Where is the "self" in teacher self-assessment?: an examination of teachers' reflection and assessment practices in relation to their teaching practices

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Where is the "self" in teacher self-assessment?
An examination of teachers' reflection and assessment practices in relation to their teaching practices

by

Andrea Jean Madsen

A dissertation submitted to the graduate faculty in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Education

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For the Major Program
DEDICATION

This work is dedicated to my family.

To my parents, Bob and Jane, for the love, encouragement, support, and discipline you have given generously to me.

To my brother, Michael, for all you sacrificed, and the honor and courage you displayed during your deployment in Iraq.

I love you all very much.
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ABSTRACT

The purpose of this study was to identify the levels of explicit reflection-on-action and criteria with which teachers self-assess their teaching, and to compare these levels and criteria to classroom practices. These reflections and practices were then compared to the participants' preservice preparation to determine the extent to which strategies taught transferred to classroom practice. To investigate these issues, this study utilized classroom observations, interviews, and relevant documents from thirteen second-, third-, fourth-, or fifth-year teachers who had graduated from a traditional elementary teacher education program at a landgrant university in the Midwestern United States. Classroom observations were rated using the Local Systemic Change Observation Protocol (Horizon Research, 2004). Teacher interviews examined the criteria teachers consider, as well as the reasoning and reflection they use to make sense of the assessment criteria and their classroom decisions. Interviews were coded using the five reflection levels used by Manouchehri (2002).

This study responds to Kagan's (1990) concern about the lack of information linking reflection to practice, and provides evidence that such a relationship exists. This relationship is most evident in the use of theory. Only the most effective teachers spoke of theory and educational literature, and their use in personal teaching practices. In addition, the content and focus of teachers' reflections differed markedly as teachers demonstrated more effective teaching practices. Even though self-assessment and reflection practices were taught to the participants of this study during their preservice education program, such knowledge bases were often implemented in a piecemeal fashion, particularly by the least effective teachers in this study. Only the most effective teachers in this study implement self-assessment practices in ways that will most likely lead to changes consistent with current reform documents. Implications for preservice and inservice elementary science education professional development and recommendations for further study are discussed.
CHAPTER 1. INTRODUCTION

Overview

For over two decades the current state of teaching and learning in our nation's schools has been a contentious point of concern for policy-makers, teacher educators, administrators, teachers, parents, and others who hold a personal stake in the daily activities of teaching and learning in our nation's schools (Goodlad, 1983; NCEE, 1983; Schimdt et al., 1998; Yager & Penick, 1983). As educational researchers and cognitive psychologists have made progress in understanding the strategies, behaviors, and cognitive tasks that effectively promote meaningful student learning (i.e., learning cycle, thought-provoking questions, wait time, cooperative grouping, concept mapping, discerning prior knowledge, etc.), research on the current state of education demonstrates many teachers have modified research-based strategies in ways that decrease their effectiveness for students' learning (Windschitl, 2002) or have not incorporated such strategies into their teaching repertoires. Further compounding this problem, university teacher education programs seek to provide preservice teachers with the most current research-based practices for effective teaching; however, preservice teachers quickly discern discrepancies between what is taught at the university and what actually is done in classrooms. Unfortunately, overwhelming evidence exists that many preservice teachers dismiss their university coursework and in turn rely on practica, student teaching, and beginning teaching experiences to provide what they perceive they need to teach children adequately (Goodlad, 1990; Kagan, 1992; Ohana, 1999; Zeichner & Tabachnick, 1981). Such lack of coherence between school classrooms, university coursework, and educational research serves to perpetuate the status quo.

Not surprising is the struggle of preservice teachers to comprehend the relevance of their teacher education coursework. Often coursework is theoretical; novice teachers are concerned with keeping control of the classroom and appearing competent. Thus preservice teachers seek activities that "work" so students will be engaged and less likely to cause a management concern (Appleton, 2005; Kagan, 1992). Munby, Russell, and Martin (2001) elaborate upon this tension between the theoretical and the practical:

Good teaching tends to reinforce the view that teaching is effortless because the knowledge and experience supporting it are invisible to those taught. Good teaching looks like the ordering and deployment of skills, so learning to teach looks like acquiring these skills. This mechanistic view of teaching accounts, in part, for the
prescriptive demands of some preservice students to acquire particular, prerequisite skills, while dismissing theory and research. (p. 887)

Furthermore, preservice teachers' thinking is often fraught with inconsistencies demonstrating insufficient knowledge of how to teach children in ways consistent with how children learn (Madsen & Olson, 2005; Olson, in press; Olson, Madsen, Bruxvoort, & Clough, 2004; Skamp & Mueller, 2001). Research on students' learning provides evidence that students often dismiss what they don't understand rather than seek to resolve the inconsistencies of their thinking (Annenberg/CPB, 1998; Driver & Oldham, 1986; Posner, Strike, Hewson, & Gertzog, 1982; Stoddart, Connell, Stofflett, & Peck, 1993). Similarly, preservice teachers often cling tightly to what is familiar and traditional, and in turn dismiss more reform-based strategies and concepts taught during their teacher education program.

Considering novice teachers' inconsistent knowledge base and piecemeal implementation of research-based teaching skills (Kagan, 1992), the unproductive nature of traditional professional development in many American schools (Loucks-Horsley, Hewson, Love, & Stiles, 1998), and the lack of teacher leadership and professionalism in schools (Fullan, 1994; Lemleh, 1995; Sarason, 1993), the development of novice teachers' knowledge and teaching skills toward more competent and proficient levels is somewhat surprising. Yet, individual teachers, teams of teachers, whole schools, and entire school districts exist that provide exemplary instruction for students (Berliner, 1987; Brunkhorst, 1992; Penick, 1983a, 1983b; Penick & Bonnstetter, 1983; Penick & Lunetta, 1984; Penick & Meinhard-Pellens, 1984; Penick & Yager, 1983; Penick, Yager, & Bonnstetter, 1986). Considering all the constraints that limit professional growth, how do novice teachers develop teaching expertise? While much has been written describing the differences between novice and expert teachers, little is known about the development of teacher cognition and skill as novice teachers work to become more competent and proficient at what they know and do (Burden, 1990; Carter, 1990; Leinhardt, 1993; Richardson, 1990a).

One thing is certain—teaching experience is certainly required, yet alone is insufficient, for novice teachers to develop teaching expertise (Berliner, 1987). Many other factors, such as school context, colleagues, teaching assignments, and parental relationships, affect the growth of teachers (Kagan, 1992; Wildman, Niles, Magliaro, & McLaughlin, 1990). Various strategies have been advocated by teacher educators, policy-makers, and administrators to impact the growth of teachers positively. Currently, reflection is a pervasive and ill-defined strategy used with many preservice and inservice teachers to improve their knowledge of teaching and learning, and their classroom practices. Bryan and Abell (1999) highlight the coupling of experience and reflection: “[e]xperience as a
professional provides perturbing encounters that highlight tensions in thinking about teaching and learning. Such encounters yield feedback; reflection stimulates reframing and revising practice” (p. 136).

Additionally, there has been a quieter call for teachers to engage in self-assessment of teaching practices (Fullan, 1994; Goodlad, 1994; Sarason, 1993). Self-assessment and self-reflection are related, and at times used interchangeably in literature (Jones & Airasian, 1995). Clough (2003) writes, “[f]rom these rich reflection-on-action episodes come more meaningful and productive action plans for improvement that, in time, make for better reflection-in-action” (p. 17). Accurate reflection-on-action is needed to assess one’s teaching. As a teacher learns more about what needs to be improved and how he or she might proceed, this knowledge can impact further reflection in the midst of teaching, thus improving teaching practices.

While research on teacher reflection is popular in educational literature, little empirical research exists in the area of teacher self-assessment. Further, Kagan (1990) summarizes her review of the literature on teachers’ metacognition and reflection:

A fundamental problem with all of the techniques described in this section—whether designed to evaluate metacognition or reflection—is the lack of evidence indicating that they assess anything more than verbal facility. I could find no evidence or reference thereof that a teacher’s ability to verbalize his or her thinking is related to experience or expertise. In this respect, measures of self-reflection, like measures of metacognitive knowledge, require systematic use with populations of teachers at different points in their careers and in studies where relationships between teachers’ performances on some of these taxonomies could be related to teachers’ classroom behaviors. (p. 438)

To further our understanding of the development of teachers’ cognition and how such cognition relates to classroom practices, this study seeks to investigate the self-assessment practices in which teachers engage and determine the extent to which this kind of thinking about one’s own teaching is related to effective teaching practices in the classroom. Further, novice-expert literature typically has described teachers with one or fewer years of experience, and ten or more years of experience, but has failed to address adequately the first years of full-time teaching experience—the second through fifth years—that exert a powerful influence on a person’s entire career (Anderson & Mitchner, 1994).

Purpose

This study has two fundamental purposes. First, it seeks to determine the extent to which elementary teachers’ reflections on teaching are related to their use of more reform-based teaching
practices. Specifically, in what ways do teachers who articulate more sophisticated reflection concerning teaching exhibit effective practices in their elementary math and/or science teaching? Currently, self-reflection is advocated as a viable option for teacher evaluation, yet the support systems, time, and skills with which to analyze teaching pose barriers to effective self-assessment (Airasian & Gullickson, 1994), and, to date, no evidence exists that such practices would improve teaching. Empirical evidence is needed to demonstrate the relationship between self-assessment and reflection, on the one hand, and reform-based teaching strategies, on the other hand, to inform educational policy, teacher education, and inservice professional development, specifically, and the climate and socialization of teachers, more generally.

Second, this study will investigate the extent to which elementary teachers utilize the self-assessment and self-reflection strategies taught to them during their preservice elementary science methods course. Finley, Lawrenz, and Heller (1992) argue that studies on teacher education programs "will be of limited value if we do not learn how preservice students' thinking about teaching develops, which of the teaching practices provided in methods courses are actually employed by students, and determine the types of experiences that are important for preservice teachers as they begin to enter the profession" (p. 302). Self-assessment is taught explicitly during the elementary science methods course at Iowa State University; therefore, it is imperative to follow former graduates into the early years of their careers to determine whether these self-assessment and self-reflection skills transfer to their classroom practice.

Research Questions

To understand better the relationship between reflection and classroom practice and the extent to which such reflection transfers from preservice to inservice practices, this study is framed by the following two research questions:

(1) To what extent does the sophistication of elementary teachers’ self-reflection on teaching relate to their effective use of reform-based teaching practices during their math and/or science lessons?
(2) To what extent do self-assessment practices taught in a teacher education program transfer to classroom teaching practices?
Overview of Research Methods

Using qualitative research methods, this study investigated recent Iowa State University elementary education graduates in their 2nd, 3rd, 4th, or 5th years of teaching. All participants were observed teaching a math and/or science lesson. All classroom observations were scored using the LSC Classroom Observation Protocol developed by Horizon Research, Inc. (2004). Following each observation, teachers were interviewed to determine how they assess their lessons and their teaching effectiveness. These interviews were analyzed using open and axial coding techniques (Strauss & Corbin, 1998). Specifically, the sophistication of teachers’ reflections was coded using Manouchehri’s (2002) five levels of reflection.

Assumptions

The researcher assumes the following are true, but currently unverifiable: (1) The sample of teachers observed and interviewed is representative of the entire population of elementary education graduates from Iowa State University. (2) The classroom observation made by the researcher had no reactive effects on the elementary teacher’s teaching skills during the lesson observed. (3) The information told to the researcher during the teacher interview is true and accurate. In other words, teachers did not lie about their self-assessment practices and professional development involvement.

Limitations

This study focuses on the sophistication of reflection teachers use to assess their teaching effectiveness, the systematic strategies employed to analyze teaching, and the rationales teachers utilize to make educational decisions. It is beyond the scope of this study to investigate other related factors, such as administrative policies, teacher socialization, educational contexts, and time, that influence teacher self-assessment. This restricts the conclusions of the study.

Delimitations

This study investigated recent graduates of Iowa State University’s elementary teacher education program in their 2nd, 3rd, 4th, or 5th year of teaching. This population is predominantly female, Caucasian, 24-30 years of age, and natives of the Midwestern United States. Therefore, the
conclusions of this study may apply to other teacher education programs in the Midwest with similar student populations; however, this student population cannot be extrapolated readily to teacher education programs across the nation.

Definitions

The following terms are defined for use in this study:

Teacher’s Knowledge Base: To quote William Gardner (1989), the knowledge base for teaching “is not known by those who are simply well-educated people, who walk into the profession off the street” (p. ix). This knowledge base is expressed in the articulated understandings, skills, judgments, and stories of teachers and includes Shulman’s (1986, 1987) categories of content, pedagogy, and pedagogical content knowledge (PCK), to name a few, and Fullan’s (1994) categories considering teacher professionalism and teacher change. Importantly, the teaching professional “is capable not only of practicing and understanding his or her craft, but of communicating the reasons for professional decisions and actions to others” (Shulman, 1986, p. 13).

Self-assessment: Airasian and Gullickson (1994) define self-assessment as “the process of making judgments about the appropriateness or effectiveness of one’s own knowledge, performance, beliefs, products, or effects, so that they can be improved or refined” (p. 6). Importantly, the teacher’s knowledge utilized during self-assessment must be articulated to determine consciously what needs to change and consider the steps that will be taken to refine future teaching skills or understanding.

Reflection: The concept of reflection has become a popular term within educational literature, yet, as the writings concerning teacher reflection grow, the concept has developed multiple meanings directly related to the philosophical underpinnings used by the author. Reflection, in this study, refers to the thinking teachers do about their practice—this thinking could be done during teaching (reflection-in-action) or following the teaching episode (reflection-on-action) (Schön, 1983). Reflection also refers to the metacognitive processes teachers employ to compare, evaluate, and provide direction for their teaching practices (Calderhead, 1989; Ertmer & Newby, 1996). Researchers often describe the tacit nature of teachers’ reflections (Grimmett, 1988; Richardson, 1990a) and the use of feelings, intuition, or trial and error to make educational decisions (Grimmett & MacKinnon, 1992). This study does not dispute that teachers’ reflections can be tacit, but for reflection to inform and change teaching practices most effectively, it is necessary for teachers to compare their classroom practices explicitly to those practices advocated by the education community. Thus, in this study reflection refers to teachers’ explicit thoughts concerning teaching.
Reform-based practice, or research-based practice: This phrase refers to those educational practices that align with what we know about how children learn, while simultaneously promoting the noble goals discussed by Goodlad (1983). Such teaching practices are discussed and elaborated in the National Science Education Standards (NRC, 1996) and the Principles and Standards for School Mathematics (NCTM, 2000). As exemplified by Clough & Kauffman (1999), Clough (2003), and Windschitl (2002), reform-based practice often requires students to interact with each other, and with their teacher, in a manner whereby thoughtful questions are asked and students’ ideas are shared, used, and questioned when appropriate. Research from both the mathematics and science education communities advocates an educational environment in which students create solutions to problems or seek to answer questions. Further, reform efforts and research-based practices place importance on students “doing” math and science actively in contexts that are relevant to their lives.
CHAPTER 2. REVIEW OF THE LITERATURE

The purpose of this chapter is to review the theoretical background and literature that impacts self-assessment. Self-assessment is part of a larger body of research concerning teachers' knowledge development. While researchers seem to disagree as to what the knowledge base for teaching is and how it develops (Munby et al., 2001), there must be a standard of teaching against which teachers can effectively self-assess their own practice. Thus, this review will highlight the teachers' knowledge base that seems most productive and relevant to this line of research. Second, the literature on expert teachers and novice teachers will be described. This research, while describing the two groups' thinking and actions in classrooms, fails to adequately describe novices' growth in their understandings and practices of effective teaching. Third, the limited studies on teacher self-assessment will be described. Additionally, relevant studies concerning teacher self-reflection will be addressed. Finally, this review ends with a summary of literature reviewed and establishes a context for this study.

The Development of Teachers’ Knowledge Bases

The interest in teachers’ knowledge and its development has increased over the years as evidenced by its inclusion in several research handbooks on teaching and learning (Borko & Putnam, 1996; Calderhead, 1996; Carter, 1990; Christensen, 1996; Clark & Peterson, 1986; Munby et al., 2001). “People talk freely of the ‘knowledge base’ for teaching” (Munby et al., 2001, p. 877), yet this knowledge base is “vast and somewhat idiosyncratic...continuously changing and restructuring” (Calderhead, 1996, p. 710). Munby et al.'s review of teachers’ knowledge development concludes:

What is at first disarmingly simple turns out to be endlessly complex with many conceptions, many researchers, many viewpoints, and many epistemological and moral issues each vying for our attention. ...There is a tension in the different views of what counts as professional knowledge and even of how to conceptualize knowledge. (p. 900)

Traditionally, teacher education programs assumed preservice teachers would learn propositional knowledge via coursework and directly apply such knowledge to classroom practice (Bryan & Abell, 1999). Further, programs assumed preservice “teachers developed professional knowledge before experience rather than in conjunction with experience” (Bryan & Abell, 1999, p.
However, as researchers understand more about human learning, the importance of preservice teachers' prior understanding of teaching and learning increases. Preservice teachers use their prior understanding about teaching and learning to selectively filter the content and experiences of their preservice teaching program to best fit their prior notions of education (Borko & Putnam, 1996; Munby et al., 2001). Consequently, teacher education programs that do not challenge preservice teachers' prior knowledge of schooling through cognitive dilemmas appear to effect shallow and imitative learning in their graduates, thus perpetuating the status quo (Kagan, 1992). Further, the use of a knowledge base as a technical prescription for classroom practice does not account for the complexity inherent in classroom teaching and decisionmaking.

Current ideas concerning teachers' knowledge development challenge traditional assumptions (Bryan & Abell, 1999; Erat, 1994; Feiman-Nemser & Remillard, 1996; Munby et al., 2001). Carter (1990) claims teachers' knowledge cannot "be formalized into a set of specific skills or preset answers to specific problems. Rather it is experiential, procedural, situational, and particularistic" (p. 307). Thus several constructs, such as situated knowledge (Leinhardt, 1988), event-structured knowledge (Carter & Doyle, 1987), personal practical knowledge (Clandinin & Connelley, 1987), images (Calderhead, 1988; Clandinin, 1986), knowing-in-action (Schön, 1983), metaphors (Munby, 1986), voice (Richert, 1992), and craft knowledge (Grimmett & MacKinnon, 1992), have been created to represent the practical knowledge of teachers. This practical knowledge is based in teachers' discovery of an educational knowledge base through experience, rather than the use of educational research to drive practice. For instance, Grimmett and MacKinnon (1992) describe the rigor of craft knowledge "in the judgment of teachers, their feel for their work, their love for students and learning, and so on, almost on aesthetic grounds" (p. 437). Further, they state, "Ryle and Schon reminded us that there were good reasons for distinguishing between 'knowing what' and 'knowing how,' suggesting that craft is something that is acquired 'at the elbows' rather than in books" (p. 437).

While the traditional view of teachers' knowledge was accused of being too rigid, some current views reflect a sense of relativism that is unproductive for the profession of education (Floden & Klinzing, 1990; Zimpher & Sherrill, 1996). For instance, Clark and Lambert (1986) claim, "Teachers work in situations where they are expected to accomplish complex and even conflicting goals. Under these circumstances, a priori knowledge identified by researchers about the relationship among particular decisions or actions and their outcomes is of limited worth" (p. 28). In a rebuttal to Clark and Lambert, Floden and Klinzing (1990) agree that it is inappropriate to use research rigidly as a prescript for practice, yet they dismiss the complete reliance on "personal (often idiosyncratic)
experience as a basis for teaching” (p. 16). Further, “it is better to have some information about what is more likely to happen than to have no information at all” (Floden & Klinzing, 1990, p. 16).

The tension in the current literature on teachers’ knowledge development is that experience alone does not lead to expertise in teaching (Berliner, 1987). Berliner (1987) speaks of the importance of extensive knowledge bases in acquiring teaching expertise. Consequently, the rejection of such knowledge bases, in favor of teachers’ personal experiences, seems to be an extreme viewpoint. Zimpher and Sherrill (1996) claim “a substantial knowledge base exists already” but unfortunately this knowledge base is “either underutilized or unrecognized by teacher educators in the academy or in the field” (p. 281). Similarly, Fenstermacher comments:

The old criteria for “knowledge” are kaput, while there are yet no new criteria to take the place of the old. A difficult spot. The question is whether this difficulty is temporary. Will we eventually gain a new, more generous and robust set of criteria for using the concept of knowledge, or are the post-modernists going to prevail with their claims that there are multiple sets of criteria, depending on one’s culture and discourse? (in Munby et al., 2001, p. 879)

*The Knowledge Base for Teaching*

This study rejects the notion that teachers’ knowledge bases are so grounded in the particulars of practice as to be undefined. Additionally, this study rejects the use of educational research as a rigid prescript for practice. Instead, this study attempts to find a balance utilizing the synergy of educational research (Clough, 2003) with the learning that comes from reflection upon experience (Berliner, 1987). Further support for the demarcation of a knowledge base for teaching is provided by Fullan (1994), Goodlad (1990), Sarason (1993) and Shulman (1986, 1987).

