, p = .689 \), however, prior to conducting the Kruskal-Wallis test, Levene’s test for equality of variances was found to be violated for the present analysis, \( F(1, 12) = 6.19, p = .020 \). Owing to this violated assumption the Kruskal–Wallis results for this question may not be reported with any degree of reliability and must be interpreted with caution (Fagerland & Sandvik 2009).

**Research Question 2**

Does immediate feedback delivered by BIE coaching change teachers’ use of the low-access strategies of call-outs and blurt outs (i.e., as measured by student responses via SRS) in middle school math classes?

**Visual analysis.**

**Phase 1 baseline.** Low-access instructional strategies including: teacher prompts (during instruction) that encourage student blurt-outs, hand-raising and subsequent individual student call-on, or a question posed directly to a student, were frequent for T1
(control) during the baseline phase \((M = 11, \text{ range } = 8-13)\). T2 and T3 utilized the low-access strategies of blurt-outs and call-outs far less frequently (T2, \(M = 4, \text{ range } = 3-5\); T3, \(M = 3.3, \text{ range } = 2-4\)).

**Phase 2 intervention 1.** The frequency of the use of the low-access strategies of blurt-outs and call-outs increased for all three teacher participants during phase two (intervention 1) of the study. Use of call-outs and blurt-outs remained more frequent for T1 (control) \((M = 12, \text{ Range } = 7-18)\) than for Teacher 2 or Teacher 3, but T2 increased the use of call-outs and blurt-outs by a percentage of 100 while T3 demonstrated a 91% increase.

**Phase 3 Intervention 2.** Descriptive data yielded a percentage increase of 33% \((M = 16, \text{ range } = 15-17)\) in the use of call-outs and blurt-outs from phase two (intervention 1) to phase three (intervention 2) for T1 (control) who was receiving no immediate feedback from the instructional coach. On the contrary, both T2 and T3 demonstrated significant decreases in the use of call-outs and blurt-outs \((T2, M = 4.8, \text{ range } = 1-9; T3, M = 4.25, \text{ range } = 2-9)\) during this phase.

During the first of two maintenance probes, T1 (control) and T3 decreased their frequency of call-outs and blurt-outs to less than baseline frequencies \((T1, 4; T3, 2)\) while T2 increased her use of call-outs and blurt-outs by 25% over baseline. All teachers demonstrated a decrease in call-outs and blurt-outs during the second maintenance probe that was below baseline \((T1, 0; T2, 2; T3, 3)\). Results of the generalization probe were similar to the second maintenance probe except for a slight increase by Teacher 3 \((T1, 0; T2, 2; T3, 4)\).
Statistical analysis. A Kruskal-Wallis test, was conducted to evaluate the differences between the three teacher participants (control, teacher 1, and teacher 2) on median change in teacher use of the low-access strategies of call-outs and blurt-outs from phase 1 (baseline) through phase 3 (intervention 2). The test results showed that there was a statistically significant difference in the frequency of teacher call-outs and blurt-outs between the different teacher participants, \( x^2(2, N = 39) = 7.211, p = .027 \), with a mean rank of frequency of call-outs and blurt-outs of 27.17 for T1 (control), 17.96 for T2, and 15.58 for T3. Pairwise comparisons using Kruskal Wallis were then conducted for the two pairs of teachers (control-T2 and control-T3). Consistent with the test results for the entire group, the results conducted between the control teacher (T1) and T3 revealed statistically significant differences in the frequency of call-outs and blurt-outs between participants \( x^2(1, N = 25) = 5.648, p = .017 \), with a mean rank of frequency of call-outs and blurt-outs of 16.63 for T1 (control) and 9.65 for T2. Similarly, statistically significant differences between T1 and T2 were reported related to frequency of call-outs and blurt-outs between participants \( x^2(1, N = 26) = 4.808, p = .028 \), with a mean rank of frequency of call-outs and blurt-outs of 17.04 for T1 (control) and 10.46 for T2.

Research Question 3

Does the frequency of classroom management prompts (i.e., re-directs and reprimands) used by the teacher change related to delivery of re-directs, reprimands, and precise praise statements by BIE coaching?

Visual analysis.

Phase 1 baseline. During baseline, the frequency of teacher use of classroom management prompts varied by teacher (T1, \( M = 2.7 \), range = 2-4; T2, \( M = 3.7 \), range = 2-5; T3, \( M = 11.33 \), range = 9-15). Classroom management prompts included individual
and choral re-directs, and individual and choral reprimands. Frequency of teacher-directed praise was also calculated and included both praise to individual students and choral praise statements (Figure 4.2). During baseline, no praise statements were given by T1 (control) or T3. T2 had a mean frequency of praise statements of 3.33 with a range of 2-4 per observation. Table 7 summarizes the frequency of teacher use of re-directs and reprimands during the baseline and intervention phases of the study.

Table 7

Teacher Use of Re-directs and Reprimands

<table>
<thead>
<tr>
<th>Participants</th>
<th>Conditions</th>
<th>Teacher Use of Redirects and Reprimands</th>
<th>Coach Classroom Management Prompt</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td>Range</td>
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<td>Control</td>
<td>Baseline</td>
<td>2.7</td>
<td>2-4</td>
</tr>
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<td></td>
<td>Intervention 1</td>
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<tr>
<td></td>
<td>Intervention 2</td>
<td>5.7</td>
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<td>Teacher 2</td>
<td>Baseline</td>
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<td>Intervention 2</td>
<td>21.2</td>
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</tbody>
</table>
**Phase 2 Intervention 1.** With the introduction of immediate feedback by BIE coaching in Phase 2 (intervention 1), the use of teacher re-directs and reprimands remained close to baseline levels for T1 (control) ($M = 2.6$, range = 0-4) but increased significantly for T2. For example, T2 who demonstrated the largest increase (540%), had

*Figure 4. Frequency of Teacher Praise Statements.*
a mean frequency of use of re-directs and reprimands of 23.67 with a range of 21-29. T3 also increased his use of re-directs and reprimands during this phase ($M = 12.33$, range = 12-13) though it was only an increase of 8.8%.

Figure 5. Frequency of Teacher Use of Re-directs and Reprimands.

**Phase 3 Intervention 2.** Phase 3 (intervention 2) included the introduction of immediate feedback by BIE coaching coupled with coach directed use of student
response systems to be used as part of technology-enhanced choral response as part of completed TTC trials. During this phase, T1 (control) and T3 both demonstrated increases in the use of re-directs and reprimands. T1 increased her use of teacher re-directs and reprimands by 119% from phase 2 (intervention 1) to phase 3 (intervention 2) \((M = 5.7, \text{ range } 3-7)\) and 111% from phase 1 (baseline) to phase 3 (intervention 2). Results for Teacher 3 indicated a larger increase in the use of re-directs and reprimands (52%, \(M = 18.75, \text{ range } 14-25\)) from phase 2 (intervention 1) to phase 3 (intervention 2) which was a 65.5% increase up from phase 1 (baseline).

**Statistical analysis.** Consistent with the descriptive analysis related to change in teacher use of re-directs and reprimands which demonstrated increases of the frequency of teacher use of re-directs and reprimands between the control teacher and both teacher 1 and teacher 2 across the baseline and intervention phases (phase 1 to phase 3) results from a Kruskal-Wallis test found the relationship between frequency of teacher use of re-directs and reprimands across all three teacher participants to be statistically significant, \(x^2(2, N = 39) = 16.922, p < .0001\), with a mean rank of teacher use of re-directs and reprimands of 25.73 for T3, 24.29 for T2, and 8.79 for T1 (control) who was not receiving immediate feedback by BIE coaching. Statistically reliable results for differences in teacher use of re-directs and reprimands were further supported by conducting pairwise tests across the two pairs to assess the null hypothesis that the medians are equal across groups. For the control (T1) and T2, results were significant at the .05 level \(x^2(1, N = 26) = 9.583, p = .002\) with a mean rank of teacher use of re-directs and reprimands of 17.79 for T2, and 8.50 for T1 (control). Results were significant for the second pair (T1 and T3)
at \( x^2(1, N = 25) = 16.529, p < .0001 \) with a mean rank of teacher use of re-directs and reprimands of 18.73 for T3 and 6.79 for T1 (control).

**Research Question 4**

*Does the frequency or nature of instructional prompts provided by the instructional coach change related to the teachers’ use of the high-access strategy of technology-enhanced student choral responding (i.e., using SRS) as part of a completed teacher three-term contingency trial (e.g., question, student response, corrective feedback/teacher reinforcement) in middle school math classes?*

**Visual Analysis.**

*Phase 3 Intervention 2.* Immediate feedback delivered by BIE coaching was introduced to T2 and T3 during phase 2 (intervention 1) of this study, however, the control teacher (T1) received only delayed feedback. Therefore, no data will be reported for T1 (control) for this question. Further, there was no use of student response systems as part of technology-enhanced TTC trials until phase 3 (intervention 2), so data is only reported for this portion of the study. Finally, too few data points prevented the use of analysis other than descriptive analysis to answer this question.

During phase 3 (intervention 2), T2 and T3 experienced high and stable frequencies of percentage of completed TTC trials using technology-enhanced choral response (T2, \( M = 96\% \), range = 80\% - 100\%; T3, 100\%). Accordingly, T2 who received a mean frequency of 7 instructional prompts (range = 5-8) during phase 2 (intervention 1), experienced a 37.5\% decrease in the mean number of coaching prompts received during phase 3 (intervention 2) and a mean decrease of 6.5 (range = 0-6) in number of prompts received from the first data point to the last data point collected. In contrast, T3
received a higher mean in number of instructional prompts received than did Teacher 2 during this phase ($M = 4.75$, range = 2-8) and actually increased in the frequency of number of prompts received during phase 2 (intervention 1) by 54%, but coaching prompts received decreased by 66% between the first two data points collected and the last two data points collect. Table 8 summarizes the ratio of frequency of coaching prompts delivered to teacher completion of TTC trials for Teacher 2 and Teacher 3. No immediate instructional feedback was given during the two maintenance probes or the generalization probe.

Table 8

*Frequency of Coaching prompts to Completed TTC trials*

<table>
<thead>
<tr>
<th>Participants</th>
<th>Condition</th>
<th>Percentage Three Term Contingencies Completed</th>
<th>All Coaching Prompts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Range</td>
</tr>
<tr>
<td>Teacher 2</td>
<td>Baseline</td>
<td>82%</td>
<td>67-100%</td>
</tr>
<tr>
<td></td>
<td>Intervention 1</td>
<td>96%</td>
<td>88-100%</td>
</tr>
<tr>
<td></td>
<td>Intervention 2 w/o SRS</td>
<td>92%</td>
<td>0-100%</td>
</tr>
<tr>
<td></td>
<td>Intervention 2 w/SRS</td>
<td>96%</td>
<td>88-100%</td>
</tr>
<tr>
<td>Teacher 3</td>
<td>Baseline</td>
<td>75%</td>
<td>75-75%</td>
</tr>
<tr>
<td></td>
<td>Intervention 1</td>
<td>79%</td>
<td>71-87%</td>
</tr>
<tr>
<td></td>
<td>Intervention 2 w/o SRS</td>
<td>88%</td>
<td>83-100%</td>
</tr>
<tr>
<td></td>
<td>Intervention 2 w/SRS</td>
<td>100%</td>
<td>100-100%</td>
</tr>
</tbody>
</table>

**Statistical analysis.** No statistical analysis was reported for this question.

**Research Question 5**

Does the frequency of classroom management prompts provided by the instructional coach change related to use of re-directs, reprimands, and praise statements by middle school math teachers?

**Visual Analysis.**

**Phase 1 Baseline.** This multiple time-series study was designed so that each teacher could serve as his or her own control group throughout the study. An additional
control group was also included. As such, each of the three teacher participants received delayed feedback during baseline, but no immediate feedback via BIE was delivered. Baseline data related to the frequency of teacher use of re-directs and reprimands which includes individual and choral re-directs, and individual and choral reprimands is summarized in Table 9.

Table 9

*Coach's Classroom Management Prompts to Teacher Re-directs and Reprimands*

<table>
<thead>
<tr>
<th>Participants</th>
<th>Conditions</th>
<th>Teacher Use of Redirects and Reprimands</th>
<th>Coach Classroom Management Prompts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Range</td>
</tr>
<tr>
<td>Control</td>
<td>Baseline</td>
<td>2.7</td>
<td>2-4</td>
</tr>
<tr>
<td></td>
<td>Intervention 1</td>
<td>2.6</td>
<td>0-4</td>
</tr>
<tr>
<td></td>
<td>Intervention 2</td>
<td>3.7</td>
<td>3-7</td>
</tr>
<tr>
<td>Teacher 2</td>
<td>Baseline</td>
<td>3.7</td>
<td>2-5</td>
</tr>
<tr>
<td></td>
<td>Intervention 1</td>
<td>23.7</td>
<td>21-29</td>
</tr>
<tr>
<td></td>
<td>Intervention 2</td>
<td>21.2</td>
<td>4-35</td>
</tr>
<tr>
<td>Teacher 3</td>
<td>Baseline</td>
<td>11.3</td>
<td>9-15</td>
</tr>
<tr>
<td></td>
<td>Intervention 1</td>
<td>12.3</td>
<td>12-13</td>
</tr>
<tr>
<td></td>
<td>Intervention 2</td>
<td>18.8</td>
<td>14-25</td>
</tr>
</tbody>
</table>

What follows are the results for changes in the frequency of classroom management coaching prompts related to changes in frequency of teacher use of instructional strategies that promote student call-outs and blurt-outs.

**Phase 2 Intervention 1.** During phase 2 (intervention 1) a mean frequency of 23.7 (range = 21-29) of re-directs and reprimands by T2 was accompanied by classroom management prompts delivered by the instructional coach at a mean rate of 5 prompts (range = 4-6) per instructional observation. T3 who demonstrated a mean frequency of 12.3 (range = 12-13) re-directs and reprimands during this phase received fewer classroom management prompts from the instructional coach ($M = 2.3$, range = 0-4).

**Phase 3 Intervention 2.** With the addition of technology-enhanced choral response as part of completed TTC trials in phase 3 (intervention 2), T2 showed a slight
decrease in the use of re-directs and reprimands ($M = 11$, range = 14-25) while T3
increased his use of re-directs and reprimands from Phase 2 to Phase 3 (52%, $M = 18.75$,
range = 14-25). Simultaneously, both Teacher 2 and Teacher 3 experienced a decrease in
the number of classroom management prompts delivered by the instructional coach. T2
experienced a mean decrease of 60% (range = 0-3) and T3 experienced a 35% decrease.
No immediate instructional feedback was given during the two maintenance probes or the
generalization probe.

**Statistical analysis.** No statistical analysis was reported for this question.

**Research Question 6**

**To what degree does student achievement as measured by electronic student
responses to questions created in collaboration with teacher participants relate to
the teachers 'use of the high access strategy of technology-enhanced choral response
during instruction?**

There was insufficient data to answer this question with any degree of reliability.

Any results that were obtained will be discussed in chapter 5.

**Social Validity Survey**

A social validity survey sought to examine the participants’ satisfaction with
instructional coaching and with the use of BIE technology to receive instructional
coaching. On the last day of the study, each participant was given a survey to fill out and
asked to return it anonymously to a folder. The survey was comprised of 8 Likert-style
questions (Appendix E) and was completed by all three participants. Table 10 shows the
percent of each answer chosen.
All three teachers responded that instructional coaching helped their instructional delivery and that they would recommend instructional coaching to their peers. In accordance, all three teachers reported that the BIE technology was easy to use and that they were very satisfied with the experience.