The knowledge base for teaching utilized by this study incorporates Shulman’s (1986, 1987) seven facets of teachers’ knowledge: (1) content knowledge, (2) general pedagogical knowledge, (3) curriculum knowledge, (4) pedagogical content knowledge, (5) knowledge of learners and their characteristics, (6) knowledge of educational contexts, and (7) knowledge of educational ends, purposes, and values. Additionally, this study utilizes Fullan’s (1994) facets of teacher professionalism: (1) knowledge of teaching and learning, (2) knowledge of collegiality, (3) knowledge of educational contexts, (4) knowledge through continuous learning, (5) knowledge of the change process, and (6) moral purpose. Comparatively, Fullan’s ideas incorporate all of Shulman’s categories, while adding collegiality, teacher learning, and the processes of school change. Borko and Putnam (1996) expressed caution in describing teachers’ knowledge using distinct, separate categories because teachers do not store their knowledge as discrete units and certainly do not implement knowledge in such a categorical fashion. Furthermore, the categories mentioned above
overlap and impact each other. Given these limitations, the use of such categories serves to describe the nature of teachers’ knowledge in a way that makes communication and research more feasible.

While the categories defined by Shulman (1986, 1987) and Fullan (1994) describe teachers’ knowledge, the categories of teacher professionalism described by Fullan capitalize the dynamic nature of teachers’ knowledge bases and how experience, in addition to reflection, self-assessment, professional reading, and professional conversation, can lead to advanced understanding and more effective classroom practices. Furthermore, Clough (2003), Clough and Kauffman (1999), Fullan (1994), Penick (2003) and Richardson (1990b) explicate the importance of having a research-based rationale to inform teaching practices. Some researchers argue that teachers’ knowledge bases are inherently tacit and not easily articulated, and consequently give less credence to the idea of teachers’ rationales (Leinhardt, 1990; McIntyre & Hagger, 1993) However, Fullan (1994) contends that teachers who cannot articulate the reasons behind their classroom decisions are apt to be perceived by others as not credible. Articulating one's rationale is considered part of the knowledge base for teaching (Fullan, 1994). Richardson (1990b) explains the importance of rationales for teaching practices, teachers’ knowledge bases, and the teaching profession more generally:

Without an understanding of the theoretical framework and the opportunity to talk about how the premises in the theory agree or disagree with the teachers’ own premises, teachers may accept or reject practices on the basis of whether they meet the personality needs of the teacher and other more ecologically created concerns such as classroom management (see Doyle, 1986) and content coverage. Teachers then become trapped by their inability to take control of their practices, and instead resort to explanations based on external pressures. Empowerment is threatened when teachers are asked to make changes in activities without being asked to examine their theoretical frameworks. In fact, teacher empowerment does not occur without reflection and the development of the means to express justifications. Without such empowerment, teachers may become victims of their personal biographies, systemic political demands, and ecological conditions, rather than making use of them in developing and sustaining worthwhile and significant change. (p. 16)

This study assumes the knowledge base of teaching most productive for the classroom includes the categories of Shulman (1986, 1987) and Fullan (1994), including teachers’ knowledge, teachers’ rationales, and professional strategies that foster knowledge growth and development, in addition to the development of classroom practice. This review now turns to the literature on expert-novice differences to help describe how teachers’ knowledge bases differ according to the expertise teachers demonstrate in the classroom. Additionally, the review on expert-novice differences will consider how novices develop knowledge and teaching practices to become more expert-like in thought and practice.
Expert-Novice Differences

Research from endeavors as varied as chess (Chase & Simon, 1973; deGroot, 1978), physics (Anzai, 1991; Chi, Feltovich & Glaser, 1981; deJong & Ferguson-Hessler, 1986), bridge (Chariness, 1991), medicine (Hmelo-Silver, Nagarajan, & Day, 2002), nursing (Daley, 1999), computer programming (Adelson, 1981), writing (Scardamalia & Bereiter, 1991), and music (Ericsson, Krampe, & Tesch-Römer, 1993; Sloboda, 1991) demonstrates that differences exist in the knowledge, thinking, and actions of experts and novices. While studies of expertise in other fields can certainly inform education, of interest in this review are the studies about novice-expert differences in teaching. Interestingly, Berliner (1987) notes that expert teachers demonstrate several similarities to experts in other fields.

Expert Teachers “See” What Others Cannot

Expert teachers represent their learning and store information about teaching and learning in more integrated and organized networks than do novices (Hogan, Rabinowitz, & Craven, 2003; Klein & Hoffman, 1993). These mental representations, in turn, impact how experts perceive classroom situations (Klein & Hoffman, 1993), the meaning they attribute to students’ behavior (Clarridge & Berliner, 1991), the meaning they attribute to classroom situations more generally (Carter et al., 1987), and how they solve classroom problems (McNamara, 1994). Such complex mental representations of teaching and learning help experts see classroom scenarios differently than novices. While novices look at classroom events using literal descriptions and rarely attribute relevant meaning to classroom events (Carter et al., 1988), “experts see things other people cannot” (Klein & Hoffman, 1991, p. 209). It is not that experts see differently than novices in the literal sense, but that experts use their extensive knowledge base to interpret events differently to create more meaningful information from classroom events.

As experts attribute meaning to classroom events, they categorize situations as typical or atypical (Carter et al., 1987, 1988) and use this information to inform subsequent teaching moves. This leads to automation of teaching skills for typical situations, thus freeing up cognitive space for teachers to concentrate on the atypical situations that arise during teaching (Carter et al., 1987, 1988; Leinhardt & Greeno, 1986). This automation of teaching skills during routine teaching and learning tasks, in addition to the extensive and complex storing of previous classroom information, makes it possible for experts to be more improvisational in their teaching methods. Borko and Livingston (1989) report that expert teachers make mental plans that focus on what students are to learn, in
addition to spontaneously rehearsing teaching skills throughout the day. As expert teachers interact with their students, they demonstrate flexibility as they react to students’ needs and shift their teaching accordingly (Borko & Livingston, 1989; Westerman, 1991).

Not surprisingly, expert teachers evaluate their lessons by analyzing specific instructional strategies employed by the teacher (Sabers, Cushing, & Berliner, 1991), in addition to evaluating the actions utilized by both the students and the teacher (Borko & Livingston, 1989; Hogan et al., 2003). Additionally, expert teachers evaluate their lessons based on student outcomes and the processes students use to learn with the end goal of improving student learning and achievement (Hogan et al., 2003). Furthermore, research indicates expert teachers tend to be more evaluative than novices when analyzing teaching situations (Sabers et al., 1991).

**Novice Teachers Fly Behind the Airplane**

In contrast to experts, novices store information about teaching and learning in discrete units and seem unable to articulate clean conceptual connections between various aspects of effective teaching and learning (Olson, in press; Olson et al., 2004). The limited knowledge base of novice teachers impacts their classroom performance in several ways. First, novice teachers demonstrate strained, hesitant recall of classroom lessons. Further, this recall is focused on neutral student behavior, the content and objectives of the lesson, and superficial aspects of their own behavior (Borko & Livingston, 1989). Alarmingly, the novices in Clarridge and Berliner’s (1991) study expressed an inability to recall inappropriate student behavior. This lack of thoroughness and inability to see important aspects of the classroom are expounded upon by Klein and Hoffman (1991):

Novices … have difficulty in seeing anything other than the current state of a situation, and for this reason they are often unclear about the dynamics of a situation. Novices … also have difficulty in keeping up with situations, because they lack a basis for anticipating changes and generating expectancies. To use an aviation term, they are usually flying behind the airplane. It is no wonder that their responses are variable, awkward, and unintegrated. (p. 214)

This inability to monitor and accurately interpret the multiple classroom events that occur within a given lesson drastically impair novice teachers’ classroom performance, in addition to their development in thinking about teaching and learning (Clarridge & Berliner, 1991, Hogan et al., 2003).

Second, because novice teachers, as Klein and Hoffman put it, are “flying behind the airplane” they rely on short-term pre-planned scripts to make it through a teaching situation and demonstrate a lack of flexibility when classroom scenarios do not follow the script (Borko &
Livingston, 1989; Schemp, Manross, Tan, & Fincher, 1998). Not surprising, novices then evaluate their lessons based on their ability to clearly and efficiently communicate to students, thus elevating the importance of having a well-rehearsed script (Hogan et al., 2003).

Third, novice teachers rarely utilize routines in their classroom teaching, thus they use more time and energy to explain intended student actions and procedures than do expert teachers (Leinhardt & Greeno, 1986). As a result, novices can have a difficult time maintaining control of the lesson agenda, likely due to the students’ constant confusion as to the teachers’ expectations. The lack of routines is perhaps related to novices’ inability to accurately interpret what is going on in the classroom. Additionally, the lack of routines may lead to increased classroom management issues, thus perpetuating novices’ concerns about controlling students (Kagan, 1992). Furthermore, novice teachers will frequently attribute success or failure of a lesson to the behaviors of the students, rather than evaluating the learning strategies used or the teacher’s role in the lesson (Hogan et al., 2003). Therefore, if novice teachers perceive the lesson failed due to students’ misbehavior, rather than a teachers’ lack of consistency, the novice teacher will see no need for a routine.

Methodological Considerations

Expert-novice literature seeks to understand and describe differences in teachers and how they think, how they solve problems, and how they organize their knowledge of teaching and learning. This literature primarily utilizes small sample sizes and qualitative research methodologies and procedures. Needles (1991) reports a rather large sample of 18 student teachers, 14 first-year teachers, and 19 experienced teachers. Comparatively, other expert-novice research commonly utilizes much smaller sample sizes of 3-8 novice teachers and 3-8 expert teachers (Allen & Casbergue, 1997; Artzt & Armour-Thomas, 1998; Borko & Livingston, 1989; Carter et al., 1988; Clarridge & Berliner, 1991; Leinhardt & Greeno, 1986; Westerman, 1991). Bullough and Baughman (1995) describe the development of one teacher over a span of seven years. Researchers studying expert-novice differences typically observe the teaching of a lesson and interview teachers afterwards about their decision-making and thinking during the lesson. While the in-depth research on a sample of a small number of teachers can be informative and even offer explanations, the generalization of such research findings has been questioned (Krathwohl, 1998).

The literature on expert-novice teachers often makes the assumption that experience produces expertise. For instance, novice teachers are often classified as preservice, student teachers, or first-year teachers (Borko & Putnam, 1996; Hogan et al., 2003). Conversely, expert teachers are defined as those with 7-25 years of experience (Artzt & Armour-Thomas, 1998) or those with 5 years of
experience and working toward a master's degree (Needles, 1991). Additional studies attempt to find expert teachers through the recommendations of principals and participation as a cooperating teacher (Allen & Casbergue, 1997; Borko & Livingston, 1989; Westerman, 1991). While more reliable than experience alone, administrators might not identify expertise utilizing the same criteria as an educational researcher. Perhaps the most solid definition of expertise is that by Berliner and his research group. Experts in their studies were nominated by administrators and observed by trained research personnel to ensure expert-like qualities were evident. Subsequently, these expert teachers were found to have more than 5 years of experience (Carter et al., 1987; 1988; Clarridge & Berliner, 1991).

While expert studies have often defined expertise as experience, Berliner (1987) states, "experience is a necessary but certainly not a sufficient condition for expertise" (p. 60). Research comparing educators working for a university extension adult-education program found that grouping educators by sophistication of reflection, rather than years of experience, revealed more similarities in thinking and problem-solving techniques (Ferry & Ross-Gordon, 1998). These authors further assert that years of experience did not seem to change the way the extension educators thought about their practice. Thus, "how one uses experience may be the more crucial element to understanding why some individuals use reflection to grow in their professional learning" (Ferry & Ross-Gordon, 1998, p. 99). Similarly, Berliner argues "experience that is reflected on and examined, in order to derive ways to improve one's own performance, is a very valuable teacher" (p. 60). Consequently, a discussion of how teachers learn from experience is needed.

Teachers' Development Through Experience

While substantial differences are noted between novice and expert teachers, "knowing how experts tend to behave does not help in getting someone to that point, and more importantly, simply copying expertise alone is likely to result in an inappropriate conservatism and lack of innovation" (Leinhardt, 1993; p. 44). Considering the disconnected nature of novice teachers' understandings, their inability to attribute meaningful interpretations to classroom events, their focus on superficial teacher behaviors without a clear focus on students and their learning, and the unpredictable and inflexible nature of their instruction, how then do novice teachers develop understandings and teaching skills that could be classified as more proficient and "expert"-like? Novice teachers often know they need to improve, yet the lack of complex knowledge bases and insufficient experiences, coupled with a lack of ability to "read" classroom situations meaningfully, make moving forward in
their professional development a tenuous and uncertain process. This section of the literature review highlights fundamental ideas about how teachers, in particular, can learn from teaching experience. Many studies have been conducted in this area, therefore this review is not exhaustive, but addresses major ideas that are of importance to self-assessment and reflection literature.

*The Paradox of Learning*

This question of how people go about learning something they do not know has been asked since antiquity as evidenced by this passage found in Plato’s *Meno*:

*Meno*: How will you look for it Socrates, when you do not know at all what it is? How will you aim to search for something you do not know at all? If you should meet with it, how will you know that this is the thing that you did not know?

*Socrates*: I know what you want to say, Meno. Do you realize what a debater’s argument you are bringing up, that a man cannot search either for what he knows or for what he does not know? He cannot search for what he knows—since he knows it, there is no need to search—not for what he does not know, for he does not know what to look for. (trans. 1981, p. 69)

This dialogue between Meno and Socrates raises questions still pertinent to educators today. How does a teacher know how to solve a problem when he or she has never encountered the situation before? How do novice teachers come to understand teaching and learning at a deeper level and put that new knowledge into effective practice? How do we learn?

Grimmett (1988) refers to this particular dialogue in Plato’s *Meno* as the paradox of learning. He says,

> [t]his “launching out” is a necessary precursor to knowing that something exists and to knowing how something functions. This preliminary step is neither blind nor certain; rather it is steeped in the kind of experiential doubt and perplexity that a person’s mind inevitably seeks to resolve. (p. 8)

While much of new learning is uncertain and at times perplexing, we would be wise to remember the rest of Socrates’ dialogue with Meno. Socrates tells Meno, “nothing prevents a man, after recalling one thing only—a process men call learning—discovering everything else for himself, if he is brave and does not tire of the search, for searching and learning are, as a whole, recollection” (Plato, trans. 1981, p. 70). Socrates proceeds to question a boy about geometrical principles and claims, “I am not teaching the boy anything, but all I do is question him” (p. 71).

Ultimately two things were required in this dialogue to lead the boy to learn more about geometry. First, the boy had to have a willing attitude to think deeply about the matters put before
him. Second, Socrates did not tell the boy answers, but he did craft sequential and connected questions based on what the boy said to lead the boy to consider ideas he may not have thought of on his own. One can certainly reflect with a willing attitude, but often through external influences—conversations or reading books—and the search for other ideas, people find solutions to perplexing problems.

Dewey’s Reflective Experience

Dewey’s (1916) educational philosophy was based on the idea that people learn from experiences. This method of learning from experience looks similar to general problem-solving methods. First, there is bewilderment or confusion about a situation that is not fully understood. Second, a preliminary idea is proposed to explain the situation. Third, all attainable evidence is examined thoroughly to clarify the problem. Such evidence could be classroom data, educational research, or colleague advice, to name a few. Fourth, the preliminary idea is modified or elaborated upon based on the information collected. Finally, a plan of action is created and applied to the situation in order to test the idea formulated in step four.

One may notice that this method for reflective experience looks similar to “the scientific method” found in many science texts. Considering an accurate portrayal of the nature of science, this review should make known that Dewey’s method of reflective experience is merely one way of learning from experience (McComas, 1997). What is critical is the intentional effort to identify a problem, collect evidence and information to help solve the stated problem, and systematically test proposed ideas—thus the synergy of thinking about doing and doing with thinking. By combining thinking and doing into a synergistic method of inquiry, teachers’ knowledge and practice of classroom teaching and learning can advance.

Schön’s Reflective Practitioner

Schön (1983) claims that professionals “are called upon to perform tasks for which they have not been educated,” in contexts that are neither predictable nor stable (p. 14). He shuns the view of “professional knowledge as the application of scientific theory and technique to the instrumental problems of practice,” (p. 30) a kind of “high ground” where problems are well defined (p. 42). Rather, Schön believes professionals “deliberately involve themselves in messy but crucially important problems and, when asked to describe their methods of inquiry, they speak of experience, trial and error, intuition, and muddling through” (p. 43). Such muddling with messy and complicated problems Schön refers to as “the swampy lowlands” (p. 43). In the midst of teaching, teachers
encounter problems. The thinking that transpires in the midst of teaching in order to solve problems is considered to be reflection-in-action. Reflection-in-action is distinct from reflection-on-action—the thinking done by teachers on past actions.

While Dewey (1916) did not dispute the value of research and collegiality to assist the problem solving process, Schön places more emphasis on a practitioner's use of his or her own experiences and inferences, than relying on outside authority or research to guide practice. Drawing back to the earlier discussion of teachers' knowledge bases, Schön's ideas are grounded in the particulars of practice and can appear similar to discovery learning. As Gillis (1988) argues, this focus on the particular in teaching may be true to an extent, but "knowledge and professional practices must rest on a foundation of similarities rather than differences" (p. 50).

This review does not dispute the importance of reflection-in-action and reflection-on-action. Importantly, though, this review does disagree with the epistemological viewpoint of Schön. Particular problems and situations occur in teaching that require teachers to utilize outside sources (the knowledge base of teaching) to solve problems effectively and efficiently. Utilizing educational research and informed colleague advice, in addition to other resources, demonstrates a sense of professionalism and responsibility concerning teaching (Kyriakides, Campbell, & Christofidou, 2002). While researchers from the critical theory perspective shun the use of a knowledge base developed external to the teacher (Grimmitt, MacKinnon, Erickson, & Riecken, 1990), importantly, "without the development and sharing of a solid knowledge base for teaching, teachers will be doomed to continue repeating the experiments of their predecessors rather than to move forward toward the solution of problems which truly are unique" (Gillis, 1988, p. 50).

Learning Through Metacognition

Berliner (1987) asserts that teachers who learn from classroom experiences are more likely to be highly motivated to employ metacognitive skills. There are two components of metacognition, one's knowledge of cognition and one's regulation of cognition (Schraw, 1998). Knowledge of cognition refers to "what individuals know about their own cognition or about cognition in general" (p. 114). At least three different kinds of metacognitive awareness are discussed in the literature: declarative knowledge (knowing about things), procedural knowledge (knowing how to do things), and conditional knowledge (knowing the rationale for doing things). Furthermore, the regulation of metacognition refers to activities that help people control their learning (Schraw, 1998). While several strategies for regulation exist, "three essential skills are included in all accounts: planning, monitoring, and evaluation" (Schraw, p. 115). The setting of goals, self-monitoring, self-questioning,
and self-assessment are all regulation strategies that have shown to improve learning in all domains (Gourgey, 1998).

Ertmer and Newby (1996) describe the strategic, self-regulated, and reflective aspects of expert learners. Not surprisingly, their descriptions of an expert learner parallel the expectations for expert teachers. For instance, citing Brown and DeLoache (1978), they claim expert learners “are more aware than novices of when they need to check for errors, why they fail to comprehend, and how they need to redirect their efforts” (p. 4-5, italics theirs). Additionally, Ertmer and Newby claim expert learners make careful use of monitoring and self-regulating skills that enable them to know not only what is important, but how, when, where, and why to use such knowledge and actions. They claim that experts go past declarative knowledge and utilize procedural and conditional knowledge bases, thus supporting the idea of teachers having a rationale for what they are doing. Further, expert learners utilize metacognitive, motivational, and behavioral strategies to self-regulate their learning.

Ertmer and Newby describe the process of self-regulation further:

Before beginning a specific learning task, expert learners tend to consider a variety of ways to approach the task. They access their knowledge warehouses to recall past experiences with similar tasks and select an approach which matches task requirements and personal resources in such a way that the desired results can be obtained. Effective learners have a plan (either in their minds or on paper) that details how they expect to accomplish their goals. While executing the task, they constantly reflect on this plan to assess the extent to which it is working and then revise or modify it as necessary. As a result of this continuing reflection, expert learners make constant on-line adjustments, eliminating extraneous steps, implementing alternative strategies, and/or performing unplanned actions whenever necessary. (p. 10-11)

In the above quote, one could easily substitute teaching for learning; teachers involved in self-regulation should be considering similar processes throughout the act of planning, monitoring, and evaluating their teaching tasks. Figure 1 depicts the reflective nature of self-regulation.

Importantly, thorough self-assessment refers to the evaluation of teachers’ knowledge and implementation of all aspects of education that will lead to effective learning. As Figure 1 shows, evaluation is intricately connected to both planning and monitoring using reflection-in-action as well as reflection-on-action. Within a lesson, teachers constantly evaluate the performance of students and themselves to determine exactly what to do next. This kind of assessment is critical for teachers to not only maintain control of a classroom of students, but also diagnose learning needs and act accordingly.
Even though metacognitive strategies incorporate both reflection-in-action and reflection-on-action, this study is concerned primarily with self-assessment that utilizes reflection-on-action. According to Ertmer and Newby (1996), when learners take time to think about what they already know and how that applies to the situation, they are utilizing reflection-on-action. They are “making sense of past experiences for the purpose of orienting oneself for current and/or future thought and action” (p. 16). For teachers, reflection on past experiences makes possible the utilization of educational research, informed colleague expertise, and more meaningful thought on the learning that needs to occur and strategies that might lead to such learning. This kind of reflection takes time and is much more than merely recalling past situations; it involves making “inferences from one’s past experiences to create possible action plans for the future” (p. 17).

Socrates asked questions, Dewey combined thinking with experience in an experiential inquiry setting, Schön utilized teachers’ personal knowledge, and several researchers suggest the use of metacognitive strategies to learn from experience. While researchers do not necessarily agree as to how people learn from experience, the ability to accurately reflect on one’s teaching, identify problems that need to be solved, and employ strategies to plan for, monitor, and evaluate teaching
progress is critical to further teaching development. Together these ways of learning from experience are part of a strategy for improvement called self-assessment.

Self-Assessment

Self-assessment literature closely intertwines with educational research in general. When educational research had a decidedly behavioral focus, the research on teachers’ self-assessment examined teachers’ and students’ behaviors. Similarly, as the research pendulum swung to a cognitive view of learning, the research on teachers’ self-assessment described teachers’ thinking and reflection. Currently, many teacher education programs attempt to teach reflection practices to preservice and inservice teachers to help teachers develop a deeper knowledge base of teaching. It is assumed that teachers with deeper knowledge bases will implement teaching practices more effectively, but according to Kagan’s (1990) review of the literature on teachers’ cognition, research has done little to explain this gap between teachers’ theoretical understandings and their classroom practices. This particular section of the literature review highlights the historical progression of the meaning of self-assessment in teacher education, defines self-assessment as used in this study, and describes the pertinent research on self-assessment to emphasize how this study adds to the current knowledge base on teacher self-assessment.

A Historical Look at Self-Assessment

During the late 1960s, 1970s, and early 1980s, many researchers studied teaching behaviors and student behaviors that led to greater outcomes in student learning. Thus self-assessment during this era focused on the improvement of classroom instruction through the use of classroom behaviors. Such assessment made use of rating scales, check-lists, coding guides, and audio or visual equipment so teachers could focus on and improve discrete teaching behaviors, such as wait time, questioning, responding patterns, non-verbal behaviors, and classroom movement. Further, instruments to objectively identify student behaviors were used by teachers to assess their teaching performance. Bailey (1981) and Allen, Barnes, Reece, and Roberson (1970) give detailed instructions on the “how to” of self-assessment, as well as provide a bibliography of instruments useful for the assessment of teacher and student classroom behaviors.

Definitions of self-assessment made clear this focus on behavior. For instance, Centra (1979) defined self-assessment as the process by which teachers “rate their effectiveness on a scale form or provide a brief written evaluation of their teaching performance” (p. 48). Additionally, Bailey defined
self-assessment as “the process of self-examination for the purpose of instructional self-improvement” (p. 7). While classroom behaviors are important for teaching and learning, an over emphasis on behavior slights the complexities of teaching and learning and the prodigious decision-making skills that teachers must utilize every minute to conduct an effective lesson (Darling-Hammond, Wise, & Pease, 1983). Supporting their conclusion, Darling-Hammond et al. discuss how particular teaching behaviors are effective when used in moderation (Peterson & Kauchak, 1982; Soar, 1972) and when used in the right circumstances (McDonald & Elias, 1976). Simply performing all the teaching behaviors advocated by research without thinking about the when, the why, and the how of their use will, most likely, not lead to effective classroom teaching. Brophy and Evertson (1977) elaborate this point:

Effective teaching requires the ability to implement a very large number of diagnostic, instructional, managerial, and therapeutic skills, tailoring behavior in specific contexts and situations to the specific needs of the moment. Effective teachers not only must be able to do a large number of things; they also must be able to recognize which of the many things they know how to do applies at a given moment and be able to follow through by performing the behavior effectively. (p. 139)

Thus, in the late 1970s and early 1980s, researchers began to consider the reasons teachers had for using particular classroom behaviors, rather than simply examining discrete classroom behaviors separately (Fenstermacher, 1978; Shavelson & Stern, 1981). Simultaneous to this new interest in teachers’ reasoning or thinking, psychologists began studying the cognitive changes that take place during learning. With the rise of constructivism within science education in the 1980s and its prolific use as part of national reform documents, such as the National Science Education Standards (NRC, 1996), the educational pendulum has swung from behavior to that of cognition. Consequently, a major research area has become that of teachers’ thinking and how it develops. Concurrent to the rise in constructivist learning theory, was the publication of Schön’s seminal works on reflection (1983, 1987).

The ideas of Schön were quickly embraced by the education community. Soon literature abounded on how to teach reflective practices to preservice and inservice teachers (Armaline & Hoover, 1989; Bullough, 1989; Ferguson, 1989; Smyth, 1989; Zeichner & Liston, 1987). Additionally, researchers investigated teachers’ reflection about their teaching to describe what they reflect upon (Clarke, 1995), the impact of reflection upon teachers’ thinking (Cruickshank et al., 1981), tools that aid reflection (Wear & Harris, 1994), and how reflections may change over time (Wedman, Espinosa, & Laffey, 1999). However, as Kagan (1990) noted, none of the studies included
in her literature review examined the associations between teachers’ reflective thinking and classroom instruction. Similarly, Goodman (1988) states:

> Even if individuals such as these participants are able to become reflective teachers, what effect will they have on their students? Will these teachers always provide a better education than more traditional teachers? Do all students profit from teachers who are reflective decision makers? ... If the development of these teachers is a worthwhile goal, then we need to begin serious research into the experiences of individuals with this disposition ... otherwise, calls for a different type of teacher will be without substance. (in Kagan, 1990, p. 41)

To assess accurately, one needs to know the ideal end goal, determine the current state of action, and develop strategies to close the gap between the two. Self-assessment implies that a teacher is not only reflective, but is actively working on technical skills to improve classroom practices. Reflection, in and of itself, does not imply improved action. Yet, accurate reflection is needed to deliberately improve future actions. Both Kagan (1990) and Goodman (1988) highlight a fundamental problem with the literature on reflection—in the interest of cognition, researchers appear to have lost sight of the every day happenings and the fundamental goals of public education. Teacher education’s goal to produce reflective practitioners is not an end in itself. It is merely a means to a more noble end—that of well-educated teachers in every classroom who make effective classroom decisions and implement those ideas in a manner that leads to meaningful student learning.

More recently, the call for increased teacher professionalism has renewed the interest in teacher self-assessment (Nolan & Hoover, 2004; Powell, 2000). However, much of the interest in this current literature comes not from the teacher education community, but from educational leadership and administrative policy studies. For instance, in the book, Teacher Supervision and Evaluation, traditional administrative observations are described, along with differentiated supervision strategies, such as peer coaching, self-directed teacher growth (similar to self-assessment), and action research (Nolan & Hoover). Even though renewed interest exists in teacher self-assessment as a formal evaluation tool, little empirical evidence exists concerning the strategy of teacher self-assessment.

**Self-Assessment Defined**

Considering the vast terminology used in educational literature (self-assessment, self-evaluation, self-appraisal, self-reflection, self-regulation, self-directed growth, reflection-in-action, and reflection-on-action) and the multiple meanings implied by each term, it is imperative to define self-assessment as used in this study. Importantly, this study approaches self-assessment from literature based in teacher education. While the research base in educational policy and administration
can be informative, this study seeks to examine individual teachers' self-assessments, rather than a school building or school district's collective self-assessment practices. Furthermore, this study is particularly interested in the daily informal and formative self-assessments teachers make of themselves and their practice, rather than the more formal and summative self-assessment intended for teacher evaluation purposes. Therefore, self-assessment, as defined in this study, refers to teachers' learning about students and themselves that comes from reflection on classroom experiences to make "judgments about the appropriateness or effectiveness of one's own knowledge, performance, beliefs, products, or effects, so they can be improved" (Airasian & Gullickson, 1994, p. 6).

According to Airasian and Gullickson (1994) this kind of self-assessment includes the following:

1. Teachers identify classroom problems, gather information, and interpret the evidence and research to make a decision.
2. Teachers are the object of the assessment and look at themselves—their knowledge, their performance, etc.
3. Teachers evaluate and interpret all data and determine appropriate outcomes.
4. Teacher self-assessment can be initiated through a variety of factors, including but not limited to classroom problems, or teacher curiosity.
5. To self-assess teachers need to be willing to engage in and take responsibility for their classroom teaching.
6. Teacher self-assessment is not ambiguous or idiosyncratic; teachers ought to assess themselves based on criteria and standards related to effective teaching.

Accuracy of Self-Assessment

One area of research on self-assessment pertains to teachers' accuracy in their self-assessment. In a review of six teaching effectiveness studies, McNeil and Popham (1973) report that teachers tend to criticize superficial aspects of teaching, while overrating their own teaching abilities. Likewise, Harris (1975) reports overrating in teachers' self-assessments, while Wheeler and Knoop (1982) report overrating in student teachers' self-assessments. Similarly, such inaccuracy in self-assessment led Centra (1972) to conclude that self-ratings show little agreement with the ratings of students, colleagues, or administrators. In a review of the literature, Hook and Rosenshine (1979) could not find a clear relationship between the self-ratings of teachers and the ratings of external
observers for six of the eleven studies included. Therefore, they advised that teacher reports on specific activities should not be interpreted as indicative of actual practice.

Initially, this research seems to indicate that teachers are not capable of accurately assessing their own teaching. However, none of the studies mentioned utilized concrete strategies, such as video- or audiotape, to assist teacher self-assessment. Nor did the studies educate teachers on how to conduct appropriate self-evaluations. What does research have to say about other factors that may influence the quality of a teacher's self-assessment?

Use of concrete strategies. Irvine (1983) reports a study where student teachers were educated in self-assessment procedures, the instrument, and criteria with which they would evaluate themselves. Additionally, trained student teaching supervisors used a model of supervision, including relationship building, assistance with self-assessment strategies, and feedback on self-assessment. Consequently, both supervisors and student teachers rated lessons independently using the Teacher Performance Assessment Instruments (TPAI). The 45 items on the instrument were grouped into 14 categories, of which seven provided significant correlations between supervisor and student teaching evaluation scores at .50 or higher. The other seven scores ranged between .31 and .47. Irvine concludes that the relationship between student teachers' assessments and their supervisor assessments is positive and stable.

Wear and Harris (1994) report that student teachers can recall more than half of the instances that deviated from their original lesson plans. However, with the aid of stimulated recall (the use of a videotape), most student teachers recalled considerably more deviating instances. With the use of audio- or videotape, student teachers and inservice teachers are able to recall events more accurately. Unfortunately, Wildman and Niles (1987) report that none of the teachers involved in their study had considered video- or audiotape as a viable strategy to improve their teaching. Not surprising is the conclusion that most teachers' descriptions of classroom events lacked the detail and focus needed for productive reflection (Wildman & Niles, 1987).

Because some teachers miss considerable portions of their lesson without the use of such concrete strategies, it is recommended that all teachers utilize audio- or videotapes as a means to develop accurate insight into their classroom teaching practices. The use of audiotapes (Englert, 1984; Freiberg, 1987; Sprick, 1981) and videotapes (Clarke, 1995; Gunter, Shores, Jack, Denny, & DePaepe, 1993; Gunter & Reed, 1996, Struyk & McCoy, 1993) frequently has been suggested as a way to improve classroom teaching practices. Furthermore, Clarke (1995) reports the interaction with colleagues, observations with subsequent discussions considering classroom teaching, adequate time for reflection, and the explicit articulation of past experiences enhances teachers' abilities to reflect
on their teaching. Thus, the teaching of self-assessment strategies, the use of videotape or audiotape, colleague interaction, and explicit articulations of experiences and rationales all serve to help make teacher reflection and self-assessment more accurate.

*Teachers' knowledge base.* Another factor that may influence the accuracy of teacher self-assessment is the knowledge base of the teacher. Studies on the accuracy of college students' self-assessment show that "weaker and less mature students tend to overrate themselves and the weaker they are, in terms of teacher ratings, the greater the degree of overrating. Not being aware of, or choosing not to subscribe to, the standards set by teachers, they err on the side of optimism" (Boud & Falchikov, 1989, p. 544). Subscribing to a set of standards with which to evaluate one's performance is critical for accurate self-assessment. Teaching is highly complex and one cannot say with exact certainty what should transpire in a classroom each moment. Yet, one can say with reasonable certainty that particular strategies and behaviors, more than likely, will lead to more meaningful learning than others. Evaluating teaching based on the synergy of research findings, paying particular attention to the "goals, objectives, perspectives on learning, and combining related research" can provide a stable standard with which to evaluate teaching (Clough, 2003, p. 4).

A study of 31 early childhood teachers, trained to evaluate themselves using the Early Childhood Environment Rating Scale (ECERS), demonstrates that teachers working in low-quality preschools tend to overrate themselves, while teachers working in high-quality preschools tend to underestimate their performance (Sheridan, 2000). Interestingly, the teachers working in low-quality preschools focused on the present. They wanted to solve today's problems. However, the teachers working in high-quality preschools looked to the future and enhanced their methods and instruction based on long-term goals they had for their students and the preschool in general.

Self-assessment is not an easy process, and much like other learning strategies, needs to be explicitly taught to preservice and inservice teachers (Ertmer & Newby, 1996; Kremer & Ben-Peretz, 1984). The use of concrete strategies to provide evidence of teaching performance is needed to increase teachers' ability to recall classroom events accurately. Additionally, concrete strategies will prevent forward-thinking teachers with vast knowledge bases from underestimating their performance. Importantly, accurate self-assessment cannot occur without a desire for the teacher to keep learning about the profession and a willingness to think through issues that require consideration of the purposes of schooling and how children learn. As teachers become more knowledgeable of teaching and learning, and more adept at assessment procedures and the use of taping, their ability to accurately assess the teaching and learning in their classrooms should become more accurate.
Criteria Used for Self-Assessment

The purpose of teaching is, of course, to produce pupil learning; it seems perfectly logical, therefore, to evaluate teaching on the basis of outcomes. But since the function of the teacher in the production of learning is to provide pupils with experiences likely to result in learning, it also seems logical to evaluate teaching on the basis of the experiences it provides—that is, on the basis of pupil behavior in the classroom. And yet, since the means by which the teacher affects pupil behaviors and (through them) learning outcomes are the behaviors the teacher exhibits, it seems equally logical to base evaluation of teaching on teacher behavior (Medley, 1987, pp. 169-170).

The areas of student learning, student behavior, and teacher behavior traditionally have been used as criteria for judging teaching effectiveness. Interestingly, Medley comments that policymakers tend to use student achievement as the main criterion, teacher educators and school administrators tend to look at teacher behaviors, and teachers often utilize student behavior to determine the effectiveness of their teaching. This review of the literature concurs with Medley and argues that teachers must learn to utilize all three indicators to make an accurate and thorough assessment of their teaching practices.

Student behaviors. Several researchers have examined the criteria teachers use to evaluate their lessons and their success as teachers. By far, the most pervasive criteria used by both preservice and inservice teachers to evaluate teaching effectiveness are student behaviors. Jackson (1968) states, “Although teaching might be thought of as being chiefly concerned with cognitive reorganization—with producing invisible changes within the student—this select group of teachers did not rely very much on pious hopes of reaping an ‘unseen harvest’” (p. 120). The teachers in Jackson’s study used a variety of student behaviors to determine the effectiveness of their teaching. For instance, the interviewer asks, “How can you tell when you’re doing a good job?” The teacher replies with a list of student behaviors, such as “they look alert, they look interested; they look questioning...[t]hey look like they’re anxious to learn more” (p. 120). Another teacher replies to the same interview question by saying, “I can tell by the way they sound” (p. 121). Still another says, “It’s the easiest thing in the world. You know you’re missing at the first yawn” (p. 121). Jackson concludes that the teachers involved in his study justified their professional decisions by using impulse and feeling rather than reflection or thought.

Similarly, Jones and Airasian (1995) describe the self-assessment practices of seventeen “excellent” elementary teachers. All teachers were female, with 2-24 years of teaching experience. Through focus groups, the researchers determined that teachers use process indicators, such as students’ attentiveness, body language, questions, and facial expressions, to judge the quality of their
lessons. Teachers also used product indicators, such as students’ demonstrated knowledge, feelings and opinions to evaluate post-lesson effectiveness.

In other studies, both experienced elementary teachers and student teachers report frequent use of students’ behaviors, such as those reported by Jackson (1968) and Jones and Airasian (1995) for self-assessment (Dunkin, Precians, & Nettle, 1996; MacLeod, 1988; McLaughlin, 1991). By far, the most frequent criterion preservice and inservice teachers gave for judging the success of their lessons, as well as their own success as teachers were students’ behaviors. Student behavior includes participation, discussions, expressions, feelings, creativity, and listening skills, to name a few. Student teachers, while frequently mentioning students’ work-related behavior, were much more likely than inservice teachers to use a lack of discipline problems as a criterion for lesson success (MacLeod, 1988).

Dunkin et al. (1996) classified the student-based criteria that preservice teachers use into three categories: cognitive, affective, and behavioral. Within these three categories student teachers often mentioned criteria that were bound within the time-frame of the lesson, as well as those that looked for development over time. Interestingly, when student teachers assessed individual lessons, they most often used behavioral criteria. When judging their overall success as a teacher, student teachers were more likely to utilize “significant pupil development that can be attributed to the teaching within a specific program” (p. 14). This criterion unfortunately consists of three sub criteria, two of which are unreliable indicators of lesson success: (1) “learning of specific course subject matter and performance over the course and on assessment tasks overall” (p. 14), (2) attitude of pupils to the teacher, and (3) attitude of the pupils toward the subject matter being studied. Dunkin et al. do not make clear whether teachers utilize student learning growth, students’ achievement on tests to determine learning, both, or either. They do not convey which of the three criteria teachers used most often when self-assessing. The first criterion deals with students’ cognition, while the last two assess motivational and affective qualities.

Student learning. Teachers also utilize student learning to determine the success of their teaching. The extent and nature of this criterion depends on the study. Dunkin et al. (1996) report that student teachers were more likely than first year education students to utilize student learning to determine their success as teachers. Similarly, MacLeod’s (1988) study shows that experienced elementary teachers often utilize general observations of students’ academic progress to determine their teaching success. Further, experienced teachers do not find the use of students’ scores on achievement tests particularly useful for their self-assessment (Jones & Airasian, 1995).
In contrast, Lortie (1975) reports the use of testing, observation, and testing combined with observation as criteria for 65% of teachers’ self-assessments. Similarly, the less experienced teachers in MacLeod’s study placed much greater emphasis on testing as a means to determine teaching success. Additionally, a student teacher in McLaughlin’s (1991) study and several preservice teachers in Olson (in press) and Olson et al. (2004) chose to measure students’ learning via achievement scores and used such criteria to determine their teaching effectiveness.

Overall, less experienced teachers tend to use student achievement scores as a measure of their own success as a teacher. Consistent with the literature on expert teachers, as teachers gain more expertise and experience, they are more apt to focus on students’ academic growth over time. Consequently, these teachers utilize student growth, rather than testing, as a measure of their teaching effectiveness. The work of Olson (in press) and Olson et al. (2004) demonstrates that inexperienced preservice teachers, through the use of a problem-based learning videocase analysis, can be taught to utilize more dependable forms of criteria with which to evaluate their teaching practices.

*Outside authorities.* Other common criteria teachers utilize to evaluate teaching effectiveness are the comments and critiques of administrators, colleagues, university personnel, parents, and former students. Not surprisingly, student teachers base much of their self-assessments on the feedback and evaluations received from their university supervisors and cooperating teachers (Dunkin et al., 1996; MacLeod, 1988; McLaughlin, 1991). Similarly, inservice teachers highly value the feedback from colleagues and former students (Jones & Airasian, 1995; MacLeod, 1988). Additionally, the feedback and critiques of parents were highly valued by student teachers and experienced teachers alike (Dunkin et al., 1996; MacLeod, 1988).

*Teaching behaviors.* Ironically, when asked to articulate their self-assessment criteria some teachers do not mention their role as a teacher at all (Jones & Airasian, 1995) or they do so with intangible feelings (MacLeod, 1988). For instance, a kindergarten teacher in MacLeod’s (1988) study said, “There’s a feeling of satisfaction within yourself ... that wonderful feeling of almost being up in high heaven when it’s been a good lesson” (p. 399). Unfortunately, feelings are not a reliable way to evaluate one’s teaching practice. Teachers also assess the effort they put into their teaching. For example, one teacher says, “Whether I’ve put the necessary work into the organization of the lesson. The amount of effort I’m prepared to put into it. Dedication. I’m very dedicated” (Dunkin et al., 1996, p. 16). Effort and dedication are qualities of effective teachers and certainly are necessary, but insufficient to improve one’s practice.