Table 10

<table>
<thead>
<tr>
<th>Social Validity Survey</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
<td>Not Helpful</td>
</tr>
<tr>
<td>1. How helpful was the instructional feedback delivered</td>
<td>0</td>
</tr>
<tr>
<td>by the instructional coach?</td>
<td></td>
</tr>
<tr>
<td>2. How easy was it to adapt to feedback delivered using</td>
<td>0</td>
</tr>
<tr>
<td>wireless technology?</td>
<td></td>
</tr>
<tr>
<td>3. How easy was the wireless technology to use?</td>
<td>0</td>
</tr>
<tr>
<td>4. How much did the instructional coaching benefit your</td>
<td>0</td>
</tr>
<tr>
<td>instructional delivery?</td>
<td></td>
</tr>
<tr>
<td>5. How much did the instructional coaching benefit your</td>
<td>0</td>
</tr>
<tr>
<td>student’s level of engagement?</td>
<td></td>
</tr>
<tr>
<td>6. How much did the instructional coaching benefit your</td>
<td>0</td>
</tr>
<tr>
<td>student’s academic achievement?</td>
<td></td>
</tr>
<tr>
<td>7. How many of your peers would you recommend instructional</td>
<td>Only a Few</td>
</tr>
<tr>
<td>coaching to?</td>
<td></td>
</tr>
<tr>
<td>8. What is your overall satisfaction with this experience?</td>
<td>Dissatisfied</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One teacher stated that it was, “very helpful to have another teacher in the room who has had similar teaching experiences and who understands the challenges and limitations of the classroom”. Two out of the three teachers reported that the instructional feedback delivered by the coach was “very helpful” whereas one teacher reported that it
was “somewhat” helpful. Additionally, two teachers felt that the BIE technology was
very easy to adapt to while one teacher found the technology “somewhat easy” to adapt
to. Two out of three teachers felt that the instructional coaching benefited their students’
academic engagement “somewhat” while one teacher felt that it benefited student
engagement “very much”. Further, all three teachers reported that the instructional
coaching benefited student achievement “somewhat”. These results demonstrate a strong
social validity for instructional coaching and instructional coaching via BIE technology.
CHAPTER 5. DISCUSSION

Chapter five presents a brief summary of findings described in chapter four noting consistencies and contrasts relative to the extant methodological literature base on immediate feedback delivered by instructional coaching via bug-in-ear technology to increase the specific teaching behavior of the use of the high-access instructional practice of technology-enhanced choral responding as part of completed of TTC trials. The chapter concludes with a discussion of the (a) limitations of the study, (b) implications for future research, and (c) implications for practice.

The purpose of this study was to determine the relationship, if any, between the use of instructional coaching to deliver immediate feedback using BIE technology and change in specific teaching and coaching behaviors. Further, this study attempted to examine the effect of immediate feedback via BIE on student achievement. The conceptual basis for this study was derived from research conducted by Rock and colleagues (2012; 2009) and Scheeler and colleagues (2006; 2012) supporting instructional coaching via BIE technology as an effective means to increase the use of specific teaching behaviors including evidence-based instructional practices. There exists however, a paucity of research in sufficient quantity and diversity (e.g., in methodology, sample, and dependent variables studied) with this method of immediate feedback. Therefore, while the accumulated research is somewhat unequivocal in its support of the use of BIE to provide immediate feedback as part of instructional coaching, more research is required in order to substantiate this method as reliable and conclusive.
The following research questions were considered:

1. Does immediate feedback delivered by BIE coaching change teachers’ use of the high-access strategy of technology-enhanced student choral responding (i.e., using SRS) as part of a teacher TTC (e.g., question, student response, corrective feedback/teacher reinforcement) in middle school math classes?

2. Does immediate feedback delivered by BIE coaching change teachers’ use of the low-access strategy of call-outs and blurt-outs in middle school math classes?

3. Does the frequency of classroom management prompts (i.e., re-directs and reprimands) used by the teacher change related to delivery of classroom management prompts (e.g., re-directs, reprimands, and precise praise statements) by BIE coaching?

4. Does the frequency or nature of instructional prompts provided by the instructional coach change related to teachers’ use of the high-access strategy of technology-enhanced choral responding (i.e., using SRS) as part of completed TTC trials (e.g., question, student response, corrective feedback/teacher reinforcement) in middle school math classes?

5. Does the frequency of classroom management prompts provided by the instructional coach change related to use of re-directs, reprimands, and praise statements by middle school math teachers?

6. To what degree does student achievement as measured by electronic student response systems to questions created in collaboration with teacher
participants relate to the teachers' use of the high access strategy of technology-enhanced choral response during instruction?

Summary of Results

This study employed a multiple time-series non-equivalent control group design to examine the relationships between the use of immediate feedback delivered via bug-in-ear technology and changes in specific teacher and student behaviors. Hypothesis 1 posited that Math teachers receiving immediate feedback from an instructional coach via BIE would (a) increase their use of the high access strategy of technology-enhanced student choral responding as part of a completed TTC trial (e.g., question, student response, corrective feedback/teacher reinforcement), (b) decrease their use of call-outs and blurt-outs and, (c) decrease the use of re-directs and reprimands, as well as increase the use of praise statements by middle school math teachers as measured by classroom observation and audio recorded data. Results partially supported Hypothesis 1. The teachers receiving immediate feedback via BIE coaching did increase their frequency of use of technology-enhanced choral responding as part of completed TTC trials over and above that of the teacher not receiving instructional coaching (T1), and the frequency of use of precise praise statements also increased over that of the control teacher. On the contrary, all of the teacher participants increased their frequency of use of the low-access strategies of call-outs, blurt-outs, and re-directs and reprimands during instruction. Moreover, the teachers receiving immediate feedback via BIE coaching increased their frequency of use of the low-access strategy of call-outs, blurt-outs, and re-directs and reprimands significantly more than the control teacher did.
Hypothesis 2 posited that Math teachers who receive instructional coaching will (a) require fewer instructional prompts from the instructional coach to use the clickers as part of teacher TTC trials, and (b) require fewer classroom management prompts from the instructional coach related to the use of re-directs, reprimands, and/or praise statements. The data supported his hypothesis. The frequency of instructional coaching prompts did not change significantly during phase 2 (intervention 1) and phase 3 (intervention 2), however, the nature of prompts did change.

Hypothesis 3 posited that students will show improved engagement and achievement as measured by electronic student responses to questions created in collaboration with teacher participants as the teachers’ use of high access strategies also increased. Hypothesis 3 received minimal empirical support by limited opportunities for students to respond using student response systems and inconsistencies in student response.

Discussion of the Results

Research Question 1

Completed three-term contingency trials using student response systems. Is there a relationship between immediate feedback delivered by instructional coaching via bug-in-ear technology and teacher use of the high access strategy of technology-enhanced student choral responding as part of a completed TTC trial (e.g., question, student response, corrective feedback/teacher reinforcement)? It was hypothesized that the use of immediate feedback delivered by instructional coaching via BIE technology would increase the frequency of the use of technology-enhanced choral response as part of completed TTC trials. Previous studies examining the effects of immediate, corrective
feedback via bug-in-ear coaching on increase in teachers’ use of the high-access strategy of choral response (Rock et al., 2009; Rock et al., 2012) and increased completion of TTC trials (Goodman et al., 2008; Scheeler et al., 2006; Scheeler et al., 2012) demonstrated that immediate feedback via BIE coaching increased both choral response and increased completion of TTC trials. The findings of this study are both supported by and divergent from the previous research. Descriptive analysis of these data show that all three teachers, including the teacher not receiving immediate feedback via BIE coaching, increased their use of completed TTC trials from phase 1 (baseline) through phase 3 (intervention 2). One explanation for these results may be the difference in the timing of participant training in this study relevant to timing of training in prior research. To illustrate this point, in some previous research (Rock et al., 2009; Scheeler et al. 2006; Scheeler et al., 2010) teacher participants received training on the dependent variables (i.e., choral response; completion of TTC trials) after baseline data were collected. The present study trained teachers on the use of high-access instruction and completion of TTC trials prior to collecting baseline data. This was done to ensure that the results obtained in the study would be attributed to the intervention to the greatest extent possible and not due to the introduction of new skills post-baseline observation.

The two teacher participants (T2 and T3) receiving immediate feedback via BIE coaching demonstrated high rates of technology-enhanced choral responding as part of completed TTC trials response whereas the teacher not receiving the intervention did not. These results are consistent with the findings of prior research supporting immediate feedback via BIE coaching on the increase of the frequency of choral response and completion of TTC trials (Rock et al., 2009; Scheeler et al. 2006; Scheeler et al., 2010).
T1, the control teacher, used technology-enhanced choral response as part of completed TTC trials only 27% of the time whereas T2 and T3 used technology-enhanced choral response as part of completed TTC trials 96% and 100% of the time respectively. One possible reason for the difference in frequency of technology-enhanced choral response as part of completed TTC trials may be that because both T2 and T3 utilized technology as part of instruction more frequently prior to instructional coaching than did Teacher 1. It is possible that the transition from soliciting verbal responses from students to soliciting technology-generated responses was easier and more natural.

**High-access instruction.** According to Feldman and Denti (2004), high-access instruction is any instruction designed to facilitate active participation between teachers and all students. Examples of high-access instruction include: (a) choral responding, (b) “thumbs up” when you know, (c) classroom whip around, and (d) classwide peer tutoring (Feldman & Denti, 2004). Rock and colleagues (2009) demonstrated that immediate feedback by BIE coaching may increase teacher use of high-access instruction (choral response, non-verbal group response, partner strategies, and cloze). Consistent in part with Rock et al., (2009), one of the three teachers, T2, increased her use of the high-access practice of (verbal) choral response during phase 2 (intervention 1) of the intervention, however, her use of choral response deteriorated during phase 3 (intervention 2). All three teachers increased their use of “thumbs-up if you know” or “thumbs up” (to engage student attention) during phase 2 (intervention 1). T2 demonstrated the highest frequency of use of high-access practices during phase 2 (8 instances), but T1, the control participant who was not receiving immediate feedback was close behind with 5 instances. A surprising result was that T1 (control) increased her
percentage frequency of thumbs up and "bubbles-in-hands" more than 64% over that of T3 (T1, \( M = 6 \), range = 3-81; T3, \( M = 2.75 \), range = 0-6). In spite of the encouraging results indicated by increases in technology-enhanced choral response by T2 and T3 during phase 3 (intervention 2), choral response as part of completed TTC trials decreased for both during the first maintenance check and disappeared completely for all three teacher participants during the second maintenance check and generalization probe. The most probable reason for the lack of technology-enhanced choral responding during the second maintenance check and generalization probe is that the coach did not present student response software as an option for use. Further, district mandated changes to instructional delivery occurred between the first and last maintenance check. The changes required teachers to place their students into groups and have students engage in learning through inquiry. This type of instructional arrangement prevented any use of choral response.

**Research Question 2**

Does instructional coaching change teachers' use of call-outs and blurt-outs in middle school math classes? It was hypothesized that teachers would see a reduction in the number of call-outs and blurt-outs used as part of questioning. The intervention phases (phase 2 and phase 3) did not support a decrease in the number of teacher call-outs and blurt-outs. All three teachers continued to utilize the low-access practice despite reading Feldman and Denti's (2004) article and receiving corrective feedback from the coach, both delayed and immediate. For Teacher 1 who was not receiving immediate instructional feedback, the disconnect between the use of choral response (verbal or technology-enhanced) and use of the low-access strategy of call-outs and blurt-outs may
have been in response to her lack of "buy-in" with regard to the benefits of choral response. During intervention 1, she reported that a supervisor had previously informed her that it is better to call on a specific student than to prompt for choral response. Her increase in the frequency of call-outs and blurt-outs despite reading Feldman and Denti (2004) and receiving training on high-access practices, may indicate that the supervisor directive was more important to her to follow than that of the instructional coach. For T2 and T3, it is the opinion of the researcher that had the immediate feedback via BIE coaching been able to take place for a longer period of time, the data would have supported the hypothesis. That is, the frequency of call-outs and blurt-outs would have decreased. A visual analysis of the data indicates that for both of the teachers receiving immediate feedback (T2 and T3) the frequency of student questioning (teacher prompts) with and without the student response systems increased from baseline through phase 3 and remained stable. Factors contributing to this increase might include the gaining of control of disruptive and off-task students to an extent that permitted more frequent questioning. A fair number of coaching prompts were directed at helping the teachers achieve better classroom management and student engagement rather than focused on decreasing call-outs and blurt-outs. If the instructional coach had been able to remain in the classes long enough to shift coaching prompts from classroom management to the intended dependent variables (i.e., high-access strategies vs. low-access strategies), a shift in teacher use from the low-access strategies to the high-access strategy of choral response may have occurred. Call-outs and blurt-outs decreased for all teachers during the two maintenance and one generalization probes, but it is probable that the decrease
was due to changes in instructional delivery rather than any paradigm shift with regards to using high- versus low-access strategies.

Research Question 3

Does the frequency of classroom management prompts used by the teacher change related to use of re-directs, reprimands, and precise praise statements by instructional coaching? It was hypothesized that the frequency of classroom management prompts would decrease relative to instructional coaching and that precise praise statements delivered by the teacher would increase.

Research demonstrates that the use of evidence-based instructional strategies increase student engagement (Rock et al., 2009; Rock et al., 2012; Scheeler et al., 2006) and lead to subsequent decreases in student behavior that is off-task or disruptive (Gable et al., 2005; Gable et al., 2009). This study sought to increase the teacher frequency of the evidence-based strategies of choral response (Feldman & Denti, 2004; Heward, 1997) and completion of TTC trials (Skinner, 1968; Greer & McDonough, 1999) by providing immediate corrective feedback on these dependent variables via BIE coaching. At odds with the hypothesis which suggested that the frequency of teacher re-directs and reprimands would decrease with immediate corrective feedback, the results demonstrated just the opposite. All three teacher participants experienced increases in the frequency of re-directs and reprimands across all phases of the study post-baseline, but the two teachers receiving the coaching intervention had particularly high increases in the delivery of classroom management prompts. It is important to note that T1 (control) delivered minimal re-directs and reprimands throughout the course of the study. Further, there were significantly less student disruptions and instances of off-task behaviors in her
class. It is difficult to hypothesize whether the lack of student disruptions were due to the teaching expertise of T1 or whether it was due to a student population that was by nature more engaged, less disrespectful, and more on-task. Regardless, T3 engaged in a high frequency of redirects and reprimands beginning with the third observation point. The most interesting result was from that of T2 who demonstrated the most significant increase in the frequency of re-directs and reprimands from baseline through intervention. Contrary to what the results might indicate (i.e., immediate feedback did not help classroom management), the increase in re-directs and reprimands from a mean of 3.7 (range = 2-5) during baseline to mean frequencies of 23.7 and 21.2 during phase 2 (intervention 1) and phase 3 (intervention 2) speak to the efficacy of immediate feedback via BIE technology as a tool that can be used to help in-service teachers gain or re-gain control of an out-of-control class. Although T3 had a lower mean frequency of re-directs and reprimands throughout the study ($M = 14.13$; range = 11.3-18.8) than did T2, it can be hypothesized the increases in these behaviors across phases were also due in part to requiring coaching related to classroom management. Specifically, the need for coaching prompts geared towards a functional classroom may have generated the increase in re-directs and reprimands that with further coaching, may have decreased. The frequency of re-directs and reprimands diminished for all three teachers during the maintenance and generalization. That decrease is also thought to be more a result of changes to instructional delivery mandated by district supervisors than due to changes in teacher paradigm.
**Research Question 4**

Does the frequency and/or type of instructional prompts provided by the instructional coach change related to the teachers’ use of the high access strategy of technology-enhanced student choral responding (i.e., using SRS) as part of a completed teacher TTC trials (e.g., question, student response, corrective feedback/teacher reinforcement) in middle school math classes? It was hypothesized that the frequency and nature of instructional prompts delivered by the instructional coach would change relative to teachers using SRS as part of a completed teacher TTC.