Researchers and writers of reform documents have not clearly articulated the teacher’s role in classroom instruction. This is exemplified by the study of 39 first-year preservice teachers and 18
third-year preservice teachers, in which Dunkin et al. (1996) report that third-year preservice teachers are slightly more likely to use teacher-based criteria to judge lesson effectiveness and twice as likely to use teacher-based criteria to judge teaching effectiveness as are first-year preservice teachers. Initially, it seems the third-year preservice teachers are more likely to look at themselves to assess their teaching effectiveness. However, the "teacher-based criteria" labels the researchers have attributed to their data are highly problematic. To illustrate teacher-based criteria, the researchers quote participant M53 as saying her success in teaching would depend upon:

[w]hether I've provided what the children need, areas they need development in. Whether I've been able to enhance their learning through a wide range of experiences and activities. Whether I've provided them with enough resources and a variety of resources. Whether I've given them room to explore and investigate, hypothesize and be involved in the learning process. (p. 16)

In this particular example, the preservice teacher assesses effectiveness through the activities, materials, and strategies used for instruction; however, this person does not use her own teaching behaviors to evaluate the lesson. While it appears this person is critically looking at the teacher because she uses the pronoun, I, a close look at the transcript reveals the use of curricular or activity-based criteria—not teacher-based criteria. Furthermore, this preservice teacher is not specific about what is being evaluated in the interactions with students. This person looks at "whether I've given them room to explore" as criteria. What does this mean? What does "giving room" look like? What is the teacher’s role in "giving room"? Is this teacher asking effective questions, along with using effective wait time? Or is this teacher merely getting out of the way so that students can interact with the materials provided? Such a vague phrase does little to provide concrete criteria with which to assess one’s teaching practices.

In general, many exemplars used in Dunkin et al.’s (1996) “teacher-based criteria” category are fraught with problems. For instance, participant M26 determines effectiveness by “evaluating the lesson I’d taught” (p. 16) How will she evaluate her lesson? Will she look at her students? Will she depend on others’ comments? Or will she look at her own behavior? This phrase is coded as teacher-based criteria, yet this phrase does not reveal how M26 will assess quality. Most problematically, this same teacher proceeds to say, “Evaluating the children’s progress” (p. 16). This phrase is coded as a pupil-based criterion. If we put both phrases together, it seems this teacher will evaluate the lesson she taught by evaluating children’s progress, thus this comment is, by my interpretation, miscoded. Even though Dunkin et al.’s study claims preservice teachers utilize teacher-based criteria during self-assessment, due to the difficulties mentioned here, their interpretations of the data cannot be used with confidence.
A qualitative study of four student teachers claims the student teachers analyze their own behavior in the classroom and then compare that behavior to teaching objectives (McLaughlin, 1991). However, like Dunkin et al.'s study the evidence presented in the study is not convincing that evaluation based upon teachers' behaviors occurred often. Nor did it appear that the behaviors were analyzed systematically. For instance, one student teacher said she would "have a checklist of the lesson for that day. Did the class run smoothly, did I have to go over things several times, and so on" (p. 148). While this student teacher may consider her own behavior, the study does not show that this is done explicitly, nor is the student teacher specific as to what she is looking for in her own behavior.

Overall, a review of the literature reveals that teachers rarely look critically at their own behaviors to evaluate their teaching effectiveness. While some studies claim student teachers look at their behaviors to determine their success as a teacher, a careful examination of the evidence provided in those studies does not entirely support such claims. Rather, it seems student teachers have an idea that what they do effects their students' behavior and learning, yet these student teachers do not know what to look for to self-assess their teaching accurately or effectively based upon their own behaviors. For self-assessment to be effective, teachers should know what to look for in their own behavior, and do so in an explicit manner.

Evaluating Teachers' Reflective Thought

A critical component of teachers' self-assessment is the reflection they utilize to make sense of present teaching and learning events compared to what they know about effective teaching and past experiences. Researchers have developed various methods for evaluating the degree to which teachers reflect on their instruction (Clarridge, 1989; Ferguson, 1989; Krogh & Crews, 1989; Manouchehri, 2001, 2002; Ross, 1989; Simmons et al., 1989; Troyer, 1989; Zeichner & Liston, 1985). This study utilizes the coding system reported by Manouchehri (2002) to evaluate elementary teachers' reflections on their teaching. Manouchehri used this coding system to evaluate the reflection articulated by two preservice teachers during a practicum placement. Each set of reflections was evaluated for two major ideas: (1) the focus of the teachers' reflection, and (2) the depth of teachers' reflection. The preservice teachers in Manouchehri's study focused on self, mathematics content, the students' actions and understandings, the activity or task of the lesson, classroom management or control, the curriculum, the teacher's actions, the students' backgrounds, assignments, and school culture within their reflections.

In addition to coding for the focus of reflections, Manouchehri also coded teachers' reflections. Such coding was based on the degree to which teachers sought to change their teaching
practices. Manouchehri refers to this as a "[layered] reflective discourse model" (p. 721). This layered model consists of five categories of reflection, referred to as: "Describing," "Explaining," "Theorizing," "Confronting," and "Restructuring" (p. 721). When teachers "describe" their practice, they typically tell stories or recall classroom events and activities; this is the lowest layer of reflection as they merely recall events. As teachers consider the impact their teaching has on students, on themselves, and on parents, or compare current teaching situations to past teaching experiences, they begin to "explain" their teaching practices. When teachers explain they are not explicitly utilizing a theoretical knowledge base. Instead, they are drawing from related events and exploring cause and effect relationships related to learning or teaching events. As teachers explain teaching choices utilizing an educational research base, past coursework, reading, etc., they begin to "theorize." Theorizing is considered a more sophisticated reflection because teachers substantiate their views using research and data. They seek to go past opinion and utilize the researched knowledge base of effective teaching. In the next layer of reflection, teachers challenge and question their teaching practices searching for areas that are potential problems. As teachers "confront" their practice they consider their own effectiveness, challenge their assumptions, and seek to consider their teaching from a different perspective. The highest layer of reflection, "restructuring," occurs when teachers "revisit the event ... focused on redesigning the experience to avoid the problem in the future” (p. 722). Teachers utilizing this layer of reflection seek solutions to classroom problems and consider what else needs to be done to make learning and teaching more effective.

Importantly, reflection, as referred to in the literature, should lead teachers to consider aspects of their practice that need to be changed. This dissatisfaction with one’s own teaching then leads teachers to consider possible solutions that will improve the dilemma they face in their classroom. Further, as teachers question their instruction, they will begin to learn from their reflected upon experience. The five-category model used by Manouchehri fits well with general self-assessment models because it analyzes a teacher’s description and explanation of classroom events, the teacher’s ability to consider theoretical explanations relevant to his or her teaching, the teacher’s perceived questions and problems pertaining to instruction, and potential solutions the teacher may consider to improve practice. Thus, the five-layered reflection evaluation tool used by Manouchehri (2002) is utilized in this study to determine the sophistication and focus of elementary teachers’ reflections and self-assessments.
Improving Teaching Practices

Kagan (1990) claimed research on teachers’ cognition had not made an adequate link between the sophistication of teachers’ reflection and metacognitive strategies and their classroom teaching ability. This review of the literature agrees with Kagan. One study exemplifies the limited research that has been done to address this question. Hoover and Carroll (1987) examined the results of an inservice professional development program designed to educate teachers on self-assessment, utilizing audiotapes of classroom practices. Using a checklist, teachers assessed their behavior. Comparisons of teaching practices before and after taping show improvement in teachers’ classroom teaching practices after the use of systematic taping and rating strategies.

Importantly, this study examined teacher behavior in the most behavioral sense without considering how teachers made classroom decisions or how they thought through classroom problems. As stated previously, research on teacher behavior itself is valuable to an extent, but is limited when not coupled with research on teacher thinking. The problem with this research study is the teachers’ thought processes and reasons for displaying particular behaviors are not considered, yet these factors drive the very behaviors being studied. To effect greater change in schools, research needs to examine teachers’ thinking as well as their action in classrooms (Fullan, 1994).

This review concludes that teachers are capable of self-assessment, but they may need explicit instruction and guidance in how to utilize such strategies. Furthermore, the use of systematic strategies such as videotape or audiotape, engagement in dialogue with informed colleagues about teaching, and observation and feedback by others should promote greater awareness of one’s teaching practices. Of concern is the overwhelming reliance teachers’ place on students to inform their teaching practices. In an ideal situation, student learning and behavior would directly correlate to teaching practices and thus the use of such criteria could be considered an adequate measure of teaching effectiveness. However, learning situations exist where highly motivated students learn despite poor instruction, while the opposite is certainly true as well. Finally, this review has demonstrated that Kagan’s (1990) concern holds true today and little, if any, research has adequately addressed the relationship between teachers’ thinking and metacognitive strategies and their classroom teaching effectiveness.

Summary of Major Conclusions

The knowledge base for teaching employed in this study utilizes the categories considering content, pedagogy, curriculum, and pedagogical content knowledge, as well as knowledge of learners,
educational contexts, and the purposes of schooling by Shulman (1986, 1987), in conjunction with professionalism, collegiality, and rationales voiced by Fullan (1994). Importantly, self-assessment, as defined by this study, is much more than the behavioral checklists utilized by researchers and teachers during the process-product age of teaching. Self-assessment of teaching includes analysis of teachers' behaviors, decision-making, and rationales utilizing a variety of criteria, including but not limited to students' learning, students' behaviors, teachers' thinking, teachers' behaviors, advice from colleagues, administrators, or parents, and professional communication via reading, conferences, and networking. Furthermore, such analysis includes an accurate assessment of the current situation, an explicit sense of the ideal state of teaching, and a plan that articulates specific strategies to move the current state of teaching forward to look more similar to the desired state of teaching.

Self-assessment is a strategy often mentioned in literature on teacher professionalism, teacher empowerment, teacher evaluation, and professional development. While this strategy is not new to the field of teacher education, empirical research considering teacher self-assessment is limited. Research demonstrates teachers who use systematic strategies, such as audiotape or videotape analyses, are more accurate in their recall of lesson events. Therefore, frequent use of such strategies should aid all teachers in interpreting their classroom teaching more accurately. Considering novice teachers' inadequate abilities in interpreting relevant and meaningful information from classroom events to further inform future teaching and learning situations, it seems likely that all preservice and beginning inservice teachers should utilize videotaping and/or audiotaping to help them learn to make sense of the multiple classroom events occurring simultaneously throughout their lessons.

Additionally, teachers who possess a deeper knowledge base of teaching and learning tend to self-assess more accurately. However, as teachers' develop more complex ways of thinking, this complexity could lead to an underassessment of ability due to the subtleties such complex thinking is able to interpret and evaluate. Underassessment of teaching skills, while not desirable, should not often lead to undesirable effects in the classroom. However, consider the unfortunate scenario of a teacher who overassesses his or her teaching. This individual has the potential to cause unintended and undesirable consequences for children because of his or her inability to recognize that particular aspects of teaching need to be improved.

Other research describes the criteria teachers use to assess their teaching, yet the quality of some of these research studies is debatable (Dunkin et al., 1996). Expert teachers were found to utilize student learning, student behaviors, in addition to their own role in the teaching scenario as criteria for judging effectiveness of teaching. Comparatively, many of the studies on teacher self-assessment criteria investigate preservice teachers. Not surprising is the consistency of these studies
with the literature on novice teachers, more generally. Novice teachers tend to focus on student achievement, classroom management, and superficial aspects of the teachers’ role. Generally speaking, novices do not critique their own role in teaching as thoroughly as some researchers assert they should (Olson, in press; Olson et al., 2004).

Considering the lack of meaningful professional development programs in U.S. schools (Loucks-Horsley et al., 1998), and the lack of meaningful supervision for inservice teachers (Jones & Airasian, 1995), self-assessment is a strategy researchers assert should be taught to preservice teachers (Ertmer & Newby, 1996; Freiberg & Waxman, 1990; Kremer & Ben-Peretz, 1984). The science methods course at Iowa State University deliberately teaches self-assessment to preservice teachers (The contents and nature of this course is elaborated in Chapter Three). Furthermore, throughout the science methods course preservice teachers are expected to demonstrate accurate self-assessment of their interactions with elementary children, as well as their understanding of teaching and learning.

Even though self-assessment is taught in this course, such explicit instruction is of little value if teachers do not utilize the strategies taught them during their teacher education program. Therefore, one purpose of this study is to determine if and how recent ISU elementary teaching graduates, now in their 2nd, 3rd, 4th, or 5th year of teaching, utilize the self-assessment strategies taught to them in during their teacher education program.

Second, research on teachers’ thinking and metacognitive strategies should be connected to teaching performance in the classroom to better inform educational policy, teacher education, and teacher professional development (Goodman, 1988; Kagan, 1990). Yet a search of the literature reveals little is understood about how teachers think about their own teaching practices, the strategies they use to assess their teaching, and the effectiveness of the teaching skills actually employed in the classroom setting. Consequently, this study utilizes the coding scheme of Manouchehri (2002) to understand more about these complex relationships.
CHAPTER 3. RESEARCH METHODS

Purpose of Study Summary

For over two decades the current state of teaching and learning in our nation’s schools has been reported repeatedly as less than desirable (Goodlad, 1983; NCEE, 1983; Schmidt et al., 1998; Yager & Penick, 1983). School administrators, teacher educators, teacher associations, and teachers who analyze this pervasive problem and seek practical solutions that will lead to changes in our nations’ schools consistently have referred to the continual learning and professional development of teachers through teacher self-assessment (Airasian & Gullickson, 1994; Bailey, 1981; Fullan, 1994; Goodlad, 1994; Nolan & Hoover, 2004; NRC, 1996; Sarason, 1993). Even though this strategy is mentioned frequently in teacher change and teacher evaluation documents, little empirical research exists to support a relationship between teachers’ self-assessment and classroom practices.

The goal of this study is to identify the levels of explicit reflection-on-action and criteria with which teachers self-assess their teaching, and to compare these levels and criteria to classroom practices. These reflections and practices will then be compared to the participants’ preservice preparation to determine the extent to which strategies taught transfer to classroom practice. To investigate these issues, this study utilizes classroom observations and interviews. The participants are teachers relatively new to the field of elementary science and/or mathematics teaching. The interview includes an examination of the criteria teachers consider, as well as the reasoning and reflection they use to make sense of the assessment criteria. By understanding the possible influences of teacher self-assessment and reflection on effective teaching practices, we may better understand what strategies are important for teachers’ professional development, and for inclusion in both inservice and preservice teacher education programs. In addition, we will better understand what aspects of self reflection taught in the science methods course remain with participants as they become teachers.

Currently, teacher socialization and professional demands minimize the time and energy teachers have for accurate reflection and assessment. This research study has the potential to demonstrate the relationship between self-assessment and effective teaching practice. Such information could serve to change administrative policies and school procedures, thus providing classroom teachers with the necessary time, resources, and support to conduct accurate and much
needed self-assessments and reflection. This qualitative study seeks to investigate the following two research questions:

(1) To what extent does the sophistication of elementary teachers' self-reflection relate to their effective use of reform-based teaching practices during their mathematics and/or science lessons?

(2) To what extent do self-assessment practices taught in a teacher education program transfer to classroom teaching practices?

Because expert teachers use more connected knowledge bases, interpret classroom events in more meaningful and integrated ways (Hogan et al., 2003), and are more evaluative in their assessments of classrooms and teaching (Berliner, 1988), this study asserts that teachers who demonstrate more complexity and variety in the use of their knowledge bases are more sophisticated in their self-assessments. Specifically, more expert-like teachers will evaluate more kinds of classroom criteria critically, include credible rationales indicating complex knowledge bases of teaching and learning, and seek out information to assist them in their decision-making. While other factors, such as school climate and administrator support may impact the sophistication of self-assessment, they are beyond the scope of this study.

This study determines the effectiveness of the teacher by observing classroom lessons and rating the effectiveness of the instruction demonstrated by the teacher within the observed lesson. While one could certainly study student learning to determine the effectiveness of a teacher, this study assumes that the effectiveness of a teacher can be determined by observing the teacher, his or her behavior, and the classroom decisions he or she employs. This assumption can be made confidently given the vast literature base describing how children learn, in addition to the purposes of public elementary education. Current theories of learning (i.e. constructivism, social learning theory, and developmental learning theory) elucidate how children learn, thus the effective application of these theories of learning in classrooms should promote student learning. Furthermore, elementary schools serve to help students grow in their content knowledge, as well as in problem-solving skills, social skills, and other noble ends of education (Goodlad, 1983). Reform documents, such as the National Science Education Standards (NRC, 1996) and the Principles and Standards for School Mathematics (NCTM, 2000) also serve to outline intended purposes of elementary education. Observing teachers who actively promote such purposes of schooling are thus considered effective because they are consistent with the stated ends of education.

Other research questions about teachers' self-assessment could be studied. For instance, one could investigate the accuracy of teachers' self-assessments, the change in teachers' practices over time utilizing various self-assessment procedures, or the impact of school socialization, administrator
leadership, or district professional development on teachers' utilization of self-assessment. While these are valuable questions, they will not be pursued here because the purpose of this study is to determine the relationship between the use of particular self-assessment strategies and the effectiveness of teachers' classroom practices. Knowing how self-assessment practices promoted in a teacher education program influence teachers beyond their student teaching and first-year teaching experience is desirable to understand more thoroughly the impact of self-assessment and self-reflection practices taught in teacher education on classroom teaching.

Description of the Elementary Science Methods Course

The state of Iowa has established outcome standards to guide teacher education programs. All preservice teachers must demonstrate competence in all standard areas. One of the standards considers reflection and professional development:

The practitioner continually evaluates the effects of the practitioner’s choices and actions on students, parents, and other professionals in the learning community, and actively seeks out opportunities to grow professionally. (Connor, Huey, & Killmer, 2003)

While other courses within the Teacher Education Program at Iowa State University address this standard, of interest to this study is the elementary science methods course (CI 449) because it explicitly teaches self-assessment strategies and requires students to demonstrate proficient use of such strategies. Because this course stresses the importance of teacher self-assessment throughout the 16-week semester and this study seeks to determine how this emphasis influences recent graduates, a more thorough description of the course, specifically with regard to self-assessment, will be elucidated.

Learning the Pieces of Effective Science Instruction

The elementary science methods course is designed to address the findings of Goodlad's (1983) study of schools in which he found that teachers had noble goals for students, but focused almost exclusively on the teaching of content, employed with “sameness of instructional practice ... [characterized by] bland, repetitive procedures of lecturing, questioning, monitoring, and quizzing” (p. 249). The fundamental objective of the course is that preservice teachers will develop and come to understand the significance of student goals, and clearly articulate how they will promote those goals in their classroom, using credible resources to support their decisions.
The course is structured to promote conceptual change in students. First, it is critical that students come to understand what their prior science learning experiences were like. Students often had textbook-based science instruction, involving memorization of vocabulary and worksheets, with some hands-on experiences and field trips. Not surprisingly, students frequently share their dislike of science due to their dull and tedious K-college instruction. As students read Goodlad (1983), and Yager and Penick (1983) they begin to see similarities between their own personal experience and what research shows is ineffective instruction. Second, preservice students work to create a list of goals for students—the knowledge, characteristics, skills, and attitudes students would ideally possess after K-12 education. Penick (2000) provides a detailed description of goal development in a methods classroom. This list of 10-15 student goals frames the rest of the semester and is revisited frequently. Because the goal list is student-generated, it varies for each course, but typically includes: Students will possess a deep understanding of content, think critically, use problemsolving skills, appreciate diverse perspectives, think creatively, use effective communication skills, use appropriate social skills, access and use resources effectively, and apply knowledge to out-of-school situations.

Once the list of goals is developed, students are introduced to the schematic in Figure 2. Subsequent classes focus on various areas of the schematic, beginning with science content, materials, and activities. Two different, hands-on, inquiry-based activities closely following the learning cycle are used. After each activity, students are asked what student goals were promoted by the activities and what could be done to ruin each activity. They are also asked what the teacher's role for each activity was. Typically, students are unsure, and say vague things such as, “The teacher is the facilitator” or “The teacher just stood by and let it happen.”

The role of the teacher is addressed explicitly. Specifically, the five core behaviors of effective questioning, responding, wait time, non-verbal communication, and listening are explicated. Students view tapes of teachers who have similar lesson structures, but markedly different student engagement and different teaching behavior patterns exhibited. Students are provided instruction on how to use a teaching interaction coding instrument modified from Abraham and Schlitt (1973). They practice the coding and analysis of teacher-student interactions in the following ways: (1) throughout the course, students are explicitly asked questions through which they are attended to the instructor’s teaching behaviors in methods; (2) they analyze at least three videotapes of teachers in the methods course; and (3) they analyze their own interactions within small groups in class. All of these methods prepare students to audiotape themselves while teaching a lesson during the practicum, analyze the lesson for strengths and weaknesses, and make suitable recommendations for further improvement in
teaching practices. Further, this explicit and defined self-assessment also helps prepare preservice teachers for the self-assessment they will conduct during the oral defense at the end of the semester.

A Research-Based Framework for Teaching Science

```
student goals

consistent with

student actions

selected to facilitate

teacher behaviors

selected to assess

affects choice of

students’ ability to handle abstractions

students’ thinking

students’ prior ideas

selected to facilitate

content, materials, activities, and strategies

affects choice of

selected to assess
```

Figure 2. The above schematic illustrates aspects that are critical to consider when making decisions in the classroom (Modified from Clough & Kauffman, 1999, p. 2.).

The role of learning theories in effective decision-making is also addressed explicitly. Students are asked to recall what they learned from educational psychology—frequently they admit they do not remember much. The focus of the methods class is not to recall names and vocabulary, but to apply the principles of the four major learning theories (constructivism, developmental, social, and behaviorism), when appropriate, to lesson plans and classroom decisions.