The current findings support the current hypothesis in that both the frequency and the nature of coaching prompts delivered to Teacher 2 and Teacher 3 changed relative to completion of TTC trials utilizing SRS. Figure 5.1 shows the 1:1 correspondence between completed TTC trials with SRS as the student response method and number of coaching prompts delivered. The data supports a relationship between the frequency of completed TTC trials using SRS and the frequency of instructional coaching prompts delivered. Specifically, the frequency of instructional coaching prompts decreased from the first observation point collected to the last observation point collected.

The second part of the current hypothesis which posited that the nature of coaching prompts delivered to T2 and T3 would change relative to high rates of TTC trial completion was also supported by the visual data. For example, during phase 2 intervention 1, the instructional coach provided T2 a mean of 3 prompts (range = 2-5) per observation session related to teacher proximity whereas during Phase 3 (Intervention 2) only a mean of 1.5 (range = 0-4) prompts related to proximity were given.
Figure 6. Comparing frequency of completed TTC trials using student response systems to frequency of coaching prompts delivered.

Similarly, T3 received a mean of 2.3 prompts (range = 0-4) related to proximity during Phase 2 (Intervention 1) yet received only a mean of 1.5 prompts related to proximity
during Phase 3 (Intervention 2). This may lend support to the results previously discussed in that as classroom management became less of a focus, instructional coaching was better able to target variables directly related to student engagement and achievement (e.g., pose question now, offer behavior-specific praise).

Research Question 5

Does the frequency of classroom management prompts provided by the instructional coach change related to use of re-directs, reprimands, and praise statements by middle school math teachers? It was hypothesized that the frequency of classroom management prompts delivered by the coach would decrease related to frequency of teacher use of re-directs, reprimands, and praise statements.

It was hypothesized in research question 3 that the frequency of teacher use of re-directs, reprimands, and praise statements would decrease as a result of immediate feedback via BIE coaching, yet, the frequency of re-directs and reprimands increased significantly. Accordingly, this research question (RQ5) posited a decrease in classroom management prompts delivered by the instructional coach fully expecting that an inverse relationship would materialize as a result of fewer teacher initiated re-directs and reprimands. What followed were results that support the hypothesis that classroom management prompts did decrease related to teacher use of re-directs and reprimands, but not for the reasons initially expected. Teacher 2 experienced a 60% decrease in classroom management prompts from phase 2 (intervention 1) to phase 3 (intervention 2) and T3 experienced a 35% decrease across the two intervention phases. Thus, although teacher use of re-direct and reprimands remained frequent, classroom management prompts
delivered by the instructional coach were not required for the teachers to utilize sound classroom management practices.

\begin{figure}
\centering
\begin{minipage}{\textwidth}
\begin{center}
\textbf{T2 Coaching Prompts vs RDRM}
\end{center}
\begin{axis}[
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    xlabel={Sessions},
    ylabel={Frequency},
    xmin=1, xmax=7,
    ymin=0, ymax=40,
]
\addplot [mark=o, color=black] coordinates {
(1, 5) (2, 20) (3, 25) (4, 30) (5, 35) (6, 40) (7, 40)
};
\addplot [mark=*, color=red] coordinates {
(1, 15) (2, 20) (3, 25) (4, 30) (5, 35) (6, 40) (7, 40)
};
\end{axis}
\end{minipage}
\end{figure}

\begin{figure}
\centering
\begin{minipage}{\textwidth}
\begin{center}
\textbf{T3 Coaching Prompts vs RDRM}
\end{center}
\begin{axis}[
    title={T3 Coaching Prompts vs RDRM},
    xlabel={Sessions},
    ylabel={Frequency},
    xmin=1, xmax=7,
    ymin=0, ymax=30,
]
\addplot [mark=o, color=black] coordinates {
(1, 5) (2, 20) (3, 25) (4, 30) (5, 10) (6, 15) (7, 20)
};
\addplot [mark=*, color=red] coordinates {
(1, 15) (2, 20) (3, 25) (4, 30) (5, 20) (6, 15) (7, 10)
};
\end{axis}
\end{minipage}
\end{figure}

\textit{Figure 7.} Comparing frequency of teacher use of re-directs and reprimands to frequency of coaching prompts delivered.
Research Question 6

To what degree does student achievement as measured by electronic student responses to questions created in collaboration with teacher participants relate to the teachers’ use of the high access strategy of technology-enhanced choral response during instruction? It was hypothesized that student achievement as measured by SRS would increase.

Choral response of any nature was not present in any of the three classes prior to this study. Further, the high frequency with which all three teacher participants engaged in the low-access instructional strategy of call-outs and blurt-outs suggests an inability of any of the three teacher participants to efficiently or accurately assess student knowledge on a large scale on a regular basis as part of formative assessment.

Results obtained from the use of student response systems during the study supports prior research demonstrating that student response systems increase active engagement of all students (Poirier & Feldman, 2007) and shows promise for technology-enhanced choral responding as a means to: (a) engage all students in questioning, (b) receive responses from all students in a short time frame, and (c) provide corrective or reinforcing feedback to students based on their responses.

Unfortunately, technology difficulties coupled with an insufficient number of students consistently responding to questions posed using the SRS, prevented this question from being answered with any reliability. Examples of middle school math questions asked with the student response system are highlighted in Appendix C.
Social Validity

In previous research using BIE technology, immediate feedback was delivered via BIE technology to increase the frequency of either high-access strategies (Rock et al., 2012; Rock et al., 2009) or to increase the frequency of completion of TTC trials (Goodman et al., 2008; Scheeler et al., 2012). This study is unique in that it utilized immediate feedback via BIE to increase the high-access strategy of choral response as part of completed TTC trials. An additional component of student response systems for delivery of teacher prompts and submission of choral student responses was added. Therefore, this study, is the first to examine the relationship between immediate feedback delivered by BIE technology on technology-enhanced choral response as part of completed TTC trials. Recent studies on instructional coaching of teachers have utilized remote coaching via Bluetooth technology (Rock et al., 2012; Scheeler et al., 2012). Moreover, Rock and colleagues (2012) and Scheeler et al. (2012) assert that the advantages of remote coaching include instructional coaching that is less intrusive and less disruptive to class. Further, they report the ease with which advanced technologies including Bluetooth™ and SKYPE make remote coaching possible (Rock et al., 2012 Scheeler et al., 2012). Unlike recent research conducted remotely, this study was conducted on-site, in the classroom, during normal instruction. Not only were there no reported disruptions of instruction from any of the three participating teachers, but T2 and T3 actually articulated the benefit of having the instructional coach on-site to both the coach, and to the Principal. To quote Teacher 3, “your being in the classroom actually made me a better teacher”. Additionally, one teacher reported the benefit of having a teacher with similar experiences in the classroom on the social validity survey.
All teachers reported the BIE technology as being “very easy” to use, however one teacher reported that it was “somewhat easy” to adapt to. During the beginning of the study, Teacher 1 (control) reported that wearing the equipment around her neck was “a bit annoying”. Three observation sessions later when the instructional coach was collecting the BIE equipment at the end of class, the teacher stated, “I forgot I had it on”. It is important to note that the teachers had on a pocket lanyard with both the LENA dlp and the FM receiver so it is possible that it was the combination of equipment that Teacher 1 found “annoying”. Regardless, after a couple of days, she reported satisfaction with the equipment.

**Controlling for Threats to Validity**

**Internal validity.** Several measures were taken in order to control for threats to the internal validity of this study. First, data collection methods remained constant across all phases. The primary researcher who was also the instructional coach was present during all phases ensuring reliability with regards to measures of data collection. To control for the Hawthorne effect among both teachers and students (Leedy & Ormond, 2010) a prebaseline phase during which no data were taken was conducted. Further, the BIE equipment and LENA dlp audio recording device were worn by the teachers and coach for phases of the study. Threats to internal validity due to history and maturation were significantly reduced by the brief nature of this study (Gast, 2005).

**External validity.** The external validity of this study was limited by the small number of participants. However, a degree of generalizability was introduced by way of the multiple-time series non-equivalent control group design utilized in this study which allowed replication of two different interventions across two participants with a third
participant (control) serving as a non-equivalent comparison group. Further, generalization and extrapolation of these results are clearly limited by the unavoidable circumstances that arise when sacrificing experimental control in order to conduct research in situ. Notwithstanding these limitations, research conducted in actual classrooms is critical to examining cause and effect relationships as they exist in the natural classroom setting.

Limitations of the Present Study

Limitations with the research design, sampling, and methods require that the results of this study should be interpreted with caution. The multiple time-series non-equivalent control group design utilized in this study permits multiple intervention phases including withdrawal of the intervention for each participant (maintenance probe one and two). Similar to an alternating treatment design, this design allows any change in behavior to be attributed to the intervention. Yet, despite the aforementioned benefits of the study design, the small sample size and limited number of data points provided insufficient evidence to suggest that immediate feedback delivered via BIE increased teacher use of technology-enhanced choral responding as part of completed TTC trials.

It is not uncommon in time-series designs to base the transition between phases on a set number of data points rather than attainment of a specific criterion. While time constraints due to district rules and teacher availability made phase transitions based on number of data points the most feasible option, the lack of criterion based phase changes not only limited the number of data points, but may have limited the true potential of the intervention. Accordingly, the results may have been different if the instructional coach had spent longer with the teacher participants. For example, with criterion-based
intervention phases, the results may have demonstrated an increase in the high-access strategies of verbal choral response and "thumbs-up if you know". Additionally, there may have been a decrease in teacher use of the low-access strategies of call-outs and blurt outs and in teacher frequency of re-directs and reprimands. Further, changes in teacher behavior may have been evident during the two maintenance probes. It is difficult if not impossible to draw valid conclusions about the relationships between immediate feedback and the dependent variables targeted in this study with so few data points collected.

A third limitation to this study is sampling. Three middle school math teachers and one class each of their students were purposely selected for this study in order to extend the research base which is currently comprised of research conducted primarily in elementary schools (Scheeler et al., 2006; Scheeler et al., 2012). Limiting the sample to middle school math teachers and one class each of their students introduces a potential source of bias (Gall, Gall, & Borg, 2002) and limits external validity due to the probability that the both the teacher and student participants are different than the actual population.

Further compounding the limitations of this study, is the potential Hawthorne effect. The design of this study included pre-training on the use of high-access strategies, completion of TTC trials, and training on all technology components (i.e., BIE, LENA dlp, student response systems). In that the teacher participants knew that they were being coached for use of high-access strategies, completed TTC trials, and choral response via SRS as part of TTC trials, they may have engaged in the target behaviors more frequently than they would have had the instructional coach not been present. Thus, some successful
results attributed to the study, such as an increase in the use of technology-enhanced choral response and increase in specific praise statements could have been the result of the Hawthorne effect (Leedy & Ormond, 2010).

Another limitation to this study was teacher “buy-in”. Prior to baseline training, T1 (control) expressed that she did not utilize student response systems in conjunction with the SMARTboard very often due to the inconvenient design of the classroom which prevented electrical plug-in and SMARTboard to laptop cable plug-in without extending cords across the classroom in a manner that might facilitate a tripping accident or fall. Further, as mentioned previously, T1 expressed that, despite the training and delayed feedback, she believed that she was engaging in “best practice”. Teacher 1 had a preconceived notion about what strategies she should use and what strategies she shouldn’t use. To further complicate this, her class was comprised of very well-mannered, attentive students, so it is likely that she saw no need to change her teaching behaviors. Therefore, the differences noted between the control teacher and the two teachers receiving the intervention may not be due to immediate feedback but rather due to lack of “buy-in” by the control teacher.

Another limitation related to teacher “buy in” include the inability of the researcher to: (1) get the teachers to work with the school computer resource specialist (CRS) to get the appropriate student response system software loaded onto their computers, and (2) get the teachers to provide 5 questions in advance to use with the student response system software. Teachers are busy, computer resource specialists are busy. Understandably, without a true understanding of the promise that the use of choral response via a great formative assessment tool (i.e., SRS) might offer, there was no
urgency on part of the three teachers or the CRS to make sure that all the parts were in place. Unfortunately, the inability to set the teachers up to use the SRS as intended, coupled with lack of preparation with regard to questions asked, severely impacted the intended purpose of this study. Additional limitations related the student response systems were technical problems that sometimes prevented student log-in or student responding.

A third limitation related to teacher “buy-in” is the refusal of teachers to follow-thru on instructional prompts delivered by the coach. For example, on four occasions, one of the teachers receiving the intervention ignored prompts delivered by the coach. In that this was a voluntary study, teacher participants could not be badgered or made to feel bad if they did not follow prompts.

Another limitation to this study, proportionally related to the lack of pre-planned questions and coach-driven use of the student response systems was related to the delivery of immediate feedback. First, with so many working parts (instructional coach was observing, taking frequency counts, providing immediate feedback to Teacher 2 and Teacher 3, and plugging questions into the student response systems in real time) it is certain that the frequency and quality of immediate feedback was compromised. Further, without the ability of the instructional coach to predict what teacher responses to questions would be or what teacher responses to other instructional or classroom management issues would be, there was a lack of continuity to the immediate feedback delivered to the two teachers receiving the intervention. Moreover, the extremely challenging behavioral and classroom management problems that T2 and T3 were facing were not able to be adequately addressed by immediate feedback during instruction.
A final limitation mentioned in this discussion is related to time. The length of the study was shortened and gaps introduced in between phases due to the teacher illness (or teacher family illness), state mandated testing, holidays, and other events that present when conducting research in the natural classroom setting. These events may have limited the full potential of this study.

**Implications and Recommendations for Future Research**

Research on the use of BIE technology as part of professional preparation and professional development is increasing rapidly in the field of education. The extant literature base related to the delivery of immediate feedback via BIE technology supports BIE technology as an efficient, effective, and inexpensive method of providing professional coaching. Current literature supports immediate corrective feedback delivered via BIE technology as a means to increase not only the use of evidence-based instruction by preservice, novice, and in-service teachers, but also as facilitating improvement in student behavior, engagement, and achievement outcomes.

The findings of this study support immediate feedback via BIE coaching as a means to effect change in teacher and student behavior, but such conclusions may yet be premature. Still, despite a paucity in research of this nature, the implications of this study may serve as a preliminary step towards narrowing the research to practice gap and increasing the frequency of use of evidence-based instruction by teachers. Accordingly, this research has implications for teacher educators, administrators, professional coaches and students alike; the most critical of which is narrowing the persistent and prevalent achievement gap among the sub-groups of “at-risk” populations.
Professional development. The use of BIE technology to deliver immediate supervisory or peer feedback has been shown to be effective in increasing desired teacher behaviors (Kahan, 2002; Farrell & Chandler, 2008; Scheeler et al., 2010). Based on this study, which supports previous findings on the efficacy of immediate feedback via BIE technology to change specific teaching behaviors, we can posit that instructional coaching may help in-service teachers increase their knowledge and delivery of evidence-based instruction, which may in turn support an increase in student achievement. The results of this study indicated a surprising and significant implication with regards to instructional coaching as a means of professional development. That is, the nature of classroom management problems being experienced by both T2 and T3 could not have been captured to the full extent that they were had the study been conducted remotely; nor could the appropriate feedback been delivered. Both T2 and T3 articulated the benefit of having an on-site coach as being as meaningful to them as was the instructional feedback. Moreover, in terms of future research and professional development, it is important to be mindful that the original intent of an intervention (or supervisory coaching) may take a back seat to issues that must be remediated prior to introduction of the intervention or coaching. Furthermore, it would appear shortsighted to believe that supervisory coaching or a research intervention will experience maximum results if dysfunctional infrastructures are not first remediated.

Finally, the researcher was graciously permitted to conduct research in a district, by a Principal, by teachers that were volunteers. Therefore, regardless of instructional or classroom management practices that the instructional coach deemed detrimental to the process of instruction and to the ultimate achievement outcomes of students (e.g.,
teachers taking phone calls during instructional time, 10-minute rants on students, stopping in the middle of instruction to write lengthy referrals, more than half the class talking and playing loudly during instruction, lack of high-access instruction), the instructional coach was a guest and was obligated to: (1) respect the confidentiality of teachers, and (2) provide feedback that was helpful but neither critical nor threatening.

**Supervisory personnel.** Instructional coaching via BIE technology offers administrators a new mechanism for supervisory evaluations that let them provide immediate feedback. In that immediate feedback has been demonstrated to change teacher behaviors and sustain change in those behaviors (Rock et al., 2012, Scheeler et al., 2012), administrators may find that the results of instructional coaching via BIE are favorable to traditional delayed feedback methods. Further, immediate feedback may prove to be more useful for teachers that are in need of support than traditional action plans have been in the past. Administrators may also find that employing professional coaches via BIE technology is an efficient and affordable way to increase evidence-based practice in the classroom which will in turn raise student achievement scores.

The implications of this study for teachers is the ability to receive professional development that is unobtrusive and immediate. Given the achievement gap that remains persistent across sub-groups of at-risk students and the number of classroom teachers that have more than three years of teaching experience, there is clearly a benefit to be had from instructional coaching. Between the frustrations that many teachers feel regarding “pay for performance”, teachers may increasingly be interested in receiving feedback that helps them bridge the gap from research to practice. This study supports immediate feedback by instructional coaching to help bridge that gap.
**Student achievement.** Evidence-based instruction has been demonstrated to increase student engagement and foster increased student achievement outcomes (Cook & Cook, 2011; Detrich & Lewis, 2013). Likewise, research on the use of student response systems as part of instructional delivery and formative assessment during instruction has shown promise with regards to both student engagement and student achievement (Piorer & Feldman, 2007; Synder 2003). The results of this study support the supposition that teachers who receive immediate feedback via BIE coaching may change their behavior. In accordance, supervisory coaching using immediate feedback via BIE technology may prompt a reduction in the frequency with which teachers (preservice, novice, in-service) engage in undesirable teaching practices (e.g., low-access strategies, practices that are not empirically supported) and increase in the frequency with which high-access instruction, evidence-based instruction, and technology-enhanced choral responding are used. Together these changes to teacher practice may increase student achievement and narrow the achievement gap among student groups.

**Teacher training and researchers.** Institutions of Higher Learning are experiencing economic cuts more frequently and at increasing rates. Fall-out from these cuts include diminished faculty, less money for travel, and less funding for research. Not surprisingly, these factors complicate the supervision of preservice and novice teachers. Limited funding for travel to and from student teaching placements coupled with the lack of man-power to conduct supervisory observations due to staff reductions may limit Teacher Education programs. Similarly, research that is essential to the validation, facilitation and sustaining of evidence-based practice in the classroom may be hindered by budget cuts. Although this study chose to conduct the intervention on-site, advances in
wireless communication technology and videoconferencing capabilities at affordable prices lend promise to the viability of supervisory coaching of preservice teachers and continuing research despite funding limitations and staff shortages.

**Future research.** The results of this study indicate that further research on the use of immediate feedback to increase teacher use of technology-enhanced choral response as part of completed TTC trials is warranted. Additionally, this study demonstrates that increased research on the use of instructional coaching to deliver immediate feedback via BIE technology is as important to in-service teachers as it is to preservice teachers. An unexpected finding of this study is that delayed feedback given during baseline was critical in preparing T2 and T3 for the intervention of receiving immediate feedback. Both T2 and T3 were experiencing significant classroom management problems prior to the beginning of the study. Delayed feedback offered prior to the introduction of immediate feedback included evidence-based suggestions to help with classroom management. In light of evidence of student engagement issues, teacher frustration, and infrequent use of high-access instruction, this study supports a need for additional research on a combination of delayed feedback and immediate feedback as a professional development tool. Software problems limited the ability of this study to investigate the real potential of using student response systems as part of choral response. Therefore future research should investigate the use of choral response via SRS with teachers that have acceptable student response software available on their computer and SMART boards (if applicable). Further research should also investigate the use of real-time data (i.e., as generated by student response systems) as the second component of a completed TTC trial (i.e., response) and subsequent teacher corrective feedback or behavior-specific
praise. Finally, this study supports future research using technology-enhanced choral response as part of completed TTC trials in STEM fields, formative assessment, BIE, and evidenced-based instruction.

Conclusions

Results of the current study supported the relationship between immediate feedback delivered by BIE coaching and change in teacher behavior. Results also supported immediate feedback via BIE coaching as an efficacious approach to changing teacher behavior. Specifically, the two teacher participants receiving the intervention of immediate feedback increased their frequency of use of the high-access strategy of technology-enhanced choral responding as part of completed TTC trials whereas the teacher not receiving immediate feedback did not. In addition, as the rate of completed TTC trials for the two teachers increased, the frequency of immediate feedback prompts decreased. Unexpected results of this study included an increase in the frequency of teacher use of re-directs and reprimands by the two teachers receiving the coaching intervention as well as an increase during phase 2 (intervention 1) in the frequency of the use of the low-access strategy of call-outs and blurt-outs followed by a decrease of call-outs and blurt-outs during phase 3 (intervention 2). T1 (control) who was receiving delayed feedback only, sustained a high frequency of call-outs and blurt-outs throughout the study. All three teacher participants reported that receiving instructional coaching via BIE technology benefited their instructional delivery and was very easy to use. One teacher reported initial discomfort with wearing the BIE equipment but shortly thereafter expressed that any discomfort had disappeared. Results of this study support using
immediate feedback via BIE coaching as a professional development tool with in-service teachers.

The findings in this study highlight the effects of immediate feedback delivered by BIE coaching on a small sample of secondary math teachers. These findings also support the combination of the high-access strategy of choral response with student response systems and the combination of technology-enhanced choral response as part of completed TTC trials as a method to increase student engagement and student achievement. Overall, this study contributes positively to the evidence supporting the translation of research to practice.
References


students during whole-class science instruction. *Journal of applied behavior analysis*, 27(1), 63-71.


Sutherland, K. S., & Wehby, J. H. (2001). Exploring the relationship between increased opportunities to respond to academic requests and the academic and behavioral outcomes of students with EBD: A review. Remedial and Special Education, 22, 113-121.

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Appendix A

March 7, 2014

Approved Application Number 201401082

Dr. Corrin C. Richels
Department of Communication Disorders and Special Education

Dear Dr. Richels:

Your Application for Exempt Research with Ellen Browning entitled “The Effect of Instructional Coaching via Bug-in-Ear Technology on Specific Teaching Behaviors and Student Achievement During Classroom Instruction,” has been found to be EXEMPT under Category 6.1 from IRB review by the Human Subjects Review Committee of the Darden College of Education with the following condition: In your informed consent document and in your letter to parents, you provide contact information if anyone is concerned about the study. The contact information should be changed from the IRB and the university. Instead, direct individuals to contact Dr. Theodore P. Remley, Jr., Chair, Darden College of Education Human Subjects Review Committee at tremley@odu.edu.

The determination that this study is EXEMPT from IRB review is for an indefinite period of time provided no significant changes are made to your study. If any significant changes occur, notify me or the chair of this committee at that time and provide complete information regarding such changes.

In the future, if this research project is funded externally, you must submit an application to the University IRB for approval to continue the study.

Best wishes in completing your study.

Sincerely,

Theodore P. Remley, Jr., J.D., Ph.D.
Professor and Batten Endowed Chair in Counseling
Department of Counseling and Human Services
ED 110
Norfolk, VA 23529

Chair
Darden College of Education Human Subjects Review Committee
Old Dominion University

tremley@odu.edu
November 17, 2014

Ellen L. Browning

Re: Investigating the impact on instructional coaching via Bluetooth technology on specific teaching behaviors of teachers and subsequent changes in student engagement and achievement.

Dear Ms. Browning:

The Office of Assessment, Accountability, and Evaluation of County Schools has approved your request for research. Based on your proposal, your research request will be approved from November 17, 2014 through December 31, 2014. Should you desire to continue your research efforts after this period of time, you must submit a progress report on the status of your research and request renewed approval for continuation of the project. Any significant changes or amendments to the procedures or design of this study must be approved by resubmitting the request for research (identifying the changes) to this office.

In the interest of continued research benefits and the coordination of research interests, please send this office one copy of your results and discussion. This information, and any other relevant information you may have, will be filed in our research library and added to the annotated listing of research projects. We look forward to your results and any suggestions they may offer toward improving the educational process in County Schools.

If you need further assistance, please contact the Office of Assessment, Accountability and Evaluation at

Sincerely,

Senior Coordinator
Chair, Research Review Committee
Research and Evaluation
December 1, 2014

Ellen L. Browning

Re: Investigating the impact on instructional coaching via Bluetooth technology on specific teaching behaviors of teachers and subsequent changes in student engagement and achievement.

Dear Ms. Browning:

Due to time delays and the holiday schedule, your request to extend your research timeline until February 28, 2015 is APPROVED. Should you desire to continue your research efforts after this period of time, you must submit a progress report on the status of your research and request renewed approval for continuation of the project. Any significant changes or amendments to the procedures or design of this study must be approved by resubmitting the request for research (identifying the changes) to this office.

In the interest of continued research benefits and the coordination of research interests, please send this office one copy of your results and discussion. This information, and any other relevant information you may have, will be filed in our research library and added to the annotated listing of research projects. We look forward to your results and any suggestions they may offer toward improving the educational process in County Schools.

If you need further assistance, please contact the Office of Assessment, Accountability and Evaluation at

Sincerely,

[Name]

Chair, Research Review Committee
Research and Evaluation

*The Mission of County Public Schools is to provide a high quality education for all students.*
### SAMPLE INSTRUCTIONAL COACHING PROMPTS

<table>
<thead>
<tr>
<th>Prompt or Feedback</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
<td>Pose a question now using the SRS.</td>
</tr>
<tr>
<td>High-Access</td>
<td>Ask students to hold their thumbs up when they know the answer.</td>
</tr>
<tr>
<td>Pause</td>
<td>Give students think time.</td>
</tr>
<tr>
<td>Signal</td>
<td>Signal your students when you are ready for them to respond.</td>
</tr>
<tr>
<td>Correction</td>
<td>Provide a correction for incorrect responses.</td>
</tr>
<tr>
<td>Reinforce</td>
<td>Provide a specific and positive praise statement.</td>
</tr>
<tr>
<td>Proximity</td>
<td>Walk over to the student in the third row on the left.</td>
</tr>
<tr>
<td>Keep teaching</td>
<td>Go back to instruction.</td>
</tr>
<tr>
<td>Classroom Management</td>
<td>Write student name on the board and tell them what and why you’re doing it.</td>
</tr>
<tr>
<td></td>
<td>Place a check under the student’s name but keep teaching.</td>
</tr>
<tr>
<td>Encouragement</td>
<td>Great job!</td>
</tr>
<tr>
<td>SRS</td>
<td>9 out of 10 students have answered.</td>
</tr>
<tr>
<td></td>
<td>67% answered “B”</td>
</tr>
</tbody>
</table>
Appendix C
SAMPLE SRS MATH QUESTIONS

Name ___________________________ Date ___________ Class __________________

LESSON 11-2 Angle Theorems for Triangles

Practice and Problem Solving: A/B

Find the unknown angle measure in each triangle. Choose the letter for the best answer.

1. \begin{align*}
\triangle ABC &: A \quad 45^\circ \\
&: B \quad 90^\circ \quad ? \quad 70^\circ \\
\end{align*}

- A 45°
- B 55°
- C 90°
- D 135°

2. \begin{align*}
\triangle DEF &: A \quad 40^\circ \\
&: B \quad 50^\circ \\
&: C \quad 60^\circ \\
\end{align*}

Find the unknown angle measure in each triangle.

3. \begin{align*}
\triangle EFG &: A \quad 85^\circ \\
&: B \quad 65^\circ \quad ? \\
\end{align*}

- A 85°
- B 65°
- C 70°
- D 70°

4. \begin{align*}
\triangle HJK &: A \quad 104^\circ \\
&: B \quad 30^\circ \\
\end{align*}

- A 104°
- B 30°
- C 60°
- D 70°

Find the value of the variable in problems 6–8.

6. \begin{align*}
\triangle LMN &: x^\circ \quad 70^\circ \\
\end{align*}

7. \begin{align*}
\triangle MNO &: y^\circ \quad 55^\circ \quad 60^\circ \\
\end{align*}

8. \begin{align*}
\triangle PQR &: n^\circ \quad n^\circ \quad 50^\circ \\
\end{align*}

Use the diagram at the right to answer each question below.

9. What is the measure of \( \angle DEF \)?

10. What is the measure of \( \angle DEG \)?

11. A triangular sign has three angles that all have the same measure. What is the measure of each angle?
4. What kind of angle pair do angles 1 and 2 form? What is their relationship?

5. What kind of angle pair do angles 1 and 2 form? What is their relationship?

6. What kind of angle pair do angles 1 and 2 form? What is their relationship?

7. What kind of angle pair do angles 1 and 2 form? What is their relationship?
Appendix D. INSTRUCTIONAL COACHING OBSERVATION FORM (ICOF)

Class ID__________________  Date _________________

Directions:

Instructional Coach/Data Collector Will:

1. Write class ID number and date of observation at top of ICOF.

2. Begin recording data when the teacher begins instruction.

3. Record every instance of the following: high access strategy of choral responding (verbal and SRS), the low access strategies of: call-outs and blurt-outs; completed and incomplete TTC trials; re-directs, reprimands, and praise statements with a single tally mark for each occurrence.

4. Stop the observation for any major interruptions such as emergency drills.

5. End the observation at 30 minutes when the teacher stops delivering instruction.

6. Determine the frequency of the high access strategy of choral responding (verbal and SRS), the low access strategies of: call-outs and blurt-outs; completed and incomplete TTC trials; re-directs, reprimands, and praise statements.