During the first five weeks, students are introduced to student goals and congruent student actions, lesson planning decisions considering content, materials, and activities, the teacher’s critical role, in addition to how all classroom decisions should be informed by an accurate sense of how students learn. During this time, students typically work in groups to create unit plans or analyze a
videocase of elementary teaching. The expectation of these assignments is for students to begin to utilize the pieces of effective instruction in a connected and coherent manner and convey how they see classroom decisions being informed by their goals for students and learning theory.

**Blending Theory and Practice in the Practicum Setting**

At this point, students enter the practicum setting and do not attend methods class. The first assignment, consisting of a unit plan or videocase analysis is due during the first week of the practicum teaching experience. During the four-week teaching experience, students audiotape themselves teaching a lesson and code their interaction patterns using the modified Abraham and Schlitt (1973) SATIC instrument. They complete an analysis of their interaction patterns, comparing it to a pattern that is more congruent with their student goals and how students learn, followed by a description of how they will improve their interactions with students. This analysis of their own teaching interactions is due the week they return to methods class.

**Creating a Research-Based Framework for Teaching**

After the practicum teaching experience, students share their successes and struggles, and typically are in a state of cognitive disequilibrium after listening to themselves teach. The unit plan or videocase assignment is returned, containing extensive feedback that is structured around the schematic in Figure 2 to help them focus their learning for the remainder of the semester. Typically, students are not accustomed to receiving such extensive feedback on assignments; therefore, they express shock at the amount of constructive criticism given to them. Importantly, this assignment has a letter grade placed on it. Students are asked to determine how the feedback on their assignment is consistent with the course grading criteria listed in Appendix A.

As soon as possible, the instructor returns the second assignment to students. This assignment expects preservice teachers to self-assess their teaching interactions with elementary students. Consistent with the course’s focus on self-assessment, feedback is written on the assignment, but importantly no letter grade is placed on it. Students are directed to compare the feedback to the grading criteria for the course and determine what grade their assignment has earned. Further, students are instructed to email their instructor describing the letter grade they would place on their self-assessment assignment and their rationale for choosing that grade. Consequently, the instructor replies to each student giving feedback as to the accuracy of the students’ self-assessment. Through this process, preservice teachers learn to utilize the grading criteria for the course to help them self-assess their own performance and understanding.
Learning to self-assess is difficult for the preservice students at ISU. As one might expect, some students resist this change in instruction (and grading), hopeful that the instructor will surrender course expectations and essentially give the students what they want and expect from a college course (Felder & Brent, 1996). Critical to navigating this emotional rollercoaster of student-centered instruction is the continual assessment of students' concerns and frustrations. At some point near the end of the semester, students have doubts about self-assessment and their own understandings.

At this point, course instructors help preservice teachers see the reality of their profession. As a classroom teacher, they will rarely receive feedback from others as to the quality and effectiveness of their teaching; therefore, it is imperative they can assess such things on their own, and do so accurately. By the end of the semester, course evaluations reveal many students view the teaching interaction self-assessment assignment as one of the most valuable assignments within their teacher education program. Additionally, several students each semester expound on the depth and breadth of their learning as a result of the course.

The rest of the course is designed to prepare students to create a research-based framework (RBF) for teaching science (Clough, 2003; Clough & Kauffman, 1999; Olson, 2003). At the end of the course, students will submit a 20-page paper outlining their goals for elementary students and the content, materials, strategies, activities, and teacher behaviors that will promote their goals. Further, students are expected to articulate how such decisions are consistent with the literature on effective teaching and how students learn. Thus the remaining time in class is devoted to preparing students to successfully create and defend their research-based frameworks.

This assignment is challenging for students; therefore students work together to create parts of their developing framework. For example, methods students form groups of three, select one of their goals for students, and search the ERIC database to find relevant educational articles. Student groups present their selected goal and articulate how they will promote it in their classroom. Handouts of abstract summaries from relevant research are provided for each goal; these serve as a resource for students to use when developing their RBF paper, and gives them a sense of how to better promote their goals. After the first presentation, the instructor models questions that might appear during the oral defense, “You said you would primarily be a facilitator. What does that look like?” “How might constructivist learning theory help you decide what questions to ask when you are walking around during group work?” By the end of the third presentation, students are asking all of the questions to one another.

The remainder of the semester is designed to help students continue to make sense of how they will promote their goals in the classroom. The students engage in additional elementary science
activities and identify goals that were promoted. Additionally, the course addresses how to modify activities to better promote student goals, deepen student understanding, support children with varying needs; how to assess children’s understanding; and how to use consolidation strategies such as concept mapping and class discussions. Students examine the *National Science Education Standards* (NRC, 1996) and several local school district curricula, and compare these to both learning theories and the research they have found. Finally, students examine a variety of commercial elementary science kits, and compare them to their developing research-based framework.

As the course is focused on decision-making related to promoting goals in the classroom, the instructor is not interested in having students memorize information or having students take the same position on teaching as the instructor. Students can modify their goals from the class list, and teacher behaviors, strategies, content, materials, and activities should be consistent with those goals. The course does not advocate relativism, however. Whatever position students take should be informed by research on the state of science education (such as Goodlad’s 1983 study or others they may find on their own) and the desired state set forth in documents such as the *National Science Education Standards* (NRC, 1996).

**Self-Assessment of Written and Oral Research-Based Frameworks**

All students turn in their 20-page RBF paper and subsequently sit with their course instructor for an hour and a half exit interview that assess their understanding of teaching and learning. Instructors go to great lengths to make students feel comfortable (such as wearing casual clothes, and providing food/drink) during the interview. The first hour consists of a conversation about the students’ understanding of science teaching and learning. Typically this conversation contains questions like:

- What did you learn by writing your RBF paper?
- What would you do and consider in order to promote the goal of problem-solving in your classroom?
- What would I see you doing if I visited your classroom in five years?
- How will you determine if you are an effective teacher?
- How would you respond to a parent who questions your use of cooperative groups?

Throughout the oral defense, instructors offer feedback as to how effectively the student is responding to questions. These clues look different depending on the student and the quality of their responses. For instance, instructors follow most questions with probing questions to help students to make connections between components of effective teaching, in addition to helping students realize
the depth and breadth of their understandings. At times, instructors may ask questions like: What might it convey that you have not discussed what you will do to promote your goal? At this point in your interview, what areas on the RBF schematic (Figure 2) have you not discussed yet? What is your rationale for excluding those areas? Such questions and the flexible use of feedback throughout the exit interview aid the student in their own self-assessment.

The last half hour is devoted to student self-assessment. Typically, students are told, “Please take some time and look at the grading criteria that are in front of you. Please note that the different categories are worth different percentages of your final grade. For each category, determine where you assess your performance and understanding as compared to the criteria. After you have thoughtfully considered all the categories, determine what letter grade you have earned for the course. Be prepared to explain your rationale for your self-assessment.” Students then assess their grade for the course and defend their grade with a rationale. Importantly, students do not receive the grade they want; they receive the grade they have earned based on the criteria of the course. In the case that a student has over- or under-assessed their performance, he or she is directed by the course instructor to the problematic area through explicit questioning. For example, the instructor might say, “What strengths in your paper makes you think it’s an ‘A’? What weaknesses does your paper have?” Students’ responses to such questions indicate their self-assessment abilities and help teach them how to self-assess more accurately. Additionally, other probing questions are asked to help students realize where they are in their understanding of teaching and learning, and to help them come to assess their performance accurately, if they do not do so initially during the grade defense. For more information on the elementary science methods course at our institution, please see Olson (2003) and Olson and Appleton (2005).

Description of the Researcher

The researcher of this study earned a biology teaching degree with a chemistry teaching minor, and prior to attending graduate school taught two years of high school biology and chemistry. The researcher’s highest degree at the time of this study is a master’s degree in science education. Concurrent with science education coursework, this researcher taught seven semesters of elementary science methods, two semesters of early childhood science methods, and supervised six secondary science student teachers. In addition, the researcher has assisted with elementary science education professional development through an NSF-funded Local Systemic Change (LSC) project in rural schools. The researcher has previously used the LSC classroom observation protocol to assess both
elementary and secondary science lessons. This unique professional background of the researcher has provided the necessary experiences to understand, analyze, and evaluate effective elementary science teaching.

The researcher taught several sections of elementary science methods at the same university attended by the participants of this study. Consequently, four of the participants, Jill, Lois, Cora, and Tricia, are former students of the researcher. Three other participants, Nancy, Brady, and Chris, had interactions with the researcher prior to this study. Nancy was part of the LSC rural elementary science professional development program, Brady’s classroom was visited by the researcher and her major professor before the researcher began to teach elementary science methods, and Chris was a fellow student in a graduate level curriculum class at the university. Thus seven of the 13 participants had some degree of familiarity with the researcher prior to this study. This familiarity may have introduced bias, yet these seven participants do not cluster together in teaching effectiveness or sophistication of self-assessment. Further, the degree of familiarity perhaps benefited the study because these participants appeared to be at ease and seemed eager to discuss their teaching during the teacher interview. The researcher was careful to treat these seven participants no differently than the rest of the participants and analysis of data was conducted in similar ways; therefore, it is assumed this familiarity with some participants does not alter the results of this study.

Participants

The population studied consists of teachers who are recent graduates from the College of Education at Iowa State University with a degree in Elementary Education. These graduates are predominantly female, Caucasian, 24-30 years of age, and natives of the Midwestern United States. From this population, a purposeful, convenience sample of 13 teachers was chosen.

The participants in this study have been fully employed by a public school district for at least two years, but no more than five years. To understand how novice teachers develop more complex knowledge bases and teaching skills, it is imperative to study teachers who are beyond their first year of teaching but not past their fifth year. While including teachers who have more than five years of experience would be interesting, such inclusion is beyond the scope of this study.

All participants teach science and/or mathematics. While the teaching of science is preferable for this study, due to the lack of consistent science teaching at the elementary level, mathematics teaching is a close viable option for observation of teaching skills. Elementary mathematics and science utilize similar process skills and problem-solving methods. Additionally, current reform
Table 1. Description of study participants.

<table>
<thead>
<tr>
<th>Name</th>
<th>Years of experience</th>
<th>Teaching position</th>
<th>Location</th>
<th>Educational background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jill</td>
<td>2</td>
<td>Kindergarten</td>
<td>IA (urban)</td>
<td>B.A.</td>
</tr>
<tr>
<td>Kay</td>
<td>2</td>
<td>Kindergarten</td>
<td>IA (rural)</td>
<td>B.A.</td>
</tr>
<tr>
<td>Lois</td>
<td>2</td>
<td>1st Grade (year 2) Title I Reading (year 1)</td>
<td>IA (suburban)</td>
<td>M.S., Wildlife Biology</td>
</tr>
<tr>
<td>Cora</td>
<td>2</td>
<td>3rd Grade (year 2) 6th Grade (year 1)</td>
<td>IA (suburban)</td>
<td>B.A.</td>
</tr>
<tr>
<td>Alex</td>
<td>2</td>
<td>5th Grade (year 2) 6th Grade (year 1)</td>
<td>IA (rural)</td>
<td>B.A.</td>
</tr>
<tr>
<td>Becky</td>
<td>2</td>
<td>7th Grade Science</td>
<td>IA (rural)</td>
<td>B.A.</td>
</tr>
<tr>
<td>Tricia</td>
<td>2</td>
<td>3rd Grade (year 2) Technology K-5 (year 1)</td>
<td>WI (suburban)</td>
<td>B.A.</td>
</tr>
<tr>
<td>Linda</td>
<td>3</td>
<td>4th Grade</td>
<td>MN (suburban)</td>
<td>B.A.</td>
</tr>
<tr>
<td>Keith</td>
<td>4</td>
<td>6th Grade Math (years 3 &amp; 4) 2nd Grade (years 1 &amp; 2)</td>
<td>WI (suburban)</td>
<td>B.A.</td>
</tr>
<tr>
<td>MO (rural)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brady</td>
<td>4</td>
<td>2nd Grade (years 3 &amp; 4) Kindergarten (years 1 &amp; 2)</td>
<td>IA (suburban)</td>
<td>B.A., working towards National Board Certification</td>
</tr>
<tr>
<td>Nancy</td>
<td>4</td>
<td>3rd Grade</td>
<td>IA (rural)</td>
<td>M.A. in education</td>
</tr>
<tr>
<td>Chris</td>
<td>4</td>
<td>K-5 Science (year 4) 2nd Grade (years 1 - 3)</td>
<td>IA (urban)</td>
<td>M.A. in educational leadership</td>
</tr>
<tr>
<td>Kelly</td>
<td>5</td>
<td>3rd Grade (years 3 -5) 3rd &amp; 5th Grade math &amp; reading (years 1 &amp; 2)</td>
<td>IA (suburban)</td>
<td>B.A.</td>
</tr>
</tbody>
</table>

Note. The most current teaching position for each teacher is listed first.

documents in both disciplines recommend the use of teaching strategies and methods that are consistent with constructivist, social and developmental learning theories (NRC, 1996; NCTM, 2000), and current classroom assessment instruments assess both math and science instruction
(Horizon Research, Inc., 2004; Piburn et al., 2000). Further details about the participants of this study are provided in Table 1.

It is not likely that the participants in this study differ significantly from other second-, third-, fourth-, or fifth year elementary science and/or math teachers who have graduated from Iowa State University. Therefore, this study assumed that the purposive sampling measures did not introduce significant bias to the study. For convenience, the sample selection was bounded as much as possible in geographic proximity to central Iowa. Because finding and recruiting teachers for this study was a formidable task, three of the teachers in this study teach outside the state of Iowa. This was done to increase the sample size. While bias may be introduced into the study through these sampling measures, it is likely that teachers hired by school districts in Iowa, Minnesota, and Wisconsin are representative of teachers hired by school districts elsewhere in the Midwest region.

Study Design

Recruitment

Recruitment of participants began as soon as this study gained approval from the ISU Institutional Review Board. The ISU alumni database was compared to science methods class lists to find former students matching the sample criteria. Additionally, through word of mouth, teachers in the field provided names of additional possible participants. All participants were contacted initially through an email or letter that explained the study and asked for their participation. Because all participants once took science methods at ISU, rapport was established through common experiences of teaching and issues in schools. Additionally, the researcher made it very clear that this study would not put more work or stress on classroom teachers. Participants were given a time frame and particular dates that would work for the researcher to visit their classroom. Teachers then decided which day would work the best for the visit. Generally, a month lapsed between initial contact and the classroom observation. All participants signed a letter of consent (Appendix B). Furthermore, building administrators signed a letter of consent for research to be conducted within their school.

Data Collection

This study utilizes three sources of data: (1) classroom observations, (2) post-lesson interviews, and (3) relevant documents collected during classroom observations.

(1) Classroom observations. All elementary teachers were observed teaching elementary mathematics and/or science lessons. In some circumstances, participants only taught math or
science. Generally, each lesson observed lasted approximately 30 minutes. During the observation, the researcher kept extensive field notes containing detailed and specific descriptions of the classroom environment, the activity, materials, and content of the lesson, what students did and said, and what the teacher did and said. Following the classroom observation, the characteristics of the entire lesson were scored using the Local Systemic Change (LSC) Classroom Observation Protocol (Horizon Research, Inc., 2004). A copy of the LSC instrument can be found in Appendix C.

This combination of open-ended observation and the completion of an observation instrument maximizes the strengths of the observation, while minimizing potential weaknesses. For instance, open-ended observation provides detailed information and greater flexibility than an observation instrument alone. By recording descriptions of the lesson, the possibility that meaningful classroom behavior will be overlooked because it is not part of the observation form is minimized. Additionally, through translating the observation notes to an LSC score, a measure of standardization between observations can occur (Krathwohl, 1998). Further, the observation coding guide helps to minimize ambiguities in recording and to provide consistent focus for the observations (Krathwohl, 1998).

(2) Post-lesson interviews. Following the lesson observation, each teacher participated in a semi-structured post-lesson interview. The interviews took place during a break, lunch, or after school and generally lasted 20 - 40 minutes, depending on the amount of time the teacher had available. Interview questions sought to determine what types of knowledge teachers drew upon as they reflected about various aspects of the lesson observed. Consistent with semi-structured interviews, identical questions were asked of every participant (Patton, 1990). The researcher deviated from the prescribed questions in order to probe further into participants’ responses about their decision-making and self-assessment practices. A semi-structured interview ensures that data relevant to the research question is discussed. Additionally, the open-ended nature of the questions creates interviews that are more conversational, which helps put participants at ease (Patton, 1990). See Appendix D for a copy of the interview questions. Each interview was audiotaped and later transcribed.

(3) Documents. Additional data, such as copies of student activity sheets and lesson self-evaluations, were collected when possible. Such document collection was dependent on the teacher’s willingness to share such information. These artifacts provide triangulation for the classroom observations and, at times, were also discussed in the interview.
Instrumentation

The Local Systemic Change Classroom Observation Protocol (LSC) is an observational instrument developed for use in mathematics and science lessons by Horizon Research, Inc. (2004). The LSC is criterion-referenced and can be used at all levels of mathematics and science instruction, from elementary schools through university classrooms. The instrument contains 4 categories consisting of lesson design, lesson implementation, science/mathematics content, and classroom culture. Each of the four categories contains key indicators the observer is to rate on a scale from 1 (not observed) to 5 (observed to a great extent). Using the ratings of the key indicators the observer then gives each of the four categories a synthesis rating based on a scale from 1 (not at all reflective of best practice in science/mathematics education) to 5 (extremely reflective of best practice in science/mathematics education). Finally, the observer determines an overall capsule rating of lesson quality. This capsule rating is not a summative score based upon the previous categories. The observer determines the overall effectiveness of the lesson based on specific criteria elucidated within the observation protocol. The final capsule ratings consist of (1) Ineffective instruction through lecture or “activitymania,” (2) Elements of effective instruction, (3) Beginning stages of effective instruction (low, medium, and high), (4) Accomplished, effective instruction, and (5) Exemplary instruction. Higher scores within each category and for the capsule rating indicate more accomplished instruction consistent with current reforms in both mathematics and science education.

Reliability for the LSC instrument’s overall capsule rating indicates that 92% of the time trained observers were within one rating level of the rating key standard (Horizon Research, Inc., 2000). Further, 57% of the trained observers were in exact agreement with the standard score. Reported measures of internal reliabilities for the LSC categories are 0.97 for lesson design, 0.95 for lesson implementation, 0.94 for mathematics/science content, and 0.94 for classroom culture. Measures of reliability indicate that trained observers use the LSC instrument in a highly consistent manner.

 Approximately 60 science and mathematics educators determined the construct validity of the LSC categories by analyzing the items’ agreement with reform documents in math and science (NRC, 1996; NCTM, 2000). A numerical score indicating internal validity of the instrument is not reported (Horizon Research, Inc., 2000).

LSC synthesis ratings for lesson design, lesson implementation, science/mathematics content, and classroom culture, in addition to the overall capsule rating for the lesson provide a way to compare teaching effectiveness across teachers in the secondary data analysis. Because the LSC instrument measures the degree to which a lesson is consistent with current reform documents in
science and mathematics education, it is important to determine the consistency between the researcher’s observations and other educators in the fields of science and mathematics. The researcher in this study was trained to use this instrument by a trained observer who completed training with the instrument developers at Horizons Research, Inc. The interrater reliability between this researcher and the Horizons-trained researcher was 93%.

Analysis

This study utilizes qualitative data analysis to determine the relationship between teachers’ self-assessment practices and classroom teaching practices. Initial data analysis occurred immediately following classroom observations and interviews as the researcher rated the observations using the LSC observation protocol and transcribed and coded the teacher interviews. This initial coding serves to reduce the data into more manageable chunks of information useful for secondary qualitative analysis.

Coding of Teacher Interviews

The coding and analysis of teacher interviews took place using the computer program, ATLAS.ti Version 5.0 (Scientific Software Development, 2004). Transcriptions of teacher interviews were coded and categorized using open and axial coding procedures (Strauss & Corbin, 1998). First, the focus of participants’ reflection was ascertained (e.g. student behaviors, activities, teaching strategies, or student assessment). As the number of focus categories grew, similar focus categories were clumped together into a focus supercode. For instance, the open-coded categories of activity sheet, books, bulletin board, internet, resources, materials, science kit, science textbooks, student data sheet, technology, and video were all clumped into the focus supercode, materials. This clumping of pieces of data into a larger category further reduced data into more manageable and meaningful portions of information. After this data reduction, the focus supercodes present in teachers’ reflections were: activities, student assessment, classroom management, control, curriculum, external observation, get ideas, lesson planning, materials, meet needs, parents, purpose of lesson, school culture, student actions, student affect, student backgrounds, student behavior, student thinking, student understanding, teacher affect, teacher assessment, teacher background, teacher behaviors, teacher expectations, teacher thinking, teacher understanding, teaching strategies, and workload.
For each focus category created, the researcher determined the level of reflection based upon Manouchehri's (2002) model—Describing, Explaining, Theorizing, Confronting, and Restructuring. Reflections coded as describing briefly describe a facet of the lesson. Explanations are those statements that try to justify or explain a teaching decision using students, teachers, or experience. Those explanations that make use of theoretical or research-based explanations are called theorizing. As teachers begin to articulate the problems that occurred within a lesson, the reflection is called confronting. When teachers propose solutions to problems or seek to find a different way to do things, they seek to restructure their lesson decisions. Definitions and statements taken from transcripts that exemplify each level of reflection can be found in Table 2.

The distinctions between explaining and theorizing are subtle at times. In both reflection levels, teachers explain, however, in a theorizing reflection the teacher draws from a research-based idea or utilizes ideas from professional literature to substantiate their decisions. Research on teachers' cognition demonstrates that teachers do not often explicitly articulate theoretical ideas precisely or distinctly (Munby et al., 2001). Instead they often dwell in the particulars of practice, describing and

<table>
<thead>
<tr>
<th>Level of Reflection</th>
<th>Definition</th>
<th>Exemplars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe</td>
<td>Story telling</td>
<td>And then as a group I try to change things. And then, individually I will sometimes pull kids aside during like free choice time or something to work on some of the skills they are struggling with. (Kay, 15:39; meeting students needs)</td>
</tr>
<tr>
<td></td>
<td>Describe aspect of lesson</td>
<td>I found a great video that showed animals in general, how they build their homes and how when they build their homes how it affects other animals around them. (Brady, 7:20; materials)</td>
</tr>
<tr>
<td>Explain</td>
<td>Explain teaching event or decision</td>
<td>But I thought what went well during the math is that I felt like I was challenging every child. There wasn’t any child that was just quickly done and finished. Even the children that were I had the possibility of um making them explain how they know they had them all. (Brady, 8:19; meeting students needs)</td>
</tr>
<tr>
<td></td>
<td>-use past experiences</td>
<td>The thing about this curriculum also is it is real world. This is a map of the U.S. and it is something you would really use millions and millions. But then I try to drop it down to, even through the goal is to get them to understand big numbers, it is hard to really understand that 2,850,000 is close to 3 million. So I dropped it down to the classes of sports. (Alex, 6:23; teacher analogy)</td>
</tr>
<tr>
<td>Theorize</td>
<td>Explains teaching event or decision -utilizes learning theory -utilizes professional readings</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>It wasn’t something you were privy to see today because both the 2nd grade classes were at different points. But had we done the propeller one for both of those they would have come up with completely different ideas of how to make that propeller go faster. And getting them to see that from one another and to pick up on it. I’m constantly trying to use what they already know and have them not only share it with one another but to use it. So, if it’s a constant juggling act and its not the same for each class. So I’m always thinking back to what they know and how can I get them a little bit farther along. And that doesn’t always put them at the same place. (Chris, 9:10; adjust lessons)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I like how they have a lot of manipulatives to use. That’s pretty much supplied, most of my manipulatives. Except for the base 10 blocks, I’ve got myself because I still think at this age it is just still so important to have that model to show them at this age. Numbers are just so abstract. Just knowing how kids think, They can’t handle such big numbers like that you know. (Nancy., 11:30; materials)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Confront</th>
<th>Admits problems with lesson May ask questions that reveal they are unsure about aspect of lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>You always have some kids that are here and some kids that are here and then you have this cluster in the middle that you are really trying to teach to. And trying to get to those other kids is just so hard and um I wouldn’t say I have done a good job of offering enrichment at all. I would say that I have done a really poor job of that. (Linda, 1:48; meeting students needs)</td>
</tr>
<tr>
<td></td>
<td>But if I did, I want them to observe earthworms today and I want them to notice if there is a difference in their length if they constrict. So what? Why do they need to know that? Or I want them to have a race with their earthworms. These are just some of the things I saw out there as I was searching for things. So what? Why do I care if we have an earthworm race? (Brady, 8:71; activities)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Restructure</th>
<th>Provides a solution to a problem Seeks a solution to a problem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>How am I going to get them to expand this so everyone really understands it? Because if I just have them write something on the board how do I get them to really ALL have access to that? (Brady, 8:85; meeting students needs)</td>
</tr>
<tr>
<td></td>
<td>I think for math some of the um overheads that I went over like probably if I had calculators and had them punch in some of the math problems on the calculator I think that would have been helpful. (Kelly, 5:6; materials)</td>
</tr>
</tbody>
</table>
explaining classroom decisions using metaphors, images, or stories (Calderhead, 1996; Munby, et al., 2001). Considering this tacit nature of teachers' theoretical knowledge (Schön, 1983), in this study the reflections coded as theorizing do not often explicitly contain references to theory. Instead, the teacher uses ideas consistent with current educational theory, but often expressed in narrative as described by Munby et al. (2001). As shown in Table 2, in the first theorizing exemplar Chris explains why his lessons do not often end in the same place and why he adjusts his initial plans. He discusses the importance of having students share what they already know and also use this information in the hands-on activities during the lesson. What he says is highly consistent with constructivist learning theory, however, he does not explicitly mention this theory by name. Similarly, in the second theorizing exemplar Nancy draws from developmental learning theory to explain her use of manipulatives, but does not explicitly name this learning theory. This is coded as theorizing because she does express the abstract nature of numbers and the need young children have to use models to understand such large numbers, and concept consistent with developmental learning theory.

In contrast, the explaining exemplars substantiate lesson decisions based on the resulting impact for students or teachers—and often this impact is focused on behavior or affect. As shown in Table 2, Brady explains how he knows he met students' learning needs and challenged every student because all students worked throughout their math lesson on the problem and activity assigned. When students finished early, Brady was there with a question to keep those students thinking about the topic at hand. This explanation focuses on student behavior. Similarly, Alex explains his use of a teacher analogy because it might help students more easily understand larger numbers. His explanation was focused on whether this would be hard or easy for students. He did not articulate his concern for the abstract nature of large numbers or how he needs to make such numbers more concrete to aid student understanding. His explanation was based solely on student impact.

Simultaneous with the coding of interviews, written research memos captured the thinking processes and decisions made by the researcher. These written documents, though not present in this final product, were helpful in discerning patterns. Further, such documentation provides the data trail for the chain-of-reasoning that links the data to the research conclusions (Krathwohl, 1998; Merriam, 2002; Strauss & Corbin, 1998).

To analyze the data further, several simple tables were created to compare and contrast various components of effective science teaching with components of teacher reflection and self-assessment (Miles & Huberman, 1994). Each table orders teachers according to their capsule LSC rating. The tables use data that has been reduced to trace the connections that exist between and among participants to compare the LSC categories describing their level of teaching effectiveness and
the levels of self-reflection evident in the teaching interviews. Such tables can help a researcher create themes and theoretical ideas derived from the data (Strauss & Corbin, 1998). Quotations from teacher interviews are provided along with the tables to elucidate the distinctions and patterns in teacher reflection. All quotations from teacher interviews are cited within parentheses using the teacher's pseudonym, followed by the primary document number and paragraph number as found within the ATLAS.ti analysis program.

To answer research question one, tables were examined to ascertain possible trends across teachers. Specifically, differences between teachers at different levels of reflection were closely examined to determine the extent to which a relationship exists between a teacher's practice, his or her level of reflection, and the content of those reflections.

To answer research question two, the findings from research question one were compared to the objectives and outcomes of the science methods course these teachers had taken. Because of the methods course's strong emphasis on self-assessment of both teacher behaviors and content, activities, and materials, teachers' reflections pertaining to these aspects of instruction were compared to the intended outcomes of the science methods course. This determines the extent to which course content from the preservice program remains with teachers past the induction phase of teaching.
CHAPTER 4. RESEARCH FINDINGS

Summary of Problem

For over two decades the current state of teaching and learning in our nation’s schools has repeatedly been reported as less than desirable (Goodlad, 1983; NCEE, 1983; Schmidt et al., 1998; Yager & Penick, 1983). School administrators, teacher educators, teacher associations, and teachers who analyze this pervasive problem and seek practical solutions that will lead to changes in our nations’ schools have consistently referred to the importance of continual learning and professional development of teachers through teacher self-assessment (Airasian & Gullickson, 1994; Bailey, 1981; Fullan, 1994; Goodlad, 1994; Nolan & Hoover, 2004; NRC, 1996; Sarason, 1993). Even though this strategy is mentioned frequently in teacher change and teacher evaluation documents, little empirical research exists to support a relationship between teachers’ self-assessment and their classroom practices.

The goal of this study is to identify the levels of explicit reflection-on-action and criteria with which teachers self-assess their teaching, and to compare these reflections and criteria to classroom practices. These reflections and practices are also compared to the participants’ preservice preparation to determine the extent to which strategies taught transfer to classroom practice. To investigate these issues this study utilizes classroom observations and interviews with teachers relatively new to the field of elementary science and/or mathematics teaching. The interview includes an examination of the criteria teachers consider, as well as the reasoning and reflection they use to make sense of their teaching. By understanding the possible influences teacher self-assessment and reflection have on effective teaching practices, we may better understand what strategies are important for teachers’ professional development and for inclusion in both inservice and preservice teacher education programs.

Currently, teacher socialization and professional demands minimize the time and energy teachers have for accurate reflection and assessment. This research study has the potential to demonstrate the relationship between self-assessment and effective teaching practice. Such information could serve to change administrative policies and school procedures, thus providing classroom teachers with the necessary time, resources, and support to conduct accurate and much needed self-assessments and reflection.
Summary of Research Methods

This qualitative study investigated the reflection and self-assessment practices of thirteen elementary teachers in the upper Midwest region. All teachers participating graduated from the same university elementary teacher education program, were teaching mathematics and/or science, and were in their second, third, fourth, or fifth year of teaching. Data collection consisted of classroom observations, post-lesson interviews, and relevant documents collected from the lesson and/or interview. Further details pertaining to data collection and analysis are described in this section.

Classroom Observations

A total of 64 teachers were asked to participate in this study. Only thirteen teachers met the criteria and agreed to participate in the study. Of the 51 teachers declining consent, eight conveyed they did not meet the criteria; the other 43 either declined to participate or did not return communication. Initially, the researcher intended to use only teachers in central Iowa; however due to the difficulty in recruiting participants, three teachers observed taught in neighboring states.

Once participants were identified, classroom observations were difficult to schedule, as many participants were very selective in the dates of observation. For instance, teachers often said they did not want to be observed on Mondays or Fridays because students were “crazy” on those days. By the teachers’ requests, observations were scheduled around the weeks of parent-teacher conferences, Halloween, Thanksgiving, Christmas programs and festivities, Valentine’s Day, teacher inservice workshops, or any other potentially disruptive day. Additionally, units of science and social studies instruction often alternated or science was only taught on certain days of the week; this made the scheduling of science observations even more constrained. To further complicate classroom observations, several scheduled observations were postponed due to weather-related school cancellations and/or late starts. This difficulty in scheduling classroom observations implicitly conveys teachers’ uneasiness with classroom observations. Additionally, it causes the researcher to question the quality of teaching and learning that occurs during “special weeks” of the school year. For what reasons are outsiders not welcome on so many days and weeks of the school year?

Initially, the researcher intended to have multiple observations of each participant so as to ensure data saturation (Merriam, 2002); however as the school year progressed and as participants from a larger geographical area had to be included in the study, multiple observations became unrealistic. As shown in Table 3, two teachers, Jill and Kay, were observed on two different dates. This occurred because these teachers were the first two teachers to be observed and interviewed. The
researcher wanted to ensure the data collected in the fall would be consistent with the data collected in the spring. Notably, the observation ratings from the two dates are not drastically different from one another. Analysis of teacher interviews also demonstrated consistency within groups and trends across groups. Therefore, even though the number of participants and observations of each participant was fewer than anticipated, internal validity through data saturation was achieved (Merriam, 2002).

The findings of this study are robust despite differences in students because the observer, while interested primarily in the teacher, also observed the students and determined that differences in students did not warrant substantial differences in classroom observation ratings or teacher reflections. The students observed were not substantially different in behavior, academic ability, or other variables that might impact the teaching of a lesson. For instance, all classrooms were general education classrooms; thus no classroom was comprised entirely of students with special needs concerning their learning or behavior. The researcher determined that differences in classroom observations were more dependent on teacher decisions and behaviors than on any potential differences in the students observed in each elementary classroom.

As shown in Table 3, science lessons were observed of three teachers, math lessons were observed of four teachers, and both science and math lessons were observed of the remaining six teachers. Unfortunately, elementary science education is rather erratic. In many districts, only a few elementary teachers actually teach science units. Several weeks of the school year are devoted to social studies or health instruction, rather than science. Because the researcher anticipated difficulties finding elementary teachers teaching science, mathematics was included to ensure more participants. As shown in Table 3, in cases where both math and science lessons were observed, observations demonstrate consistency in teaching effectiveness. This increases the confidence one may place in this study, particularly in instances where participants taught math and/or science lessons.

The ratings issued to each classroom observation are reported in Table 3. The observations are ordered according to the resulting LSC capsule rating, with the lower capsule scores near the top of the table and the high scores near the bottom. This conveys that lessons more consistent with criteria found in math and science reform documents are at the bottom of the table. Based on the LSC capsule rating, each teacher was placed into one of four categories: Low-implementation, Mid-low-implementation, Mid-high-implementation, and High-implementation. As demonstrated in Table 3, those teachers rated at both LSC ratings of 2 and 3l (e.g. Jill) were categorized as low implementers. Teachers rated only as 3l or 3m were categorized as mid-low implementers. Teachers rated as both 3m and 3h (e.g. Nancy) were categorized as mid-high. Teachers rated at LSC 4 were categorized as high implementers. The LSC capsule rating was the sole indicator used to categorize teachers into one
of the four implementation categories. Additionally, the four subcategories of Design, Implementation, Math/Science Content, and Classroom Culture are included in Table 3.

Table 3. Ratings for Classroom Observations using the LSC Classroom Observation Protocol.

<table>
<thead>
<tr>
<th>Name</th>
<th>Date Observed</th>
<th>Subject</th>
<th>LSC Capsule Rating</th>
<th>Teacher Implementation Categories</th>
<th>Design</th>
<th>Implementation</th>
<th>Math/Science Content</th>
<th>Classroom Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jill</td>
<td>2-23-05</td>
<td>Science</td>
<td>2</td>
<td>Low</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Jill</td>
<td>2-23-05</td>
<td>Math</td>
<td>2</td>
<td>Low</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Lois</td>
<td>12-9-04</td>
<td>Science</td>
<td>2</td>
<td>Low</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Kelly</td>
<td>1-26-05</td>
<td>Science</td>
<td>2</td>
<td>Low</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Kelly</td>
<td>1-26-05</td>
<td>Math</td>
<td>3l</td>
<td>Low</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Jill</td>
<td>10-21-04</td>
<td>Math</td>
<td>3l</td>
<td>Low</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Jill</td>
<td>10-21-04</td>
<td>Science</td>
<td>3l</td>
<td>Low</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Cora</td>
<td>1-17-05</td>
<td>Math</td>
<td>3l</td>
<td>Mid-low</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Keith</td>
<td>2-18-05</td>
<td>Math</td>
<td>3m</td>
<td>Mid-low</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Linda</td>
<td>2-16-05</td>
<td>Math</td>
<td>3m</td>
<td>Mid-low</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Becky</td>
<td>1-28-05</td>
<td>Science</td>
<td>3m</td>
<td>Mid-low</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Alex</td>
<td>12-17-04</td>
<td>Math</td>
<td>3m</td>
<td>Mid-low</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Kay</td>
<td>11-2-04</td>
<td>Math</td>
<td>3m</td>
<td>Mid-high</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Nancy</td>
<td>1-10-05</td>
<td>Math</td>
<td>3m</td>
<td>Mid-high</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Tricia</td>
<td>2-17-05</td>
<td>Math</td>
<td>3h</td>
<td>Mid-high</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Tricia</td>
<td>2-17-05</td>
<td>Science</td>
<td>3h</td>
<td>Mid-high</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Kay</td>
<td>11-2-04</td>
<td>Science</td>
<td>3h</td>
<td>Mid-high</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Kay</td>
<td>2-9-05</td>
<td>Math</td>
<td>3h</td>
<td>Mid-high</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Nancy</td>
<td>1-10-05</td>
<td>Science</td>
<td>3h</td>
<td>Mid-high</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Brady</td>
<td>12-6-04</td>
<td>Math</td>
<td>4</td>
<td>High</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Brady</td>
<td>12-6-04</td>
<td>Science</td>
<td>4</td>
<td>High</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Chris</td>
<td>1-19-05</td>
<td>Science</td>
<td>4</td>
<td>High</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

*Teacher Interviews*

All teachers participated in a semi-structured interview on the same day as their classroom observations. In cases where more than one lesson was observed in a day, teachers participated in one interview that asked the teacher to reflect on both lessons taught. Interviews were conducted in
teachers' classrooms following the observed lesson(s) during lunch, a break, or after school. At times, an interview was started during a recess break, and later completed after school as the recess break did not provide enough time to thoroughly address the interview questions. Three teachers were interviewed twice. Because Jill and Kay were observed twice, once in the fall and once in the spring, they were also interviewed twice. Additionally, Brady asked to meet with the researcher again. What Brady conveyed during the second interview was very similar to what he conveyed during the first one.

Typically, interviews were 30–45 minutes in length, depending on the time the teacher had for the interview and the talkativeness of the participating teacher. Notably, two teachers, Jill and Brady, were extremely talkative. Their eagerness to talk impacts the length of their interviews and amount of information they share. This in turn impacts the number of references they make to particular aspects of their teaching. However, the amount a person talked in no way related to what they talked about. This study is more interested in what is communicated rather than how much is communicated.

All teachers were asked to reflect on the observed lesson(s). Specifically, teachers were prompted to consider the goals for the lesson observed, what they would change about the lesson taught, how well they promoted their intended goals, the teachers' recalled thoughts during the lesson, and teachers' thoughts after the lesson. Additionally, teachers were asked to describe how they determined whether their lessons are effective and how they determined whether they were effective teachers. A list of the interview questions is found in Appendix D. When appropriate, follow-up questions were asked of participants to better understand their perspectives of teacher assessment and reflection. These questions are designed to be congruent with intended outcomes of the science methods course these teachers took as undergraduates.

Interviews were transcribed and coded for the sophistication of reflection exhibited (Manouchehri, 2002) as well as the content of their reflections.

**Findings—Research Question 1**

Research Question 1: To what extent does the sophistication of elementary teachers' reflection on teaching relate to their effective use of reform-based teaching practices during their math and/or science lessons?
All teachers describe, explain, confront, and restructure aspects of their teaching practices. As shown in Table 4, mid-high- and high-level teachers tend to use more theoretical explanations in their teaching reflections. Notably, two mid-low-level teachers and two low-level teachers do not utilize theoretical explanations at all during their lesson reflections. Additionally, at least 20% of the high-level teachers' reflections contain comments considered confronting. A cluster of low-level and mid-low-level teachers confront their teaching practices 14-18% of the time. However, the mid-high-level teachers exhibit a noticeable drop in the percentage of confronting comments made about teaching, particularly when compared to the high-level teachers. Similarly, at least 8% of the reflections of high-level, low-level and three of the mid-low-level teachers seek to restructure teaching. Again, mid-high-level teachers' reflections contain fewer comments that are considered restructuring.

Table 4. Level of reflection articulated by teacher during interview, reported as percentage.

<table>
<thead>
<tr>
<th>Implementation Category</th>
<th>Name</th>
<th>Describe</th>
<th>Explain</th>
<th>Theorize</th>
<th>Confront</th>
<th>Restructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Jill</td>
<td>52</td>
<td>20</td>
<td>2</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Lois</td>
<td>55</td>
<td>21</td>
<td></td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Kelly</td>
<td>63</td>
<td>12</td>
<td></td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Cora</td>
<td>71</td>
<td>10</td>
<td></td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Keith</td>
<td>47</td>
<td>26</td>
<td>1</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td>Mid-Low</td>
<td>Linda</td>
<td>61</td>
<td>18</td>
<td></td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Becky</td>
<td>64</td>
<td>13</td>
<td>4</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Alex</td>
<td>51</td>
<td>35</td>
<td>1</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Mid-High</td>
<td>Kay</td>
<td>55</td>
<td>24</td>
<td>4</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Nancy</td>
<td>52</td>
<td>31</td>
<td>8</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Tricia</td>
<td>69</td>
<td>19</td>
<td>3</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>High</td>
<td>Brady</td>
<td>47</td>
<td>17</td>
<td>4</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Chris</td>
<td>38</td>
<td>18</td>
<td>9</td>
<td>21</td>
<td>14</td>
</tr>
</tbody>
</table>

*Note. For each teacher, the percentage reported here is the number of times each level of reflection was coded divided by the total number of coded reflections for that teacher, multiplied by 100%.*

The overall trend, as shown in Table 4, appears to be that low- and mid-low-level teachers exhibit sophisticated levels of reflection, like their high-level counterparts, but their reflections often
do not utilize theoretical ideas. In contrast, the high-level teachers also utilize sophisticated levels of reflection, but include more emphasis on theoretical explanations. Oddly, mid-high-level teachers refer to theory, yet do not articulate more sophisticated reflections, such as comments considered confronting or restructuring, to the same degree as do the teachers who are less effective in the classroom or as the two highly effective teachers. While the five levels of reflection provide insight into how the teachers reflect, to address research question one fully, details concerning what teachers reflect on is provided.

A broad look at the focus of teachers' reflections in Table 5 reveals that all teachers spend a considerable amount of their reflections thinking through curricular issues, such as their activities, strategies, assessments, and objectives. The next major focus for most teachers is that of the teacher. This category includes teaching behaviors such as questioning, wait time, and responding, in addition to teachers' feelings, motivation, and understanding. Teachers reflect on their working conditions, such as the time they have to teach, their interactions with parents, extra duties, and job security.