7. Calculate the frequency of high access strategy of choral responding (verbal and SRS), the low access strategies of: call-outs and blurt-outs; completed and incomplete TTC trials; re-directs, reprimands, and praise statements and record with a tally mark.
| INSTRUCTIONAL COACHING OBSERVATION FORM (ICOF) | Class ID ___________________ | Date ___________________
|-----------------------------------------------|-------------------------------|---------------------------|

<table>
<thead>
<tr>
<th>INSTRUCTIONAL STRATEGIES</th>
<th>HIGH ACCESS STRATEGY</th>
<th>LOW ACCESS STRATEGY</th>
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<td>SRS</td>
<td>CALL - OUTS</td>
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<td>Thumbs Up</td>
<td>RE-DIRECTS</td>
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<td>Bubbles in Hands</td>
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<td>Praise</td>
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<th>CLASSROOM MANAGEMENT PROMPTS</th>
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## Appendix E. Social Validity Survey

<table>
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<tr>
<th>Instructional Coaching Satisfaction Survey</th>
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</thead>
<tbody>
<tr>
<td>1. How helpful was the instructional feedback delivered by the instructional coach?</td>
</tr>
<tr>
<td>□ Not Helpful □ Somewhat Helpful □ Very Helpful</td>
</tr>
<tr>
<td>2. How easy was it to adapt to feedback delivered using wireless technology?</td>
</tr>
<tr>
<td>□ Difficult □ Somewhat Easy □ Very Easy</td>
</tr>
<tr>
<td>3. How easy was the wireless technology to use?</td>
</tr>
<tr>
<td>□ Difficult □ Somewhat Easy □ Very Easy</td>
</tr>
<tr>
<td>4. How much did the instructional coaching benefit your instructional delivery?</td>
</tr>
<tr>
<td>□ Not at all □ Somewhat □ Very Much</td>
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<tr>
<td>5. How much did the instructional coaching benefit your student's level of engagement?</td>
</tr>
<tr>
<td>□ Not at all □ Somewhat □ Very Much</td>
</tr>
<tr>
<td>6. How much did the instructional coaching benefit your student's academic achievement?</td>
</tr>
<tr>
<td>□ Not at all □ Somewhat □ Very Much</td>
</tr>
<tr>
<td>7. How many of your peers would you recommend instructional coaching to?</td>
</tr>
<tr>
<td>□ None □ Only a few □ All of them</td>
</tr>
<tr>
<td>8. What is your overall satisfaction with this experience?</td>
</tr>
<tr>
<td>□ Dissatisfied □ Neutral □ Satisfied</td>
</tr>
</tbody>
</table>
Appendix F. Consent Form

OLD DOMINION UNIVERSITY
Informed Consent for a Research Study

You are being asked to take part in a research study. This study is called: *Investigating the impact of instructional coaching via Bluetooth technology on specific teaching behaviors of teachers and subsequent changes in student engagement and achievement.*

Ellen Browning who is a doctoral student at Old Dominion University is conducting the study.

Drs. Corrin Richels, Robert Gable, and Shana Pribesh who are professors in the Darden College of Education at Old Dominion University, are supervising Ms. Browning.

**What is this study about?**

This study is being done to investigate the relationship between immediate feedback delivered by instructional coaching via Bug-in-Ear (BIE) technology and effective teacher practices. This study will also investigate the role that formative assessment plays in effective teaching practices and student achievement. Finally, this research will examine the relationship between teacher contribution and student behavioral and academic outcomes.

**Why is the purpose of this study?**

Information collected during this study will benefit, teachers, students, and teacher educators in that it will extend the research base supporting instructional practices that support increased student engagement and achievement while supporting teachers. It will also contribute to growing bodies of research on BIE technology and technology driven formative assessment.

**Why have I been asked to take part in this study?**

You have been asked to participate in this study because you have been identified as a certified teacher.

**How many people besides me will be in this study?**

Two other teachers will take part in this study. Student data will be used in anonymous and/or aggregated form.

**What will I be asked to do in this study?**

*If you decide to be in this study, you will be asked to do these things:*

- Read one article.
- Embed the use of student response systems into your instruction.
- Collaborate with two other teachers to create questions to be delivered/responded to via student response systems during content instruction for one unit of instruction.
- Learn to receive feedback via Bluetooth technology (earpiece).
- Take part in 15-30 minute instructional coaching sessions every class period for one unit of instruction.
- Wear a LENA audio recording device around your neck during instructional coaching sessions.
• Reflect on the experience at the end of the study by taking a short satisfaction survey.

**How much time will I spend being in this study?**
The anticipated time frame for this study from start to finish is 8 weeks. Preparation time required to use student response systems and BIE technology should not take longer than 30 minutes for each technology (1 hour total). Teacher collaboration can occur during normal planning periods or by email.

**Will I be paid for being in this study?**
You will not be paid for being in this study.

**Will being in this study cost me anything?**
There will be no cost to you except for your time in participating in the study.

**Can the researcher take me out of this study?**
The researcher may take you out of this study if she thinks you no longer meet the study requirements.

**What benefits to my teaching may occur as a participant in this study?**
There may be direct benefits for your participation in this study as it aims to support teachers as they deliver content instruction. You may see an increase in student engagement and achievement as a result of learning how to increase the use of instructional strategies that increase student engagement within your entire class. In addition, you may see a decrease in the need to deliver reprimands and re-directs during instruction.

**What are the benefits to scientists or society?**
This study will help provide researchers and teacher educators with information related to evidence-based instruction in the classroom. The information gathered through this research will assist professionals to learn how to help teachers facilitate increased student participation which is correlated to increased student achievement. Society will benefit from teachers who are more satisfied with their teaching and students who are better prepared for life outside of high school.

**What are the risks (dangers or harm) to me if I am in this study?**
This study poses no risk to teacher participants or students, however, there may be some mild discomfort related to use of the technology and the coach’s feedback. The instructional coach will conduct pre-intervention training to make sure that the teachers are as comfortable with the technology as possible. In addition, instructional coaches will model the type and timing of instructional feedback that they will be delivering prior to the start of the intervention so that teachers are not surprised or caught off guard.

**How will my confidentiality (privacy) be protected? What will happen to the information the study keeps on me?**
Anonymity and confidentiality will be protected using anonymous forms, which contain ID numbers that the primary researcher and instructional coach will use to identify the teacher participants. Student data recorded by the SRS system and unit scores will be provided anonymously and in aggregated form. Documents and audio recordings will be stored in locked files with access limited to the instructional coach and researcher. All raw data will be destroyed after it has been entered into a database. The material in the database will be deleted after five years.

**What are the alternatives to being in this study? Do I have other choices?**
The alternative/other choice is not to participate.
**What are my rights as a participant?**
Taking part in this study is voluntary. You may choose not to take part at all. You may end your participation in the study at any time without consequence or penalty.

**Whom do I call if I have questions or problems?**
If you have questions about the study at any time please call the researcher, Dr. Corrin Richels at (757) 683-5084 or Ellen Browning at (757-477-8353). You may also contact Dr. Ted Remley, the IRB chairperson for exempt applications at (757) 683-6695 or the Office of Research at (757) 683-3460.

I have read this consent form. The study has been explained to me. I understand what I will be asked to do. I freely agree to take part in it. I will receive a copy of this consent form to keep.

________________________________________________________________________
Signature of Research Participant/Date

________________________________________________________________________
Signature of Researcher/Date
Appendix G. Parent Notification Form

Dear Parent/Legal Guardian,

Your child’s teacher is participating in a research study designed to help teachers provide more effective instruction while increasing student engagement and achievement in math. To maximize the results of the study, we would like to examine the data for all students in your child’s math class. Effective instruction may increase student engagement and achievement in the classroom. For one unit of study, we will be looking at teacher behaviors, offering immediate feedback to teachers, and examining student responses to questions asked during math instruction. In addition, scores from a unit test will be collected and analyzed. Here is what we will be doing and when:

An instructional coach will visit your child’s class for about 30 minutes per visit over the course of about four to eight weeks. During the visits, the instructional coach will sit in the back of the class and observe and/or record the teacher’s interactions with the students. Sometimes, the instructional coach may deliver instructional feedback to the teacher via a wireless headset. It is likely that the students will not be able to hear the feedback and there will be no direct contact between the instructional coach and the students at any time.

Your participation, as well as, that of your child in this study is voluntary. You and your child have the right to withdraw from the study at any time without consequences. Feel free to contact me at Old Dominion University at (757) 477-8353 or by email, ebrow020@odu.edu with any questions. Should you have questions regarding your rights as a participant in research, please contact the ODU Research Foundation, (757) 683-3460. No identifying information will be collected from your child or your child’s school, and all information obtained during the course of this study will remain confidential. The results or findings will be used for the purpose of instructional research only. If the results are published, your child’s name or school’s name will not be used. All documents and/or data will be stored in a secure location and destroyed in five years.

I GIVE consent for my child (print child’s name here) ________________________________ to participate in the above study. ________________________________

Signature of child’s parent or guardian / Date

I DO NOT GIVE consent for my child (print child’s name here) ________________________________ to participate in the above study. ________________________________

Signature of child’s parent or guardian / Date
Determining how to enhance teaching and motivate students to learn continues to present a challenge for educators. The challenge today is, perhaps, greater than ever, as more diverse students with complex academic and emotional needs look to teachers for social support and academic assistance. Adding to the problem is the fact that creating opportunities for students with learning challenges to access the district’s or school’s core curriculum of study requires a significant shift in teaching attitude and focus. Research-validated instructional methods have made a substantial difference for students with diverse learning needs, but all too often, creating the time for teachers to learn these methods is not of high priority for the district or school. Further, the organization of schools is sometimes structured in a way that prevents powerful teaching, innovative organizational arrangements, and new curricular approaches. As Peter Senge, organizational expert, stated, “Schools may fail to incorporate research-validated practices for students with learning disabilities because schools themselves suffer from learning disabilities” (cited in Knight, 1998, p. 1). To truly meet the academic and social needs of a diverse population of students, organizations will need to re-create themselves to meet this diversity head-on, or they will be left sideswiped by an anachronistic system geared for a student who no longer exists (Katz & Denti, 1996).

The ensuing discourse challenges schools to redesign themselves based on the given that every classroom contains a diverse group of students with large variances in prior knowledge, skills, motivation, and ability in English. More specifically, it responds to the demands of classroom diversity by providing empirically valid and practical learning strategies that teachers can implement without extensive training. Further, it suggests that traditional approaches (e.g., undifferentiated curriculum, “sage on the stage” teaching, removing children who do not fit) only serve to widen the gaps between successful and struggling students. Challenging the notion that schools are for those students who “do school well,” this article offers teachers a view of powerful instruction that empowers all students. The focus of the article is the following question: How can teachers more effectively respond to classroom diversity and help all students improve or “get smarter”?

Kevin Feldman is the director of reading and early intervention for the Sonoma County Office of Education, and he is an adjunct professor of special education at Sonoma State University. He also serves as a leadership team consultant to the California Reading and Literature Project. Lou Denti is a Lawton Love Distinguished Professor of Special Education in the Center for Collaborative Education and Professional Studies at California State University at Monterey Bay. This article was adapted from New Ways of Looking at Learning Disabilities: Connections to Classroom Practice published by Love Publishing Company.

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WHY CHANGE THE WAY WE TEACH?

The data over the past 25 years suggest that lower level classes and special classes for students with learning difficulties often produce an opposite effect from the original intent, which was to provide intensive individualized instruction to improve or ameliorate the identified problem (Eastminger, 1991; Steinback & Steinback, 1984; Steinberg, 1991; Wang, Reynolds, & Walberg, 1986). By their very nature, these classes dilute or supplant the core curriculum, often rescuing or enabling students via a tutorial or remedial approach (Deshler & Schumaker, 1986). The result has been a less capable learner unequipped to deal with the exigencies of the general education classroom or the real world (Zigmond & Thorton, 1985). Just as distressing, many students with learning problems give up, give in, act out—an indictment, so to speak, of a system unable to adapt to meet students' needs.

To offset the negative aspects of separate schooling for students with learning disabilities, educators in the past decade have touted inclusion as educationally sound and "right." Though inclusionary efforts have been meritorious, they have not garnered the necessary support and resources to gain unilateral acceptance at most schools. Further, teachers lack the training and time to develop an appropriate strategy for special education support in general education classrooms (Denti, 1994). Whether a school is using pullout programs or inclusive programs, the need to provide more intensive focused instruction to students labeled learning disabled and other low-achieving students is critical.

On that note, we now turn to what we have called high-access instruction (HAI). High-access instruction is a method of teaching that uses instructional strategies designed to ensure that all teachers and students are actively engaged in the learning process. The remainder of this article defines HAI, contrasts high- and low-access strategies, and describes how high-access instruction can be implemented by classroom teachers.

THE CHALLENGE OF INCORPORATING HIGH-ACCESS INSTRUCTION IN SCHOOL CLASSROOMS

As a society, we can legislate and mandate opportunity—think, for example, of desegregation and inclusion—but legislation does not ensure access. That is, we can place students with learning disabilities in general education classrooms and tell ourselves that they have expanded opportunities, but the actual research data (Vaughn & Schumm, 1995; Vaughn, Schumm, Haagcr, Shuster, & Saumell, 1996; Zigmond & Baker, 1995) document that students with learning disabilities do not have the same access to classroom activities as their peers.

According to a growing body of research (Mcinlosch, Vaughn, Schumm, Haager, & Lee, 1993; Schumm, Vaughn, Gordon, & Rohlein, 1994), general education teachers have provided opportunities for students with learning disabilities to participate in the same activities as nonlabeled peers, but few adaptations or enhancements have been made. Differentiation of the curriculum to support students with learning challenges has rarely been observed. Moreover, Vaughn and Schumm (1995) found that students with learning disabilities participated minimally in general education classes. For those students, they observed low levels of participating in class, asking for help, answering and asking questions, engaging with peers, participating in teacher-directed activities, and following through with homework. Further, they found that general education classroom teachers expected less of students with learning disabilities. The teachers asked the students with learning disabilities fewer questions, interacted with them less in discussion, provided them with less feedback, and monitored their group work less. These findings occurred across grade levels and were exaggerated at middle and high
school levels. The authors concluded that there appeared to be a tacit assumption between general education teachers and students with learning disabilities that went something like this: "You don’t bother me, and I won’t bother you!"

Any rethinking of the learning disabilities paradigm must go beyond concepts of inclusion and mainstreaming to address learning activities in the classroom that empower and engage all learners. Significant changes are required on the part of general and specialist teachers to ensure that high-access instruction becomes the norm in schools serving diverse learners.

What we propose fundamentally challenges the very nature of instruction in classrooms. High-access instruction sees all students as potential assets rather than problems. It also asks teachers to analyze their teaching and look for areas where instruction may be "breaking down," rather than blame their students for not understanding the content. By shifting the paradigm of instruction to variables the teacher controls, high-access instruction lays the groundwork for more interaction between teachers, students, ancillary staff, and parent volunteers.

HIGH-ACCESS INSTRUCTION: WHAT IS IT?

High-access instruction is a way of teaching that uses empirically sound and valid learning strategies to (a) actively engage all learners in a classroom, (b) maximize student participation, and (c) ensure that diverse learners focus their attention on critical concepts and big ideas (Karnetski & Karnetski, 1998). High-access instruction combines many strategies that have their roots in cooperative learning, direct instruction, and critical thinking. These approaches have a sound research base and can be effectively implemented in almost any type of classroom at any grade level.

High-access instruction frames teaching from the perspective of "everyone does everything" in the classroom. The teacher's role shifts from disseminator of information to choreographer of learning. The lesson/unit design incorporates dynamic interaction with students. The teacher's job is to get all students actively engaged and participating. Simply put, HAI encourages students to think, speak, write, touch, build, listen, practice—to actively learn. It frames the issue of student diversity in terms of variables that teachers can powerfully respond to, rather than in terms of problems to be eliminated via administrative fiat. As Keogh (1990) indicated nearly a decade ago, major changes are needed in the delivery of services to problem learners, and these services need to be the responsibility of general and special educators. She further pointed out that teachers are the central players in bringing about change in practice and that our most pressing challenge is to determine how to improve the quality of instruction at the classroom level.

High-access instruction is an answer to Keogh's cry for change at the classroom level. It provides teachers with a means for employing concrete learning strategies at every stage of a lesson or unit, from brainstorming and predicting before new content is taught to structured review after a lesson. Many examples of high-access learning strategies are provided in this article to help teachers gain an understanding of how to employ these powerful teaching methods in their classrooms. In addition, the article points out the limited viability of low-access instruction.