Table 5. Teachers' focus when reflecting on lesson, reported as percentages.

<table>
<thead>
<tr>
<th>Implementation Category</th>
<th>Name</th>
<th>Background</th>
<th>Classroom Management</th>
<th>Curricular Planning and Materials</th>
<th>Teacher</th>
<th>School Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Jill</td>
<td>3</td>
<td>15</td>
<td>41</td>
<td>27</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Lois</td>
<td>7</td>
<td>13</td>
<td>50</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Kelly</td>
<td>6</td>
<td>7</td>
<td>57</td>
<td>22</td>
<td>9</td>
</tr>
<tr>
<td>Mid-Low</td>
<td>Cora</td>
<td>10</td>
<td>6</td>
<td>61</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Keith</td>
<td>14</td>
<td>7</td>
<td>39</td>
<td>28</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Linda</td>
<td>2</td>
<td>4</td>
<td>48</td>
<td>20</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Becky</td>
<td>9</td>
<td>11</td>
<td>49</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Alex</td>
<td>6</td>
<td>57</td>
<td>57</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>Mid-High</td>
<td>Kay</td>
<td>4</td>
<td>13</td>
<td>54</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Nancy</td>
<td>7</td>
<td>15</td>
<td>48</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Tricia</td>
<td>6</td>
<td>7</td>
<td>50</td>
<td>27</td>
<td>10</td>
</tr>
<tr>
<td>High</td>
<td>Brady</td>
<td>5</td>
<td>4</td>
<td>59</td>
<td>27</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Chris</td>
<td>10</td>
<td>2</td>
<td>65</td>
<td>17</td>
<td>6</td>
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</tbody>
</table>

Note. For each teacher, the percentage reported here is the number of times each topic for reflection was coded divided by the total number of coded reflections for that teacher, multiplied by 100%.
Additionally, they consider the students' behavior and classroom management in their room. Interestingly, both high-level teachers reflect least about their classroom management or school culture. Teachers also consider their students' backgrounds. Notably one mid-low teacher did not consider his students' backgrounds at all during his lesson reflections.

An expansive look at what teachers' reflect on provides some insight, but to consider fully the sophistication of teachers' reflections and assessments, a more detailed look is necessary. The remainder of this section seeks to explain the qualitative differences observed in teachers' reflections. Numbers alone are insufficient to convey the distinctions in the sophistication of teacher reflection. For example, two teachers can both confront curriculum, yet do so using qualitatively different levels of sophistication. The qualitative differences are communicated in a list form. Following the list of findings, each finding is further described with supporting evidence from interview transcripts.

List of Qualitative Findings

Finding 1: When low-implementation teachers exhibit high-levels of reflection, they are focused on personal issues of student behaviors and classroom management.

Finding 2: Mid-level implementation teachers desire a high degree of control in their classrooms.

Finding 3: High-level teachers confront the classroom management strategies they see colleagues use.

Finding 4: High-level teachers articulate the importance for students to make decisions and exhibit responsibility.

Finding 5: Most teachers refer to students' interests, but less effective teachers more frequently refer to affective reactions of students.

Finding 6: More effective teachers discuss students' prior knowledge, interests, and backgrounds with more detail and deeper levels of reflection.

Finding 7: Only those teachers exhibiting more effective teaching articulated theoretical explanations pertaining to curricular decisions.

Finding 8: While teachers at all implementation levels reflected on their curriculum in ways considered "confronting" or "restructuring", the high-level teachers did so more frequently and with a greater concern for students' interests and students' conceptual understanding.

Finding 8a: Teachers exhibiting low-level implementation depend on outside authorities and sources to plan lessons.
Finding 8b: Mid-level teachers consider the needs of their students and, at times convey they are willing to teach in a flexible manner, shifting instruction as students’ learning requires. However, mid-level teachers do not articulate the same degree of flexibility and thoughtful considerations of curriculum as the most effective teachers in this study.

Finding 8c: The most effective teachers thoughtfully consider their students’ backgrounds, interests, and academic needs to modify the curriculum, when needed, to promote conceptual understanding better.

Finding 9: Teachers demonstrating the most effective instruction explicitly utilized theoretical knowledge when reflecting on their use of lesson activities, strategies, and materials.

Finding 10: Teachers at all implementation levels reflect about their lesson activities, materials, and strategies in ways considered “confronting” or “restructuring,” but the nature of their comments differs markedly.

Finding 10a: Low-level teachers perceive the activities and strategies in their lessons are not the most effective, yet they struggle to articulate workable solutions.

Finding 10b: Mid-level teachers modify specific aspects of their lessons so students better attain the objectives of the lesson.

Finding 10c: High-level teachers confront activities and strategies that do not promote meaningful learning.

Finding 10d: High-level teachers articulate a vision for instruction and consider students’ interests and understanding to propose new directions for instruction.

Finding 11: Teachers at high and mid-levels of effective instruction are more likely to utilize theoretical knowledge to explain their assessments of students’ understanding.

Finding 12: Teachers who are more effective seek formative and individualized assessments, and question the validity of current assessments.

Finding 13: Only those teachers exhibiting the most effective instruction reflected on their teaching behaviors referring to theoretical knowledge.

Finding 14: Teachers at all levels of instruction identify problems and articulate solutions concerning their teacher behaviors, however, the content of these reflections differs with teaching effectiveness.

Finding 14a: High-level teachers reflect on how specific teaching behaviors help students to think more deeply.

Finding 14b: Teachers at the low and mid-levels of implementation focus on giving directions and explanations clearly.
Finding 14c: When mid and low-level teachers confront their teaching behaviors, they often do so in ways that are not as effective for improving practice.

Finding 15: Lower level teachers focus more on how teaching and their students make them feel, while more effective teachers place more importance on how they think about their students and teaching, in general.

Finding 15a: Mid and low-level teachers express many feelings concerning teaching; however, low-level teachers express more negative feelings.

Finding 15b: High-level teachers are driven by past educational experiences, personal interest, and passion.

Finding 15c: High-level teachers articulate sound teaching rationales.

Finding 16: Almost all teachers in this study confront aspects associated with their school’s culture.

In the section that follows, each finding will be described in further detail, including supporting evidence from interview transcripts and observations. Quotations are referenced by their location within the computer software program, ATLAS.ti. The teacher’s pseudonym is followed by the primary document number and paragraph number, separated by a colon, for instance, Jill (5:122) indicates that the quotation by Jill can be found in the 5th document in ATLAS.ti and in the paragraph numbered 122 of that document.

Finding 1: When low-implementation teachers exhibit high-levels of reflection, they are focused on personal issues of student behaviors and classroom management.

As Table 6 demonstrates, all teachers rated at the low-level of effective instruction made statements that were considered to be confronting or restructuring, and these statements were exclusively focused on classroom management. Generally, the low-level teachers in this study struggled to keep their students on-task during their lessons. Consequently, their reflections are filled with questions and concerns about how to manage their classrooms. These teachers readily admit they spend most of their time thinking about student behavior. For example, Jill states, “I’m often, maybe more than reflecting on how I teach, is maybe how I am dealing with the behaviors” (Jill, 12:137). Further, the questions teachers ask about their management often indicate a lack of knowledge about why students were off-task during the lesson:

Was I as firm as I should have been? (Jill, 12:139)
Was I consistent with this or that? (Jill, 12:140)
How much do I just keep raising my voice or you know standing there waiting there forever. Because I could wait all day for them to be quiet. Or do I just let it go and hope that the learning falls into place where it needs to. (Lois, 2:76)

I go home and think about that. What went wrong? Was it something I said? What was it? (Kelly, 5:72)

Behavior management is still not a smooth routine for these teachers and they spend a great deal of their time questioning and thinking through classroom behavior situations.

<table>
<thead>
<tr>
<th>Implementation Category</th>
<th>Name</th>
<th>Describe</th>
<th>Explain</th>
<th>Theorize</th>
<th>Confront</th>
<th>Restructure</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Mid-High</td>
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<td>High</td>
<td>Brady</td>
<td>2</td>
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<td>Chris</td>
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Note. Each number represents the number of times within the teacher’s interview the teacher reflected on the topics of student behavior or classroom management.

Low-level teachers spend much time seeking behavior management techniques that have worked for other teachers. For instance, even though Lois began her teaching career opposed to rewards, as she struggled to gain control of her classroom, she followed the advice of a colleague and implemented a reward system. Additionally, she tried other strategies to improve the student behavior in her room as she describes here:

We brainstormed together and it was their idea to come up with a bell to get their attention and it still doesn’t always work. … Cause for a long time I had round
tables. I had to beg, borrow, and steal to get these. With round tables, first of all, they took up so much space and ... I finally got desks which was nice because part of the problem was half of their backs were to me and I'm never in one spot in the room, but at least this way I can rearrange as I need to and move certain kids around where they work best. Whereas with those tables I didn't have that option. So those were a couple of things I've done to change that. Going with the stickers, the bell and then the desks. They've all kind of helped. (Lois, 2:82)

Jill also describes her implementation of a new behavior management strategy. She said, "This is the first week we've done the stop light, but I was realizing without it it was hard for me to be consistent. Now, it is helping me be a little more consistent with having some set consequences and treating the students the same. Not that I'm there yet, but it helps" (Jill, 12:141). These teachers keep looking for the strategies that work and find after a few weeks of implementation that they need to try something new. Rather than consider the fundamental factors impacting student disengagement and off-task behavior, they work diligently to produce a short-term solution for the problems they face in their classrooms. Despite these efforts, they seem unable to effectively and consistently manage their classrooms using the short-term solutions.

**Finding 2: Mid-level implementation teachers desire a high degree of control in their classrooms.**

Even though teachers implementing moderately engaging and effective lessons often demonstrated more effective use of classroom management techniques, they still spent a considerable amount of time thinking about and discussing student behavior. The teachers in this category seek to perfect their classroom management skills. Through reflection on transitions, directions, and the focus of the lesson, these teachers look to increase the amount of time spent teaching, referred to by Nancy as "instructional density." The teachers in this category often gauge their effectiveness by their classroom management strategies.

Even though the mid-level teachers do not often reflect on students’ behavior in a confronting or restructuring manner, as Table 6 shows, they do describe and explain their classroom management techniques with great clarity and detail. Alex provides an example:

I was giving some dollars to a guy. He's having a hard time. He's pretty good at math, but he'd rather just write numbers and not even care what we are doing. So, I'm trying to get him motivated to participate in the class and raise his hand without just saying answers or. Almost the second class, I don't know if you noticed, there was a little more focus on rewarding the hands up, who is doing it appropriately. (Alex, 6:15)

As middle level teachers describe and explain their classroom management strategies, it becomes apparent that *they view classroom management and effective teaching as separate acts.* Strategies are
in place to produce the desired student behavior—raising hands, getting in line, obeying class rules, etc. Not once did a low- or mid-level teacher discuss classroom management within the “context of student learning.” Mid-level teachers discuss classroom management strategies and teaching strategies separately. These teachers did not convey that the two could be a single entity. Further, mid-level teachers did not articulate root causes of students’ behavior. Interestingly, these teachers are often utilizing strategies similar to those used by the struggling teachers described earlier. The difference is that mid-level teachers know how to make their management strategies work. Through the use of control, routines, and procedures, somehow these teachers have found a way to provide the beginning elements of effective instruction for their students.

The mid-level teachers articulate a need to control their students’ behavior. Alex explained that it “wasn’t a set goal going into [the lesson] but that what was going through my head for a lot of that second lesson is [sic], ‘How can I control these [students]?”’ (Alex, 6:16). Tricia also articulates her need for control in the classroom. She says, “I kind of am a person who likes to know exactly where we are going. I pretty much create everything before I start teaching it because I want to know exactly what we are going to be doing” (Tricia, 3:105). While this quotation describes her approach to lesson planning and implementation, it also depicts inflexibility and a sense of ridgedness. During her reflection on the lesson, Tricia recalled how she told her students, “Stop opening your desk. And put your pencil down” (Tricia, 3:14). This need for control can manifest itself in rather subtle ways. For instance, Nancy explains where she picked up some of her classroom management ideas, “And I got a lot of things too from that book, The Essential 55 Rules. ... I just took 40 of them that I liked and kind of combined some. Like one rule is Carpe Diem. I can kind of stick that in with something else” (Nancy, 11:96). Nancy’s students have 40 rules to follow. This alone demonstrates a tendency to want to micromanage students’ classroom behavior.

**Finding 3:** High-level teachers confront the classroom management strategies they see colleagues use.

As shown in Table 6, several low and mid-level teachers reflect a great deal on their implementation of classroom management strategies, while high-level teachers seem rather uninterested in classroom management strategies. Interestingly, the high-level teachers will confront what they see other teachers doing in their classrooms. For example, Brady confronts the use of the stop light strategy, where individual cards with student names are positioned at the green light at the beginning of the day. As behavior problems arise, the teacher may ask students to move their card from green to yellow, then from yellow to red. At each light, consequences result. Brady says:
You won’t hear me say [pull a card] because I’ll say something like, “Think about what you are doing.” That’s my response. “Think about what you are doing. Think about what you are doing and what we are doing and how does that not match.” You know what I mean? Isn’t that, that’s what I really want them to end up doing. Not pull a card. (laugh) How real is that? It’s not! (Brady, 8:107)

Furthermore, Brady confronts other teachers’ use of ineffective praise, reward systems, and other extrinsic reinforcements:

I told them right from the get go. Don’t expect to hear from me, “Great Job” or I’m not going to put stickers on your papers or I’m not going to hand treats out because you did something right. One, that’s not fair to someone that’s not doing it right. Maybe they can’t do it right. Second of all, we can have the candy, we can have the stickers but I’m not just going to give it to you for that reason. I’ll just give it to you because I like you. Isn’t that humanity? Isn’t that what we really should be teaching kids? Not do this and get that? I really think that is the problem with society as a whole. We are so indulgent—getting things right away and doing it for the wrong reason that we never really think things through anymore. (Brady, 8:99)

Brady articulates quite clearly that he wants his students to understand why they are doing things. He wants them to have a rationale for everything that they do. He also wants them to develop intrinsic motivation, rather than an addiction to extrinsic reinforcements. He is not chasing after the magic strategy that will solve all behavior problems in his classroom. Rather, he is teaching his students how to behave and why they should behave that way. His goal is to have students understand and learn how to be responsible and respectful students and to behave this way because they understand the need to.

Finding 4: High-level teachers articulate the importance for students to make decisions and exhibit responsibility.

Unlike the low-level teachers’ strong focus on classroom control and student behavior, high-level teachers articulated the need for less teacher control in the classroom. Importantly, neither teacher advocates a kind of chaos in teaching. In high-level teachers’ classrooms, students obeyed classroom rules and routines. However, the teachers explicitly valued students’ thoughts, used students’ ideas, and created opportunities for students to make important decisions, teach other students, and perform meaningful duties to promote confident learners who take ownership of their classroom and their own learning. Both teachers made classroom decisions deliberately to produce environments conducive for meaningful learning. Thus, their focus was on student learning, not student behavior. For example, Chris discusses a particular classroom scenario and his thought processes as he tried to make an effective classroom decision:
I think it was just, it was somewhat overwhelming to try and control everything. And when you try to control those things—I mean if I had sat there today and told Jackson, “I know you can do this, but I’m going to do this.” Then I’m shutting him out and he is going to respond differently. He is going to be upset and he is not going to know why I did that. So I’m creating new problems for myself. Would he have started to act out? Would he have lost all interest and started doing something else at carpet? And I can use them as a resource not only for the information and background they can bring. But just by letting him stand up front with me, probably three or four kids who weren’t on task now are curious. “What’s going on?” Their focus has changed. Cause they want to see, “Why is Jackson up there? What’s Jackson getting to do?” If I had sat up there—and I was losing them because I couldn’t do it. It to me it is another resource. Its helping me. And not that its all about me, its helping them. I just think having fallen in the past and having gone through issues where maybe I’ve lost the whole class I’ve learned from that and I’ve just had to look at things differently. How could I improve that? That was a perfect example today. (Chris, 9:50)

Chris explains how management issues are intertwined with effective teaching. As he has given up the notion that he, the teacher, must control every aspect of instruction, he has, consequently, opened doors for his students to help teach each other and work collaboratively towards meaningful learning goals. By bringing one student to the front of the room to help explain how to make a paper airplane, Chris not only promoted student goals, he also simultaneously managed student behavior. For these teachers effective teaching is synonymous with effective management. From the quotation above, it is evident that Chris’s reaction in this situation was a deliberate and thoughtful teacher decision. He anticipated possible student reactions to his decisions before acting and chose the route that would, in his mind, be the most effective one.

Importantly, the high-level teachers see effective instruction happening simultaneously with effective management. For instance, giving students choices, engaging students in authentic inquiry experiences, and utilizing students’ interests are all part of effective instruction and assist in behavior management. Brady confronts the kind of instruction he sees in other classrooms at his school and explains how ineffective instruction leads to behavior problems, “I don’t think I really have discipline problems, partly because there’s choice and what I’m doing is not this [he holds up a worksheet]” (Brady, 8:137). Very clearly, the high-level teachers articulate their efforts to provide meaningful experiences that engage students. Because they address the learning needs of students in a productive way, classroom management is not an explicit focus for their teaching concerns.

**Finding 5:** Most teachers refer to students’ interests, but less effective teachers more frequently refer to affective reactions of students.
As Table 7 indicates, most teachers in this study described and explained their students' backgrounds, feelings, and interests. Generally, the low-level and mid-low-level teachers did not provide as much detail about their students and often focused on the affective reaction of the students to the lesson. The following quotations demonstrate focus on student affect:

I don’t want them to be scared of me. (Becky, 4:39)
I’m so glad when kids leave excited about math. And I felt they left excited about math today, so that’s always a success story. (Cora, 10:21)
I think visually with these kids as we were sitting and reading and they were able to see the pictures, you know, they love to read out of the books and gain information like that. (Kelly, 5:12)

These quotations exemplify teachers’ focus on how students feel. Teachers often refer to how they make decisions that students will find fun or interesting. These same teachers additionally use student interest and enthusiasm as an indicator of lesson and teaching effectiveness.

In contrast, more effective teachers often articulate how they make decisions to promote greater student confidence or motivation. For instance, Brady said, “I really feel like their confidence, these are all confident learners now. Even my low kids…” (Brady, 8:108). Chris also comments, “If we can build on that than these kids’ confidence isn’t just ongoing to be good in science, they can apply that to all things in their life. The more likely you are going to take risk, the more willing you will be to learn independently” (Chris, 9:59). For the high-level teachers, student enthusiasm or student interest is not the end purpose. They clearly utilize student interest and engagement to promote noble goals such as student confidence, independence, and responsibility, and strive to integrate such motivation to further promote student learning.

**Finding 6:** More effective teachers discuss students’ prior knowledge, interests, and backgrounds with more detail and deeper levels of reflection.

Teachers who exhibited more effective instruction made more specific statements about their students’ backgrounds, interests, and capabilities. Furthermore, these teachers also made explicit and detailed references to the background knowledge students bring with them. Nancy discussed her students’ prior knowledge of the solar system:

It is really phenomenal ... how some kids can know so little and some kids can already have a pretty good foundation of what it is. I mean the before pictures, some of them are just striking. One last year, it was all black and it had a little tiny Earth. But it didn’t even have the name Earth, it just said that’s where we live. And then this one girl was just, just phenomenal, just so bright. It was unbelievable. She knew
that there's some gas planets, there's rock planets, but gas planets have most of the moons. ... Just went into complete detail about it. (Nancy, 11:61)

As Table 7 shows, the most effective teachers also use more sophisticated levels of reflection when reflecting on their students' backgrounds, interests, abilities, and affect. Brady referred to developmental learning theory and Chris spoke about constructivism to help explain the backgrounds and characteristics of their elementary students. Additionally, both teachers conveyed ways in which they did not effectively utilize students' backgrounds, knowledge, or abilities and thus failed to promote learning for particular students. For instance, Chris conveyed that he did not thoroughly consider the abilities of one student when planning his lesson:

Sarah had problems today. Sarah comes with different challenges than other students and when I planned this lesson I wasn’t thinking. I was thinking Kindergarteners—What can kindergarteners do? (Chris, 9:67)

Table 7. Teachers' reflection concerning students' backgrounds, interests, and affect.

<table>
<thead>
<tr>
<th>Implementation</th>
<th>Category</th>
<th>Name</th>
<th>Describe</th>
<th>Explain</th>
<th>Theorize</th>
<th>Confront</th>
<th>Restructure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<td>3</td>
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</tbody>
</table>

Note. Each number represents the number of times within the teacher's interview the teacher reflected on the topic of students' background, interests, and affect.

Chris conveys that he did not consider Sarah’s particular situation and the special needs she requires. Thus for Sarah, the planned lesson was not as productive or successful as it could have been.
Chris also articulates his attempts to make science more accessible for his English Language Learners (ELLs). He says:

So what they get from this is hugely different from the English language speakers. So I see great value in these kids demonstrating for one another so it doesn’t always have to be auditory. We don’t do a lot of reading but it is much more visual and much more hands-on. So even though we may not speak the same language, you can see what I’m doing — how I’m moving a propeller and if I provide that model for you then you can do it. We don’t have to speak the same language. (Chris, 9:12)

Chris invests time to consider ways to restructure his lesson to better serve his students. Making lessons accessible for special needs students and English Language Learners is not an easy task. The reflections Chris and Brady articulate show they reflect on difficult educational issues.