WHAT DOES NOT WORK: A BRIEF LOOK AT COMMON LOW-ACCESS TEACHING PRACTICES

Before we examine the details of high-access instructional strategies, we present a brief look at some common low-access teaching practices to provide a point of comparison. The majority of these low-access teaching routines are not harmful or "bad" in and of themselves; however, they are likely to be ineffective in today's diverse classrooms because they assume homogeneity among very diverse students. Low-access practices tend to treat all students as if they have the same skill levels, motivation, fluency in English, and prior knowledge about various content area subjects. As such, they limit the ability of many students to interact with the teacher, think critically, or construct new meaning.

A significant first step to crafting schools and classrooms that truly work for all kinds of learners is to ensure that teachers' instructional "tool kits" are well stocked with validated strategies that engage every student in the learning process so that teachers may better resist using low-access strategies.

Hand Raising

The most powerful thing a teacher can do to ensure real access to powerful learning experiences may be deceptively simple: Stop the age-old practice of hand raising as the primary way to structure discussion and other forms of discourse in the classroom. It has been repeatedly documented (e.g., Cohen, 1994; Goodlad, 1984) that dramatic inequity exists in classroom verbal interactions as early as kindergarten and that these troubling social structures persist through graduate school. Some students can't get enough of the teacher's attention, continually having their hands in the air, responding to every question, blustering out answers, and so forth, while others sit quietly, either bored or daydreaming, fearful of looking inept, or otherwise disengaged from the instructional conversation. It comes as no surprise that the correlation between classroom interaction and student achievement is significant and that the "die gets cast" at an early age. All teachers know it is not the low-achieving
student, the second-language learner, the student with dis-
abilities, or the less confident student who raises his or her
hand to contribute. Thus, a logical first step for a teacher
desiring to change this inequitable classroom sociology is to
stop engaging in the practice of asking questions and wait-
foring for students to raise their hands with a response.

Allowing Students to Blurt Out Answers
Blunting out answers as soon as the teacher poses a question
is the primary-grade “cousin” to hand raising. Eager stu-
dents often want to show their enthusiasm and intelligence
by shouting out the answer before much of the class has
even figured out the question! While teachers may admon-
ish students who blurt out answers, subtle cues often com-
nunicate that this behavior is acceptable and indicative of a
quick mind. However, the student who shouts out answers is
unwittingly depriving his or her classmates of the valuable
thinking time that they need to cognitively process the ques-
tion and construct a viable response.

Round-Robin Reading
One of the most common forms of passage reading in
schools is known as round-robin reading, where students
take turns reading aloud while the rest of the class or group
follow along. Though this is practice fraught with difficul-
ties, just one of which being that only one student is actively
engaged in the reading activity, it persists as a salient teach-
ing method in most classrooms. Teachers who dismiss this
method have reported that many students are so busy count-
ing the lines until their turn to read that they pay little atten-
tion to the student who is reading aloud. In addition, less
able students are often anxiety ridden awaiting their turn and
then humiliated by demonstrating to the whole class their
lack of skill in oral reading.

Unstructured Group Work
“Get into groups and discuss the meaning of the home-
work,” exhorts a well-intended middle school teacher. The
problem with this type of instruction is that, lacking a clear
objective, the groups will simply replicate the inequities of
the larger classroom. One student will likely dominate and
take over the conversation while others will be uninvolved
in the discussion. Thus, a logical first step for a teacher
desiring to change this inequitable classroom sociology is to
stop engaging in the practice of asking questions and wait-
foring for students to raise their hands with a response.

Undifferentiated Curriculum—“One Size Fits All”
Assigning everyone the same homework assignment, the
same stories for individual reading, the same format for pro-
jects, and so on, ensures frustration for students who do not
have the required prior knowledge and skills to derive ben-
efit from the activity. Yet teachers often find themselves
confronting the reality of using an elementary reading
anthology ordered by their district’s central office for use
with all students at their grade, regardless of the fact that one
half or more of their students cannot independently read the
books. Vygotsky (1978) and others have documented that
instruction must be provided at a student’s instructional
level, or zone of proximal development. This cannot be done
with a “one-size-fits-all” curriculum that assumes homogeneity
in heterogeneous classrooms.

Undifferentiated Teaching—“Sage on the Stage”
The corollary to undifferentiated curriculum is undifferenti-
ated instruction. The teacher who views teaching as essen-
tially communicating information via oral recitation to a
number of students limits opportunities for learning. Good-
lad’s (1984) groundbreaking study documented that “sage
on the stage” teaching was the most established and univer-
sal form of classroom instruction and was especially com-
monplace at the secondary level. Very little has changed
since that study. Yet oral recitation ignores the fact that
classrooms with many diverse learners require teachers to
do more than simply cover the material. They need to ""
Additionally, high-access instructional strategies strive to provide a safe, nonthreatening environment within which students can practice developing skills and explore new information. The following sections briefly describe the high-access strategies and provide examples that demonstrate how teachers can incorporate the strategies into their lessons to effectively accommodate the needs of diverse learners.

**Choral, or Group, Responding**
1. Ask a question and tell students, "Think—don't blurt out."
2. Provide thinking time.
3. Provide a simple oral or visual cue that will signal all students to respond together.

Choral, or group, responding is an age-old strategy that works very well when the answers are short and the same (Archer, Gleason, & Issacson, 1995; Camine, Silbert, & Kameenui, 1997). It provides a safe environment for practicing new skills while keeping engagement and attention focused for all students. The teacher teaches the students how to think first and then, upon a signal such as lowering both hands, to respond as a group. Consider, for example, a first-grade teacher reviewing the sight word "was." He or she could use choral responding to ensure that all students look at the word, think about how to say it, and then say it together. The teacher would point at the word on the overhead projector and ask everyone to look at it and think about what it says. After a minute or two, the teacher would give a signal for the class to respond as a group. Individual mistakes in the group responses would cue the teacher to review the sight word in more detail before going on with the lesson.

**Thumbs Up When You Know**
1. Ask a question and tell students, "Think—don't blurt out, and put your thumb up when you know."  
2. Provide thinking time.
3. Check to see that most students have their thumbs up.
4. Either call on students randomly or cue students to respond chorally as a group (if the answer is short and the same).

Thumbs Up allows students to demonstrate that they know an answer without blurring it out, which, as noted earlier, deprives other students of the critical time they may need to cognitively process the question and form an answer. Secondary teachers often use a modification of the Thumbs Up approach by asking students to make eye contact with them when they are ready to answer. Both approaches provide all students with valuable thinking time, prevent the blurring out of answers, and give the teacher a quick and immediate assessment of student knowledge and ability to respond successfully. In addition, they avoid the pitfalls of calling on students who are not prepared or do not feel comfortable responding.

A fifth-grade teacher might, for example, ask students to reflect on the critical attributes of cold-blooded animals just reviewed in a video on the subject and to put their thumbs up when they can identify at least one. The teacher would then randomly call on individual students or ask the students to whisper the answer to their partners. Thus, all students would be actively engaged in reflecting on key aspects of the video and would have a nonthreatening opportunity to participate in the class dialogue.

**Classroom Whip Around**
1. Pose an open-ended question. Answers must be a word or a phrase, 10-word limit.
2. Provide thinking time, and model a response if needed (partner responses can be used instead to better ensure that all students have something to contribute).
3. Start anywhere in the class and "whip around the room" having students quickly share their answers. Allow no discussion or comments.
4. Students have the right to pass.

The Classroom Whip Around is a fun, engaging strategy that provides students with the opportunity to practice summarization and oral recitation in a safe classroom environment. The whip is particularly useful for encouraging students to identify key big ideas, themes, and summarative information at the end of a lesson or activity. Teachers can modify the whip by having students write their answer on a sheet of paper and simply stand to show the class their written response as the "wave" circulates around the classroom.

A fifth-grade teacher, for example, might ask students to identify the key characteristics of a region studied in the classroom or to put their thumbs up or make eye contact when they are ready to respond. Then he or she "whips around" the classroom giving each student a brief chance to share one attribute. Further discussion takes place after all students have the chance to respond.

**Partner Strategies**
Perhaps the most flexible set of HAI strategies involves various forms of structured partner responding. In all of these partner strategies, the teacher matches each student to an
appropriate partner (i.e., high-performing students with middle-performing, middle-performing with lower-performing students) and provides the partners with specific roles for the activity. Partner responding works well across the educational spectrum, from kindergarten through graduate school classrooms.

**Think-(Write)-Pair-Share**

1. Pose an open-ended question (no single answer).
2. Provide time for students to think of answers (it can be useful to have older students write responses in a notebook/double-entry journal).
3. Have students form pairs. Designate students in each pair as a "one" or a "two." Direct "ones" to share answers with their partners for a minute or two, then reverse the process.
4. Randomly call on individuals to share with the class.

Think-Pair-Share (Kagan, 1992) is a versatile high-access strategy. It is particularly useful for open-ended questions that have many possible answers, such as in brainstorming. Success with this and other partner strategies revolves around carefully structuring each detail involved in the activity. Care should be taken, for example, to structure the time frame (start short, 1-2 minutes), topic, role, and social expectations.

This example illustrates the Think-(Write)-Pair-Share strategy. A high school English teacher asks students to reflect on a character in a novel they are reading and then to individually write a list of as many attributes as they can that are distinctive about the character. After a few minutes, the teacher directs the students to work in pairs. The teacher instructs the "ones" to share what they have written about the character while the "twos" practice good listening skills. At the end of 2 minutes, he instructs the "twos" to share what they found distinctive about the character. He encourages the students to add useful items learned from their partner to their own master list. The teacher carefully monitors student responses by listening to selected pairs as they converse. This provides him with an opportunity to informally assess how well students understand the information or examples the teacher felt were necessary. Whole class discussion could then be conducted to provide additional information or examples the teacher felt were necessary. Tell-Help-Check is a textbook example of a high-access instructional strategy that dramatically increases the active participation of all learners, thus ensuring that the students, not the teacher, are actually doing the cognitive work of reviewing.

**Tell-Help-Check**

1. Assign partners. Designate students in each pair as a "one" or a "two."
2. Pose a closed-ended question (one right answer).
3. Give thinking time.
4. Have one partner in each pair tell the other all he or she can recall about the topic/subject/question (encourage students to make educated guesses—tell them to "give it a go").
5. Explain that the other partner helps by adding anything the "teller" left out, by correcting, by elaborating, and so on.
6. Explain that both partners will then check in the book, notes, overhead, etc., and validate, correct, or elaborate on their answers.

Research (Rosenshine, 1987) and common sense suggest that review of critical information is vital for all students, especially those most at risk for school failure. Evidence also suggests that teachers and higher-achieving students actually do most of the reviewing that takes place in the typical classroom (Schumm & Vaughn, 1995; Thomas & Rohwer, 1987). In fact, the students who most need to generate a response or practice their emerging English are the very students least likely to be actively engaged in classroom review activities. Tell-Help-Check (Archer, 1999) offers teachers a robust strategy for ensuring that all students are actively involved in systematic review of critical information, regardless of their prior knowledge or proficiency in English. This strategy works well when reviewing factual information that has discrete right and wrong answers.

As an example, a high school science teacher could ask her students to describe the key phases of the convection cycle they have been studying. "Ones" would tell "twos" all they could, and "twos" would help by adding, correcting, or elaborating on "ones" responses. Finally, the partners together would check the responses by reviewing a graphic in their text that summarizes the information. Whole class discussion could then be conducted to provide additional information or examples the teacher felt were necessary.

**Do-Check-Teach**

1. Assign students to partners with adjacent achievement levels.1
2. Pass out the problems/worksheet and the answer key.
3. Instruct partners to individually (independently) answer the first question without looking at the answer key.

---

1 A quick form for determining achievement levels is ranking is to rank order your classroom and then place the top student with the middle student and so forth. For example, in a class of 30, Student 1 would partner with Student 16, Student 2 with Student 17, and so on.
4. Have partners compare answers and compare their answers to the answer key.
5. If either partner missed the question, the other student should teach him or her how to work it out correctly.
6. If both partners missed the problem, they should ask another pair or you for assistance.

Do-Check-Teach is a simple partner strategy that is ideal for enhancing independent seat work in math. Similar in nature to Kagan's (1992) Pairs Check, Do-Check-Teach helps students focus on the purpose of practice by providing them with the answers for checking their work. Students are reminded that the reason for doing the worksheet is to become fluent with the process or strategy recently covered in class, not simply to arrive at the right answers. If both partners struggle, they can ask a nearby pair for assistance or summon the teacher. Use of Do-Check-Teach also gives teachers time to circulate and provide individual pairs with additional instruction, modeling, and other personalized assistance.

A primary-grade teacher might use Do-Check-Teach with her students to practice recently taught math skills. By having the time to circulate, the teacher would be able to differentiate her teaching and provide individual pairs with the exact practice they need, thereby avoiding a "one-size-fits-all" approach. Topics could range from single column addition to addition with regrouping to subtraction with borrowing. The students would also benefit from the immediate feedback by their assigned peers.

Classwide Peer Tutoring/Peer-Assisted Learning
1. Partner students via adjacent achievement levels.
2. Structure partner activity (e.g., for reading fluency, "ones" could read for 5 minutes followed by "twos" rereading the same passage for 5 minutes; continue for 20 minutes).
3. Partners earn points for on-task behavior.
4. Tutors provide partners with error correction as needed.
5. Team points are totaled weekly.

Classwide Peer Tutoring (CWPT) offers a wide range of effective high-access instructional opportunities. An extensive research base documents its effectiveness in heterogeneous elementary and secondary classrooms for developing basic skills in reading, math, and spelling (Greenwood & Delquadri, 1995). Peer-Assisted Learning Strategies (PALS), elaborations of CWPT (Fuchs, Fuchs, Mathes, & Simmons, 1997), are particularly helpful for teachers in grades 2–8 facing the challenge of diverse reading levels among their students. To implement PALS Reading, for example, the teacher structures partner reading wherein students take turns engaging in the following sequence of activities to promote reading fluency and comprehension:

Peer-Assisted Learning Strategies Reading
1. Partner 1 predicts what will happen next in a reading passage at the partners' instructional level.
2. Partner 1 then reads the section of text orally and monitors his or her prediction.
3. Partner 1 summarizes the text and says who/what the section was about—that is, the topic.
4. Partner 1 tells the most important thing about the topic, adding pertinent details.
5. Partner 1 paraphrases in 10 words or fewer the "gist" of the section.
6. Partner 1 makes a new prediction about the same section and repeats the sequence.
7. With PALS Reading, the partners take turns reading and asking each other the comprehension questions while the teacher monitors individual pairs.

Like CWPT, Peer-Assisted Learning Strategies allow teachers to differentiate instruction by having students read in texts at their instructional level while the whole class is practicing the same reading strategy (e.g., prediction, summarization). Mathes, Howard, Allen, and Fuchs (1998) recently demonstrated that a modification of PALS is equally effective for assisting first-grade readers in the acquisition of beginning reading skills.

The following example shows how PALS can be used: A fourth-grade teacher might set up PALS reading practice for 40 minutes a day. He would partner students with adjacent reading levels and find appropriate texts to match their average instructional level, ranging from second- to seventh-grade texts. The partners would take turns reading and practicing comprehension strategies using the PALS guidelines.

The teacher would circulate to listen to students as they read orally and practiced their comprehension strategies.

Clear Reading With Choral Responding
1. Read material from the text aloud to the class.
2. Have students follow along in their books.
3. Leave out selected words every sentence or so.
4. Have students read the left-out words chorally.

A powerful alternative to round-robin reading is close reading with choral responding. This strategy allows all students access to the information in the text, focuses their attention, and allows for diverse reading levels among students. The teacher reads aloud while the students follow along in their books (primary students can use their fingers as well). The teacher leaves out selected words that most
students will be able to read, and the whole class reads those words together chorally. Care should be taken to keep the pace lively to encourage all students to read the words that are left out.

Consider this scenario: A seventh-grade history teacher realizes that one half of her class cannot independently read the text. Moreover, when she reads aloud, many students are inattentive. By leaving out a word every sentence or two and prompting students to respond as a group, attentiveness increases. She makes sure that the majority of the words she leaves out are words that most of the students can read independently. With this strategy, less confident readers as well as English language learners have a safe environment in which to practice their emerging language skills without holding the class back from exploring content area concepts.

Random Questioning With 3 X 5 Name Cards
1. Write all the students' names on 3 x 5 cards.
2. Pose a question and give thinking time.
3. Use Thumbs Up or partners to ensure that all students are prepared to respond productively.
4. Randomly select a student to give the answer by picking the next card in the pile of 3 x 5 cards.

Students often enjoy game-like formats, which enliven class discussion. The use of 3 x 5 cards adds an enjoyable element to the discussion process while making students accountable for their learning. Step 3 is the key to success when using this strategy. It ensures that all students have access to the information prior to the teacher having a student answer the question.

A middle school teacher might conduct the review of study questions at the end of a history chapter by combining Thinks-Pair-Share and 3 X 5 cards to create a lively discussion. If extra pizzazz is desired, the teacher could place half of the class back from exploring content area concepts.

Give One-Get One
1. Pose a question that requires a list of answers. Have students brainstorm the answers individually and write them down in a list.
2. Have students draw a line after the final idea they noted.
3. At your signal, invite students to move around the classroom to get at least one additional idea to add to their list and to give at least one idea from their list to a classmate.
4. Have students return to their seats, review their new lists, and discuss the items with a partner or the whole class.

Brainstorming is an important classroom activity with endless permutations. Give One–Get One provides an interesting brainstorming variation by giving students a chance to get up and move around the classroom in a structured manner while at the same time holding them accountable for a productive outcome.

For example, a sixth-grade teacher could ask students to list all of the possible reasons people immigrated to the United States in the 1840s. Then, using Give One–Get One, she could give students 4 minutes to add reasons to their lists (below the line on their papers) as they circulate around the classroom. After 4 minutes, the teacher would give a "wrap it up" signal, and the students would return to their seats to review their new lists. Using Think-Pair-Share, the teacher might then direct the students to select the three most compelling reasons from their newly expanded lists and discuss with a partner why they chose them. Whole class discussion using 3 x 5 cards could follow with the teacher helping students to grapple with the key ideas behind immigration to the United States in the mid-19th century.

Heads Together
1. Place students in heterogeneous teams of three or four (combine two pairs if using partners regularly).
2. Have students number off (e.g., 1, 2, 3, 4).
3. Explain that you will pose a question and set a time limit for the groups to discuss the answer.
4. Inform the teams that you will randomly select one number and the person in each team with that number will be accountable for sharing the group's answer.
5. Pose a question that requires conversation and elaboration. Set a time limit.
6. Have the students put their heads together to find the answer.
7. Randomly select one number. Have the "lucky" students share answers with the class.

Classroom discussions are notorious for lack of equitable student participation. At a recent conference session on curricular adaptations for secondary students, one teacher quipped, "The same kids participate in high school who did in third grade." Unfortunately, the research data support this observation. Heads Together offers teachers a simple, yet elegant, alternative to traditional classroom discussions driven by hand raising. It provides all students with access to critical information while making each student responsible for responding to the question at hand. Heads Together increases performance in content area discussions and content tests for all levels of students in diverse classroom settings (Madden, Mallette, Harper, & Sacca, 1988). Our
I combined knowledge, while at the same time holding individuals with less prior knowledge to benefit from the team's entire class. Like Heads Together, Ambassadors allows students to generate in their Heads Together team.

At the conclusion of the sharing, the teacher adds additional comments to tie each student's ideas together. For homework, students compose individual letters to the author using one or two of the questions they can take back "home" to share. Observations suggest that teachers may want to assign additional roles of "checker" and "discussion facilitator" to provide even more structure for the discussion. The checker simply checks to make sure that all group members can answer appropriately if called upon, the discussion facilitator's job is to ensure that all group members participate and share information.

Here's an example of classroom use of the Heads Together strategy. A third-grade teacher places students into heterogeneous teams of four and asks them to think about and discuss four questions they would like to ask the author of the novel they have just finished. After 7 minutes of intense dialogue, the teacher brings the class back together, using the predetermined signal of turning the lights off and on once to get student attention. After the signal, the students stop talking and watch intently as the teacher spins a spinner on his desk to see who the "lucky winners" will be. The spinner lands on 4. All "fours" stand up, and the teacher randomly calls on each to share one idea. The whole class claps for each student after he or she shares an idea. After each student shares, he or she takes a seat. At the conclusion of the sharing, the teacher adds additional comments to tie the ideas together. For homework, students compose individual letters to the author using one or two of the questions generated in their Heads Together teams.

Ambassadors

1. Follow the same procedures as for Heads Together.
2. After choosing the lucky number, have each of the selected students go to the group closest, clockwise, to him or her. Explain that each group is a foreign country and that each selected student is an "ambassador."
3. Have the ambassadors share their groups' answers with the "foreign country" and ask for one different answer that they can take back "home" to share.
4. Have the ambassadors return home to share what they have learned with their team members.

Ambassadors can be a particularly effective strategy for increasing access to learning in diverse classrooms. It allows students to practice oral recitation in the relatively non-threatening context of a small group, instead of before the entire class. Like Heads Together, Ambassadors allows students with less prior knowledge to benefit from the team's combined knowledge, while at the same time holding individuals accountable for learning, because no one knows who will be selected until the number is chosen. If the topic is particularly open ended and complex, teachers may want to have the ambassadors make rotations to two or more different groups. Doing so not only expands the knowledge base of each group but provides each individual ambassador with repeated practice presenting his or her information. This type of authentic practice is exactly what English language learners, low achievers, and other diverse learners need to master critical information in a safe learning community.

The following scenario shows a classroom situation that is ideal for Ambassadors. A ninth-grade social studies teacher is working with her students to understand why Sumaria was an important civilization in the ancient world. She assigns each team of four the task of determining the four major reasons for why Sumaria was an important civilization. At the end of a Heads Together-type discussion, she randomly selects "threes" to be the appointed ambassadors. All "threes" stand and "fly" to the country to their right with a "visa" that expires in 5 minutes. They must share their group's four reasons and rationales and then must come back "home" with at least one new reason learned from the "foreign country." At the end of 5 minutes the teacher gives the signal for the ambassadors to return "home" and share what they learned. A classwide discussion follows, bringing light interesting answers from all countries. For homework, each student writes a short paper describing why ancient Sumaria was an important civilization.

Reciprocal Teaching

1. Demonstrate and model the four strategies of reciprocal teaching; predictions (cover what they are, why they are useful, and what makes a good one); questions (cover how to phrase them and why they are so helpful in reading); clarifications (cover what they are, how to phrase them, and why they are useful); and summaries (cover what they are, examples of paraphrasing, and how summaries help text understanding).
2. Read aloud, or have students silently read (if students have the decoding skills), a section of text (a paragraph or page).
3. Then lead students through a dialogue using the relevant reciprocal teaching strategies, taking care to model the thinking that would be used when applying each strategy.
4. Provide ongoing practice by shifting control for leading discussion to the students as longer passages of text are being read.

Palincsar and Brown (1984) documented the effectiveness of reciprocal teaching for developing reading comprehension with diverse students. The demonstrations and modeling show students exactly how to perform a task so that they can better comprehend narrative and factual text. The key to success with reciprocal teaching, as well as other reading comprehension strategies, is to overtly model the thinking one might use when applying the strategy (Pressley, El-Dinary, et al., 1992).
For example, a sixth-grade teacher modeling prediction when prereading a science textbook might say, "Let's see. We know these plants capture insects to eat, but the author hasn't told us anything about how the plants actually attract and seize them. I predict in the next section the author will tell us..." As the class continued to read the selection, the teacher would stop to model each of the four reciprocal teaching strategies and would prompt the students to practice using the strategies with their partners. Over the next 4-6 weeks, the students would take more and more control of the modeling and of directing the reciprocal teaching process in content area texts.

LOW- AND HIGH-ACCESS INSTRUCTION CONTRASTED

The purpose of HA1 extends beyond incorporating a few calculated instructional tricks into classroom instruction. The challenge rests in the responsibility of the teacher to create a classroom that honors active thinking and discussion while at the same time advocates for and promotes student construction of meaning either individually or as a group. In high-access classrooms, teachers are accountable for ensuring that all students are active participants in each instructional activity. These teachers understand that "learning is not a spectator sport" (Archer, 1999). The differences between high-access and low-access instruction are summarized in Table 1.

### SUMMARY

Low-access classroom activities go on in almost every classroom in America that unintentionally exclude many diverse students from having meaningful access to learning. This typical, or generic, instruction is a product of years of creating schools as assembly lines, with the underlying assumption that diversity was a problem to either ignore or eliminate. Yet, American schools are continuing to become more diverse in terms of achievement level, educational background, home language, and ethnicity. Traditional "teach to the middle" approaches to instruction and unintentional tracking into high, middle, and low groups simply do not work. Mounting research (Pressley, Harris, & Marks, 1992; Pressley, Hogan, Whareon-McDonald, & Mistretta, 1996) suggests that when teachers systematically apply high-access strategies across the curriculum, learning gains accrue for all levels of students. In essence, high-access instruction offers educators an opportunity to capitalize on the diversity in their classrooms without compromising the integrity of classroom expectations and while meeting state and district standards.

We believe that teachers need specific research-validated instructional tools, such as those described in this article, that will empower them to effectively respond to the challenges posed by increased academic diversity, including serving students identified as learning disabled. Teachers and other professionals are encouraged to use these and other high-access practices, to dialogue with others who are

### TABLE 1
Contrast Between Low- and High-Access Strategies

<table>
<thead>
<tr>
<th>Low-Access Strategies</th>
<th>High-Access Strategies</th>
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</thead>
<tbody>
<tr>
<td>Engage students one at a time</td>
<td>Engage all students simultaneously</td>
</tr>
<tr>
<td>Offer little or no thinking time</td>
<td>Prioritize thinking time for all</td>
</tr>
<tr>
<td>Assume adequate prior knowledge and skills</td>
<td>Assume diverse prior knowledge and skills</td>
</tr>
<tr>
<td>Focus on coverage of content and skills</td>
<td>Focus on learning of skills and content</td>
</tr>
<tr>
<td>Create high levels of threat/discomfort for diverse learners</td>
<td>Create low levels of threat; diverse learners are &quot;set up for success&quot;</td>
</tr>
<tr>
<td>Do not differentiate for skill levels (&quot;one size fits all&quot;)</td>
<td>Differentiate instruction for different skill levels and learning needs</td>
</tr>
<tr>
<td>Provide little or no structuring of student interaction (&quot;sage on the stage&quot;)</td>
<td>Provide careful structuring of student interaction (teacher acts as &quot;learning choreographer&quot;)</td>
</tr>
</tbody>
</table>
attracting to implement them, and to work together to transform the learning landscape from providing generic opportunity to truly providing meaningful access for all.

REFERENCES


Appendix I. Training Protocol

Teachers will be trained on each component included in the study. When each teacher expresses a sense of comfort with the technology they will place a check in the “yes” box. Proficiency with use of SRS will be demonstrated by the ability to plug-in, answer, and interpret results 5 questions with 100% accuracy.

### I. LENA

"This is LENA." (show device). It is a simple recording device that will be placed around your neck in this pocket during instruction. It will record everything that you say.

**Directions for use:**
1. Press the start button until the screen lights up.
2. Place the record button until it says, “recording”.
3. Place recording device in pouch and hang around neck
4. I will collect the LENA Device prior to exiting your class. You may turn it off if you wish by pressing the “record” button and then the “power” button.

<table>
<thead>
<tr>
<th>I understand this component</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
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<tr>
<td>No</td>
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</tr>
</tbody>
</table>

### II. BIE

This is the “bug-in-ear” device that you will wear during instruction. You will hear me issue short instructional prompts in your ear. This will be one-way communication, you will not issue a verbal response to me.

**Directions for use:**
1. Turn on “walkie-talkie”
2. Clip on your shirt/top or pocket
3. Place “BIE” in your ear
4. Receive feedback (Practice with each)
5. I will collect the BIE device prior to exiting your class. You may turn it off when you are done using it if you wish. Each of you has your own ear piece which will remain yours at the end of the study.

<table>
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<tbody>
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<td></td>
<td></td>
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<tr>
<td>No</td>
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</tbody>
</table>

### III. High-Access Instruction

I asked you each to read an article by Feldman and Denti (2004) on High access vs low-access instruction. High-access instruction is instruction that actively engages every
student, maximizes student participation, and facilitates student attention during critical instruction. Low-access instruction is not “bad”, but it tends to limit student engagement and teacher-student interactions.

**Directions:**
1. Prior to beginning instruction, say the following to your students, “If you’re ready, put your thumbs up.”
2. At the end of instruction (but before practice) say, “If you’re ready to practice, put your thumbs up.”

*** I will cover choral response with SRS in section V.

I understand this component

---

### IV. Learning Units

I would like each of you to focus on completion of a set of 3 learning units during your instruction. Together these learning units are called “three-term contingency trials” (TTC trials) and have been shown to be predictors of effective instruction. TTC trials consist of:

1. Teacher question
2. Student response
3. Teacher feedback—praise statement or corrective feedback.

**Examples:**

1. Correct student response
   (A) Teacher: “What is 2+2?”
   (B) Student: “4”
   (C) Teacher: “Correct. 2+2= 4”

2. Incorrect student response
   (A) Teacher: “What is 2+2?”
   (B) Student: “5”
   (C) Teacher: “No. 2+2= 4”
   (A) Teacher: “Try again. What is 2+2?
   (B) Student: “4”
   (C) Teacher: “Great, now you’ve got it. 2+2 +4.”

*** I will cover incorporating TTC trials into use of a SRS in section V.

I understand this component

---

### V. Student Response Systems

In this study, we are going to use student response systems (SRS) as part of both 1) choral student responding, and 2) the second part (“B”) of a TTC trial. Research on the use of SRS during instruction suggests that student participation increases which in turn facilitates greater student achievement.
Directions:
Prior to each day of instruction, I will collect (or create) 5 questions related to content taught for the day. You can email these questions or I will stop by your class and pick them up. I will input these questions into the SRS software for use during your class. You will ask each of the pre-arranged questions as part of instruction as part “A” of a TTC trial. After giving students a “think” period, students will “click in” with their responses as part “B” if a TTC trial. You will look at the data in real time as it is clicked in and give immediate corrective and/or praise feedback to the students. You may re-visit the question if you deem necessary.

Let’s practice:

5 practice questions

1)
2)
3)
4)
5)

Tomorrow, you will need to teach your students how to use the SRS to respond to questions. Similarly to how I practice with you, you will give them 5 practice questions. Once the students have achieved 100% accuracy clicking in on 5 questions, they will be deemed ready to use the technology.

I understand this component  Yes  No
SMART Response XE Guide

Setting Up the Hardware
1. Connect the receiver's USB cable to an available USB interface on your computer. The Ready light on the receiver turns on to indicate that the receiver is connected properly.
2. Choose a location for the receiver that is as high as possible and in plain view of the students' clickers.

Tip: You must connect the receiver BEFORE turning on the clickers or starting a class. Once you are properly connected a balloon message will appear telling you that it is OK to turn on the clickers.

Setting Up Teacher Tools
1. Click Create a new SMART Teacher file and set up your class lists from the Teacher Tools Screen. The Gradebook Information window appears.
2. Type your classroom information into the fields.
3. Click Done.

Adding a Class
1. Switch to Gradebook view. Click on Add a Class in the side menu.
2. Type your class information into the fields. Note: You must choose a passing grade for each class.
3. Click Add. The class displays on the Gradebook list.

Creating & Editing a Class List
You can enter student information for each class manually into Teacher Tools or import a class list.

Creating a class list in Excel
1. Open up a new worksheet in Microsoft Excel.
2. Format your class lists exactly as described below.
   Name the first cell "ID Number"
   Name the second cell "First Name"
   Name the third cell "Last Name"
3. Input all of your students names in the first and last name columns
4. Create a unique ID number for each student. For example, you might choose to use the number equivalent of their first initial and first 3 letters of their last name. (John Smith = 5764)
Tip: You can import Student names from X2 into Excel.

5. Click File > Save As. Select Comma Separated Values (.csv) from the Format drop-down menu.
6. Name the file and click Save.

Importing a Class List
1. Select File > Import > Students. The Import window appears. (You can also get to the Import Window by clicking on the Import icon in the top menu bar.)
2. Select the class to which you want to add students. Click Next.
3. Select the file type of your class list—Comma Separated Values (CSV).
4. Browse and select the file you saved in step 6 above. Click Open
5. Click OK

Adding/Editing Individual Students
1. Click the Students tab at the top of the window.
2. Click Add Students to your Class or . The Properties Window appears below the table.
3. Make sure that the Privacy is set to Off.
4. Type the student information into the fields. Press TAB to advance to the next field.
5. Click anywhere in the student table to update your class list.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Performance</th>
<th>Results</th>
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<tbody>
<tr>
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</tr>
<tr>
<td>Last name</td>
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<td></td>
</tr>
<tr>
<td>E-mail</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Inserting an Instant Question
You can insert an instant question at any time into a presentation in SMART Notebook.
1. Click on the SMART Response tab in the side bar.
2. Under the heading Ask a question now: select the appropriate type of question.
3. Follow the prompts to insert the question on the current page or the next page.

Note: If you have not already started a class you will be prompted to start a class so that you can begin to ask questions.

Creating Assessments
1. Open SMART Notebook.
2. Click on the SMART Response tab.
3. Click on the Title Page button. The Insert Title Page window will open.
4. Type your assessment information in the fields and click Add. The title page for your assessment appears in the Notebook workspace.
5. Click Next Steps in the Response tab.

Adding Questions
1. Click Add a question to the next page. The Insert Question window appears.
2. Select type of question and click Next.
   • Yes or No – Yes or No response
   • Multiple Choice – Several choices, only one correct answer allowed
   • Number, fraction, expression – Numeric response
   • True or False – True or False response
   • Multiple Answer – Several choices, multiple correct answers allowed
   • Text – If it is an opinion question, max of 140 characters. If it is not an opinion, max of 20 characters
3. Type your answers in the field provided and click Next
4. Select the correct answer and assign a point value to the question.
5. Click Finish if it is your last question. Otherwise click Insert Another

Tips: You can only add text in the Question Wizard. If you want to add images and/or media as part of a question or answer choice, leave the fields blank and insert later in the Notebook workspace. Objects can be added from the gallery or copied and pasted from other files.

Tips: Questions can be imported from PDF files or ExamView. See the SMART Responder User Guide for more information www2.smarttech.com/kbdoc/134078
Giving an Assessment

1. Open Teacher Tools and select the appropriate class and click Start Class.

2. Have students to sign in to the class using their clickers.
   a. Turn on the clicker.
   b. Select Find classes
   c. Select Join "Your Classroom Name" using the keys at the top of the clicker.
   d. Enter your student ID number and click Sign In
   e. If the name is correct, click Yes to sign in.

3. Open your assessment in SMART Notebook and click on the orange clicker symbol on the right side.

4. Click the Progress tab and then click Start this assessment now

5. Click the Next Page icon to view the questions

6. Have students respond to questions using the clickers
   a. Respond to each question using the keys at the top of the clicker and/or the keypad
   b. Select next to move to the next question
   c. When you have finished answering all the questions, click list and review your answers before clicking submit

7. (Optional) To view student progress, click Show next to "Who are we waiting for?" to see a list of the students who have not answered the question.

8. (Optional) To preview results click Show next to "Preview Results"

9. When you finish giving the assessment, click Stop this assessment. The Results button replaces the Progress button.

10. Click on the Results button to view a graph and summary of the results of each question.

11. (Optional) To save results to view them in Excel, click on Response > Export Results to > Comma Separated Value (.csv) in the main menu bar. Then save the file.

12. Click the Next Steps tab and select Clear the results to take this assessment again to allow another class to take the assessment.

13. Select Response > Stop Class in the main menu bar to turn off the clickers.
Reviewing an Assessment

Results can be reviewed in *SMART Notebook* (Step 10 above) or in the *Teacher Tools*.

1. Open **Teacher Tools** and select the class that you want to review from the Gradebook side bar.

2. Click the **Assessments** tab and select the assessment results that you want to review.

3. Review the details of the assessment in the **Assessment Detail** window.
   - Click on **Performance** to view a graphical representation of results
   - Click on **Results** to view a list of student averages

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>Student ID</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayoub</td>
<td>Nancy</td>
<td>6296</td>
<td>5</td>
</tr>
<tr>
<td>Boyd</td>
<td>Erin</td>
<td>3269</td>
<td>5</td>
</tr>
</tbody>
</table>

Tip: You can also generate reports and export results from the Teacher Tools. For
Appendix J. Treatment Protocol

✓ Collect signed informed consent forms from teacher participants.
✓ Have teachers send home parent notification forms with students.
✓ Collect parent notification forms.
✓ Email teachers Feldman and Denti (2004) article.
✓ Conduct a pre-baseline observation to wear-off any novelty effect.
✓ Conduct teacher training on use of LENA dlp, BIE equipment, High vs. Low-access instruction, three-term contingency trials, and SRS system use.
✓ Create student IDs for students in each class participating in the study.
✓ Assist teachers during student training on SRS system use.

**Procedures across all conditions/all phases of the study:**

1. Enter class.

2. Turn on tablet and connect to internet.

3. Activate SRS software for the class.

4. Turn on the coach’s LENA dlp and the teacher’s LENA dlp.

5. Speak each procedural step into the LENA for treatment fidelity checks.

5. Turn on both FM receivers.

6. Hand LENA dlp, BIE equipment, and lanyard necklace to teacher.

7. Coach will place LENA dlp, BIE and lanyard around neck.

8. Date and place identifier on ICOF form.
**Baseline Procedures (All conditions):**

1. Record frequencies of targeted teacher behaviors on the ICOF form.

2. Deliver delayed feedback to each teacher either immediately after class, during period three planning, immediately after school, or by email within one hour of the end of the school day.

* Teacher 1 will remain in baseline conditions for the entire study

**Intervention 1/Teacher 2 and Teacher 3:**

1. Record frequencies of targeted teacher behaviors (dependent variables) on the ICOF form.

2. Provide behavior specific instructional feedback (corrective or praise) and behavior specific classroom management feedback (corrective or praise) via BIE device on targeted teacher behaviors (dependent variables) and other behaviors that facilitate the desired target behaviors.

3. Utilize SRS upon teacher request only.

* Teacher 1 (control) continues to receive delayed feedback only.

**Intervention 2/Teacher 2 and Teacher 3:**

1. Record frequencies of targeted teacher behaviors (dependent variables) on the ICOF form.

2. Provide behavior specific instructional feedback (corrective or praise) and behavior specific classroom management feedback (corrective or praise) via BIE device on targeted teacher behaviors (dependent variables) and other behaviors that facilitate the desired target behaviors.

3. Prompt **ALL 3** teachers to utilize the SRS during instruction.
*Due to software problems, the instructional coach will plug questions in during instruction and feed results in real-time to the teacher.

* Teacher 1 (control) continues to receive delayed feedback only.

**Maintenance check #1/All teachers:**

1. Record frequencies of targeted teacher behaviors (dependent variables) on the ICOF form.
2. Have SRS ready for teacher use upon request.
3. No feedback given.

**Maintenance check #2/Generalization/All teachers:**

1. Record frequencies of targeted teacher behaviors (dependent variables) on the ICOF form.
2. No feedback given.
VITA

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EDUCATION:

2014 PhD Old Dominion University; Norfolk, VA; Special Education; Specialty Areas: ED/LD and High Incidence Disabilities; Literacy, Mathematics, and Assessment; Program Evaluation – RTI, PBIS, and Inclusive education (Co-taught and Non Co-taught Classrooms). August, 2015

Dissertation: Does Student Achievement Improve in Middle School Math When Teachers Receive Instructional Coaching using Bug-in-Ear Technology? Dr. Corrin Richels, Chair

2005 M.S. Old Dominion University; Norfolk, VA; Special Education with emphasis on Learning Disabilities (K- 12) and Emotional/Behavior Disorders (K-12)

1997 B.S. University of the State of New York; Albany, New York; Liberal Studies: Geology, Earth Science Education

EXPERIENCE

Academic Experience:

Sept. 2012 - 2013 Graduate Assistant/Team Leader: Distance Learning Initiative (Development, Marketing, and Implementation of Online Research Masters Degree in Special Education); Old Dominion University, Norfolk, VA.

Jan. 2012 - 2013 Research Assistant, Learning Disabilities Research; Old Dominion University, Norfolk, VA.
Conducting research with a local school system investigating the impact of content enhancement routines on middle school and high school special needs student’s achievement.

**Jan 2012 - Aug 2012**

Graduate Teaching Assistant; Old Dominion University, Norfolk, VA. Spring/Summer 2012. Adjunct instructor for two semesters of SPED 400: Foundations, Legal & Ethical Aspects in General and Special Education. Student opinion surveys for both semesters included rankings above both the department and college mean.

**Sept 2011 - June 2012**

Research Assistant, Oral Preschool Research; Old Dominion University, Norfolk, VA. Participation in research meetings, coding of data, and discussing current and future studies for pre-school children with cochlear implants.

**Jan 2011 - June 2012**

Research Assistant, Oral Preschool Research (Data Manager); Old Dominion University, Norfolk, VA. Utilizing best practice, data were recorded, analyzed, and appropriately managed as part of a study on pre-schoolers with cochlear implants and their language acquisition skills.

**Non-Academic Experience:**

**2013 - 2014**

Teacher, High School Earth Science, Inclusion Earth Science; Virginia Beach City Public Schools, Virginia Beach, VA.

**2009 – 2011**

Teacher, High School Inclusion Biology, Inclusion Earth Science, Inclusion Algebra, Academic Resource, Self-contained Math/Science; Virginia Beach City Public Schools, Virginia Beach, VA.

**2010-2011**

Varsity Boys Volleyball Coach; Virginia Beach City Public Schools, Virginia Beach, VA.

**June 2010-Aug 2010**

Teacher, Severely Disabled (6-12); Virginia Beach City Public Schools, Virginia Beach, VA.

**May 2008-Aug 2008**

Director of Education, Alternative School; The Pines Residential Treatment Center, Portsmouth, VA.
2002 - 2006  Teacher, High School Earth Science, Remedial Earth Science, Inclusion Earth Science; Virginia Beach City Public Schools, Virginia Beach, VA. (Established a remedial homework/schoolwork program for at-risk and failing students: Mentored pre-service teachers).

2004 - 2006  APPLE Instructor (Professional Development for Teachers); Virginia Beach City Public Schools, Virginia Beach, VA. (Trained teachers to use the outdoors to teach students science).

2003 - 2006  Varsity Boys Volleyball Coach; Virginia Beach City Public Schools, Virginia Beach, VA.

2003 - 2006  Varsity Cheerleading Coach; Virginia Beach City Public Schools, Virginia Beach, VA.

2004 - 2006  Teacher Mentor, High School Earth Science; Virginia Beach City Public Schools, Virginia Beach, VA.

2001 - 2002  Teacher, High School Earth Science, Inclusion Earth Science; Portsmouth Public Schools, Portsmouth, VA.

2001 - 2002  Participant in Lead Teacher Program; Portsmouth Public Schools, Portsmouth, VA. (Science Curriculum and Faculty In-service development. Conducted Faculty In-service at home school).

1999 - 2000  Teacher, High School Earth Science, Inclusion Earth Science; Portsmouth Public Schools, Portsmouth, VA.

1998 - 2000  Teacher, Middle School Gifted Earth Science; High School Earth Science; Virginia Beach City Public Schools, Virginia Beach, VA.

1996 - 1998  Teacher, High School Earth Science; Norfolk Public Schools, Norfolk, VA.
PUBLICATIONS:


PAPERS PRESENTED AT PROFESSIONAL MEETINGS:


Browning, E., & Reed, L. “Using assessment to inform your instruction of students with Special Education needs.” Presented at TED; Ft. Lauderdale, FL, November 9, 2013.


Reed, L., & Browning, E. “Using assessment to inform your instruction for students with EBD.” Presented to the CCBD Conference; Chicago, IL, September 26, 2013.

Morin, L., & Browning, E. “Investigating a content-enhancement device that supports math word problem solving.” Presented to the CEC 2013 Convention & Expo; San Antonio, TX, April 6, 2013.

Reed, L., & Browning, E. “More time in your day?! The use of self-monitoring strategies to increase academic and social behaviors of students with ED.” Presented to the 36th Annual Conference for Teacher Educators for Children with Behavioral Disorders (TECBD); Tempe, AZ, October 27, 2012.

Morin, L., & Browning, E. “Investigating content-enhancement devices that support math word problem solving: A pilot study.” Presented to the 34th International Conference on Learning Disabilities; Austin, TX, October 10, 2012.


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HONORS AND AWARDS:

2004 Passion and Persistence Award; Princess Anne High School; Virginia Beach, VA

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2004 Passion and Persistence Award; Princess Anne High School; Virginia Beach, VA

1997 Eastern District Girls Volleyball Coach of the Year; Norfolk Public Schools, Norfolk, VA

CERTIFICATION AND LICENSURE:
Earth and Space Science
Emotional Disturbance K-12
Special Ed-General Curriculum K-12
Specific Learning Disabilities K-12

PROFESSIONAL SERVICE:

Membership in Professional Societies/Organizations

2012-2013 Secretary, Executive Committee, Virginia Division for Learning Disabilities; Council for Learning Disabilities

2012-2014 Member, Executive Committee, Virginia Division for Learning Disabilities; Council for Learning Disabilities

2011-present Member, Council for Learning Disabilities (CLD)
2011-present  Member, Council for Exceptional Children (CEC)

COMMUNITY SERVICE:

May 5, 2012  Acoustic Entertainment for the American Cancer Society: Race Day Soiree; Norfolk, VA.

April 30, 2011  Acoustic Entertainment for the Chesapeake Animal Society Building Fundraiser: Tails on the Trails; Chesapeake, VA.

2008-2011  Singing pianist; monthly at Chesapeake Health and Rehabilitation Center; Chesapeake, VA.

Oct. 10, 2010  Acoustic Entertainment for the Annual Southeastern Alzheimer’s Memory Walk; Virginia Beach, VA.

Sept. 10, 2010  Acoustic Entertainment for the Chesapeake Firefighters Association; Chesapeake, VA.

1994-1996  Community League Girls Volleyball Coach

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