Interestingly, Keith, a mid-low teacher, also discusses a way to restructure his teaching to be more flexible to his students’ backgrounds. Keith noticed that when his students understand a math concept, they are then easily bored and frustrated. Keith discussed how he moves on more quickly to ease the frustration his students feel when the curriculum moves too slowly (Keith, 16:84). While Keith has proposed a solution to a problem he faces, this solution does not exhibit the same depth of thought as seen with the high-level teachers.

**Finding 7:** Only those teachers exhibiting more effective teaching articulated theoretical explanations pertaining to curricular decisions.

As demonstrated in Table 8, only those teachers exhibiting more effective reform-based teaching articulated explanations of curricular choices in ways congruent with educational theory. These teachers used ideas consistent with developmental learning theory, social learning theory, constructivism, and multiple intelligence theory. Additionally, one teacher spoke of ideas consistent with literature on the learning cycle to explain curricular choices. For instance, Chris, a high-level teacher, used ideas consistent with social learning theory as he discussed his use of the FOSS curriculum:

I think it’s [the FOSS curriculum] pretty solid. And my rationale there is because it is a lot of hands on for the kids. They are actually doing things and they are learning from one another. So we’ve got that social component. ... To have a little discussion at the beginning, set a challenge for them, let them do some experimenting, then we share those ideas together and try to process through just with questioning. (Chris, 9:7)

Tricia, a mid-high-level teacher, explains her rationale for a T-chart that she uses to teach her 3rd grade students how to interact with each other in small groups:
I've just found that kids don't know how to talk to each other yet and they need, they just need that [the chart and explicit instruction on group communication]. So I think I probably learned from making the mistake of just saying, "Talk to each other." And it doesn't [work] cause the reading groups I had before at the beginning of the year. I think I tried to give them a little bit of guidance but it wasn't enough. (Tricia, 3:79)

Tricia articulates that 3rd grade children do not yet know how to interact productively with each other in small groups, therefore, she incorporates strategies to teach social and communication skills. This rationale is consistent with the goal of student communication. From Tricia's quotation it is not clear whether she is applying social learning theory or if she has learned the importance of small group instruction through trial and error. Thus, the coding of this category errors on the side of conservatism, giving the teacher credit that aspects of theoretical knowledge are used to make these curricular decisions.

Finding 8: While teachers at all implementation levels reflected on their curriculum in ways considered confronting or restructuring, the high-level teachers did so more frequently and with a greater concern for students' interests and students' conceptual understanding.

Finding 8a: Teachers exhibiting low-level implementation depend on outside authorities and sources to plan lessons.

The low-level teachers demonstrate dependence on outside authorities, such as their district standards, district objectives, curricular materials, and on "what works" for other colleagues. They use these sources of information and expect that what they are given is accurate and will work in their classrooms. The articulations they make concerning their planning is often stilted and rigid as they seek to follow the direction of outside sources.

Standards and objectives. Low-level teachers want detailed objectives and standards. They describe the objectives of lessons in terms of the facts they want students to learn, which contradicts the reform movement emphasis on big ideas and conceptual understanding. Notably, the teachers in this group do not articulate conceptual ideas or refer to big ideas that link their curriculum together. Kelly gives a typical example of a fact-based objective:

Putting them in order and actually my goal is that they can remember a fact about each planet. So whether it's you know something in the description, its the fifth largest or its the smallest or the rings. ... if they can remember one fact about each and if they can start remembering the order I think that is the important part. (Kelly, 5:40)
These teachers also describe the district standards and how their lessons meet them. In one instance, Lois confronts her district standards:

The district is just very vague. I think in grade level expectations for science and social studies. We only have like, we have like four things we are supposed to teach in science this year and then four social studies topics. Which really gives us a lot of time. They are very general. They don’t really say much about anything. (Lois, 2:9)

Importantly, Lois does not confront the contents of the standards, but instead she confronts the fact that she doesn’t have enough information. She has been given a lot of time to teach a topic in science and she is unsure how to utilize that amount of time. I infer that her district is making strides towards a more inquiry-based approach towards the science curriculum. Having fewer science standards in the elementary grades is consistent with the National Science Education Standards. However, Lois, in her overwhelmed state, is seeking advice and wants more details on what to teach her students.

Curricular planning. Low-level teachers also demonstrate a tendency to depend on outside sources as they plan units and lessons. First, low-level teachers have an obsession with finding the right activity that “works.” Therefore, lesson planning consists of activity hunting. Kelly, for instance, describes her planning:

I don’t do much planning far ahead. Like I have an idea of what we are going to do but I really try to figure out okay, this is what we did today. Okay, the kids you know looking you know did they meet my objective? If so, then what is the next activity that’s going to lead on with that. (Kelly, 5:26)

The nature of planning lessons that go from activity to activity with little emphasis on conceptual development is highly consistent with activitymania (Moscovici & Nelson, 1998). Jill further explains how she teaches her students how to do an activity individually so she can then have them redo the activities in small groups. She likes the activities that are hands-on because she believes students learn more if the activity is hands-on (Jill, 13:42). Low-level teachers describe curriculum as either “teacher-centered” or “student-centered,” yet they do not give specific details that indicate if they understand what this jargon means. Of “student-centered instruction,” Jill says, “I could step out of the room and the room would run just fine. I like that about it because they are the ones doing the learning. And I would like that to be more my math and science but I am just not there yet” (Jill, 12:33). Unfortunately such phrases reveal that low-level teachers perceive “student-centered” instruction is activity-oriented and doesn’t need a teacher for students to learn accurate concepts.

The low-level teachers also depend on their curricular materials to help them plan lessons. As Jill explains:

You know like cause it, like the Kathy Richardson book has it in it. … has the planning guide and it has like a calendar so when I go to make my lesson plans for
March I’ll look and see what level my kindergarten students should be at in February/March. (Jill, 13:65)

Rather than plan lessons based on where her students are in their understanding and what would be the next concept that needs to be learned to move their understanding progressively forward, Jill relies on the planning timeline in the resource materials. At other times, teachers in this category do convey they use information from students to plan future lessons.

Table 8. Teachers’ reflection concerning curricular decisions and lesson planning.

<table>
<thead>
<tr>
<th>Implementation Category</th>
<th>Name</th>
<th>Describe</th>
<th>Explain</th>
<th>Theorize</th>
<th>Confront</th>
<th>Restructure</th>
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*Note.* Each number represents the number of times within the teacher’s interview the teacher reflected on the topics of curriculum, big ideas, district standards, objectives, and planning.

However, rather than utilize their perception of student understanding to plan future lessons, teachers utilize students’ learning preferences to find or create suitable activities. For instance, Kelly says, “The majority of these kids really enjoy nonfiction—just reading nonfiction books. That was part of my planning, too. Knowing that they enjoy sitting and you know looking at the science book” (Kelly, 5:19). While these teachers may in fact use student understanding to plan lessons, they do not clearly articulate this. Further, what they do articulate seems to focus on the teaching of activities and planning based on outside resources and student enjoyment.
Lack of curricular resources. Another indicator that the low-level teachers depend on curricular resources is their complaint that at some point in their teaching career they did not have the resources they needed to teach. Jill and Kelly both discuss how they struggled to plan and teach for particular curricular areas because they did not have the curricular resources they felt they needed. They had the district standards, but no textbook or other resources to teach from. Jill explains:

We have our standards but we don’t have, like for literacy I have my Kindergarten Place and for health I have a health text with posters and just ideas of what to do. And for math I just don’t have a lot and so it is hard when you don’t have the help. (Jill, 12:90)

Further, Lois and Cora both discuss how they perceive colleagues are not willing to give them ideas or activities. They complain about the lack of curricular support they receive from colleagues.

Finding 8b: Mid-level teachers consider the needs of their students and, at times convey they are willing to teach in a flexible manner, shifting instruction as students’ learning requires. Yet, mid-level teachers do not articulate the same degree of flexibility and thoughtful considerations of curriculum as the most effective teachers in this study.

Mid-level teachers articulate reflections that demonstrate a more concentrated emphasis on individual students’ needs and how their planning and instruction might need to change in order to meet the needs of their students. Additionally, the mid-high-level teachers create some big ideas for units of instruction and articulate a sense of flexibility so that their students’ interests and ideas are accounted for within lesson discussions. The following paragraphs give more detail to this group of teachers and their reflections concerning the planning and organization of units and lessons.

Big ideas. Mid-high-level teachers create “big ideas”—an overarching concept—for their units of instruction. Some examples are:

For math, I just want them to know that numbers follow a pattern. You know, math, that’s all math is—a pattern. You just have to find the pattern and it’s not hard. (Nancy, 11:72)

And with science, I want them to know that science is everywhere. It is in the news, it is in the newspapers. It’s every single thing we do. (Nancy, 11:79)

Just getting them thinking that scientific way where you think more than just the obvious. (Kay, 14:3)

While these big ideas certainly go beyond lesson objectives and district standards, the general scope of the big ideas is vague. The big ideas stated by the mid-high-level teachers do not appear to foster curricular changes. Nor does there seem to be a consistent attempt to teach the stated big idea. One
might infer that the mid-high-level teachers have not invested as much thought into the connections between units and the big ideas promoted through units of instruction. Yet, these big ideas convey that the mid-high teachers consider more than just their district’s standards and objectives when planning lessons.

*Meeting students’ needs.* The mid-level teachers discuss how they attend to the needs of their low and high learners. They very clearly recognize their low, middle, and high learners and demonstrate uncertainty in how to effectively teach when differences between students can be so vast. For instance, Linda says:

> Um. I mean there’s really just that struggle of. I know this is a universal struggle, its not limited to first year teachers or second year teachers. You always have some kids that are here and some kids that are here and then you have this cluster in the middle that you are really trying to teach to. And trying to get to those other kids is just so hard and um I wouldn’t say I have done a good job of offering enrichment at all. I would say that I have done a really poor job of that. (Linda, 1:48)

Often mid-level teachers describe the meeting of students’ individual needs as something extra that occurs beyond the bounds of the classroom. For instance, volunteers may use flash cards to help those students who need extra help. Or higher students may be given an enrichment assignment, extra homework, or spend extra time working with classroom volunteers. The following quotation exemplifies the mid-level teachers’ attitude towards most differentiation—it occurs outside the scheduled class time:

> But its just its just like there’s so much to overcome that I wouldn’t say it was hugely successful. You still have to get kids there and the ones that need it the most don’t always show. I really try to be available during lunch time or before school or after school. But again people are not always asking for help and even if you are offering it they aren’t showing. That is probably the biggest thing. (Linda, 1:50)

The conflict mid-level teachers face concerning differentiation is further evidence that they are beginning to think flexibly about teaching and learning, yet they struggle to know how to implement this effectively. Hence, we see remnants of rigid thinking, namely, that students’ individual needs can be better met by spending extra time before or after school.

One way mid-level teachers perceive they are meeting all students’ needs is through meeting different “learning styles.” Low-level teachers also talk about “learning styles,” but often did so because it was more fun for students. The mid-level teachers articulate they use students’ learning preferences because they feel students will learn better through these methods:

> I think that there are just so many different types of learners, even like with today’s lesson with some of them getting things. Myself included. I am a very visual person. And so sometimes you can’t understand something unless you are physically doing
it yourself. Some kids just need to see it. Some kids need to do it. Some kids need to hear it. So, I think by doing as many different things as you can you are more likely to hit more kids and get them to know what you are talking about. (Kay, 15:58)

*Flexibility in teaching.* Mid-level teachers plan lessons with district standards and objectives in mind. Interestingly, Nancy, the highest level teacher in this group, discusses how her objectives changed due to her response to what students were saying in the discussion. Even though she entered the lesson with a particular objective in mind, as her students took the discussion in a different direction, she shifted gears in order to use and value their ideas. Thus, the mid-high-level teachers demonstrate an awareness of what their students need, and work within lessons to adjust and respond to the learning occurring within their classrooms. Additionally, Kay also articulates her spontaneity within lessons:

I’ll a lot of times the things to be honest, the things that come to me on the spot end up being the things that help the kids the most. Like all of a sudden I’ll be like, “Alright. We are going to get this out.” Then, because you just have to go with what it seems like they are needing. (Kay, 15:17)

**Finding 8c:** The most effective teachers thoughtfully consider their students’ backgrounds, interests, and academic needs to modify the curriculum, when needed, to promote conceptual understanding better.

For the high-level teachers, the curriculum does not provide the directions for effective learning. It does provide a guide to follow, but much thought, creative energy, and flexibility goes into the planning of units so that district standards are blended with students’ prior experiences, needs, interests, and understanding. The high-level teachers speak of cultivating student learning. This cultivation begins on day one and continues through until the last day of school. The teachers create visionary big ideas that focus teaching and learning. They also create flexible lessons that shift with the demands of students’ understandings, interests, and individual needs. All of this helps students increase their conceptual understanding.

*Create big ideas.* High-level teachers discuss the importance of big ideas in their science and math curricula. For instance, within his science curriculum, Brady utilizes specific big ideas, such as: 1) living things have characteristics; and 2) living things need things in their environment to survive and if you change that they don’t survive (Brady, 8:153). Further, Brady seeks to find the big ideas that bisect subjects within his second grade curriculum:

I call it Discovery Museum. I don’t say it is social studies or science. I call it Discovery Museum. We try to have a representation of everything we have learned through the year. And so just recently figured that out. And that it is change. It is all about change. We change our land. We change. Our countries change through
immigration. Because we do all those things. Change in rocks. Change in the earth. Change in habitats. Change in the environment. Change in matter. I think all those things. Now I’ve understood the big idea is really I want them to understand that things change. So now I’ve kind of shifted and that is always a little focus I have throughout that kind of underpins everything. (Brady, 8:65)

Additionally, Brady describes how he uses past big ideas and past learning to teach new ideas. The power of big ideas is they help students and teachers see the connections between the smaller concepts that are being learned. As high-level teachers discuss big ideas, it becomes clear their curricular focus is on conceptual understanding rather than the learning of disconnected facts.

Confront district standards. High-level teachers realize they must teach to the standards of their particular school district. Yet they criticize the curriculum standards when they see discrepancies between what their students need and what the district says they should learn. Further, they deeply consider the best paths to take in order to make the curriculum connect with the life experiences their students bring to school:

I’ve really struggled with like how do I set up experiences for them to really take what they already know and challenge that thinking so it grows into what they need to know based on the district standards. (Brady, 7:33)

Using similar thoughts, Chris confronts his district’s standards. He, like Brady, is concerned that the curriculum should match students’ prior experiences. However, Chris is not so sure that his district’s curriculum standards really address the backgrounds, needs, and interests of his urban elementary students:

I just look and see, are these the best choices that we are making for our kids? Sometimes I wonder—a district like ours, which is large, someone else is making decisions about what needs to be taught and how it is to be taught. So I often look at certain lessons and certain curriculums and just wonder, how is this applying to the urban life which these kids have? Cause some of the stuff we do, we want to give them as much exposure as possible, but I don’t know if we always honor where they are coming from. (Chris, 9:71)

Chris sees the discrepancy between where his students live, and their life experiences and realizes that what he provides for them is novel and well planned but doesn’t really connect with the urban life his students know as reality.

Foster student interest. One way high-level teachers seek to plan curriculum that will cultivate students’ learning is to utilize students’ experiences and interests in their education. For example, Chris has created a science library in one corner of his room. He is currently mapping out how he and all the teachers in his elementary school might utilize this science library to the fullest
extent, while promoting the interests students have in science. He sees this science library as a way to help alleviate the deficiencies he sees in the district curriculum:

Because what I’m giving or what I’m presenting to kids and hoping they are getting is what the district is saying is important to kids. But because the district says it’s important doesn’t necessarily mean it’s important to the individual. So, if they have an interest, why not build upon that? I mean we don’t want to close them out to science just because you’re a 4th grader and you don’t necessarily find pillbugs, electricity, or water interesting. If you have an interest in animals, or you’ve got an interest in inventions, I think we keep that science door open by supporting that interest. That’s kind of where I’m hoping that library will go, at some point. (Chris, 9:16)

As Chris discusses the science library, he describes the importance of cultivating students’ interests in science. In doing so, Chris describes some broad goals he has for his science students:

Because if we can build on that then these kids’ confidence isn’t just going to be good in science, they can apply that to all things in their life. The more likely you are going to take risk, the more willing you will be to learn independently. (Chris, 9:59)

Additionally, the high-level teachers describe ways they respond to students’ interests within lessons and how they allow students’ ideas, questions, and interests to direct the flow of inquiry.

Meet students’ needs. High-level teachers sought to meet all students’ needs throughout the curriculum and within each lesson. Meeting needs is not something done at recess, lunch, or by volunteers; it is an integral aspect of their instruction. For instance, Brady’s goal for his math unit on money is for the lower students to really understand how the money system works and for the higher-level students to not only understand the system but to also be able to thoroughly explain their thinking. Within this unit, he has considered how to differentiate lessons and the unit expectations so all students will be taking what they already know in math and applying that to the concept of money.

Brady goes on to articulate what he thinks about as he reflects on lessons and plans future lessons:

I’m really thinking about: How am I going to get them to think? How am I going to get them to expand this so everyone really understands it? Because if I just have them write something on the board how do I get them to really all have access to that? Or is it just going to be the high kids that understand that? (Brady, 8:85)

Similarly, Chris speaks of the reflection-in-action that occurs as he considers how to move all students forward in their scientific understandings:

Kind of on the fly I’m trying to adjust it to meet their needs. It wasn’t something you were privy to see today because both the 2nd grade classes were at different points. But had we done the propeller one for both of those they would have come up with completely different ideas of how to make that propeller go faster. And getting them to see that from one another and to pick up on it. I’m constantly trying to use what
they already know and have them not only share it with one another but to use it. So, it's a constant juggling act and it's not the same for each class. So I'm always thinking back to what they know and how can I get them a little bit farther along. And that doesn't always put them at the same place. (Chris, 9:10)

The kind of instruction both Brady and Chris refer to is planned, yet flexible enough to include not only students' interests but the needs that present themselves in the midst of the lesson as well. As they see students struggle, they immediately shift plans to address that concern. As students finish a task early, they immediately consider what that student can do to elaborate, explain, or use their understanding. They seek ways to keep all students engaged in learning throughout the entire lesson, regardless of ability.

The teachers in this group appear to be more concerned with having all children challenged, and for all children to progress in their learning throughout each lesson. There seems to be a more sophisticated emphasis placed on considering how to plan and structure lessons in a way that helps all students access information and learn concepts.

**Finding 9:** Teachers demonstrating the most effective instruction explicitly utilized theoretical knowledge when reflecting on their use of lesson activities, strategies, and materials.

Teachers must make countless decisions concerning the materials, strategies, and activities used in each lesson. Not surprising then, is the tendency of teachers to describe and explain the decisions they make on a daily basis. As shown in Table 9, all teachers, regardless of implementation level, exhibited the tendency to describe and explain their lesson choices. However, marked differences exist in what teachers discuss as the level of implementation increases. The participants who taught math and/or science more effectively also articulated theoretical explanations to justify their decisions concerning the materials, strategies, or activities of their lessons. While theoretical explanations were not articulated often, it is still distinctive that the only teachers who explicitly utilized theoretical knowledge bases were those who demonstrated the most effective classroom teaching.

Of the theoretical connections made, seven comments used ideas consistent with developmental learning theory, two were congruent with social learning theory, one spoke about constructivism, two referred to the idea of multiple intelligences, and one rationale made use of the nature of scientific inquiry. For instance, Becky, a mid-low-level teacher, explains why she had students use a meter stick during their science quiz:
I offered them the meter stick for the quiz this time because I think having that in front of them, they could look at it and see the millimeters and centimeters and so forth. ... I think it is good to have the concrete thing to go back to. (Becky, 4:13)

Becky draws from her knowledge of developmental learning theory to inform her decision regarding the use of concrete materials in her science classroom. Additionally, Tricia, a mid-high-level teacher, explained her use of a KWL chart in a manner consistent with social learning theory:

But having them talk to their neighbor first and maybe come up with questions together because some of them had to sit for a while and really think about what questions they had. And I think a lot of times, especially for kids this age, to verbalize it first and just start talking about it, they are able to generate those questions easier. (Tricia, 3:31)

The quotation by Tricia is consistent with theoretical ideas, however, how she came to understand these ideas cannot be determined from this quotation. Tricia may be applying research-based ideas or she may be learning from the results of trial and error. This quotation was coded as theorizing giving this teacher the benefit of the doubt and erring on the side of conservativism.

Finding 10: Teachers at all implementation levels reflect about their lesson activities, materials, and strategies in ways considered confronting or restructuring, but the nature of their comments differs markedly.

Finding 10a: Low-level teachers perceive the activities and strategies in their lessons are not the most effective, yet they struggle to articulate workable solutions.

As Table 9 shows, all low-level teachers articulate higher levels of reflection concerning their lessons’ activities and strategies. They confront lesson components with an organization and management focus. For instance, Jill, a low-level teacher, questions her practice, “Is the lesson interactive enough?” (Jill, 12:64) She also confronts her implementation of small groups and says, “I think that maybe the group was still too big” (Jill, 13:35). Further, Lois laments, “Oh, that wasn’t very worthwhile with our time to do” (Lois, 2:34). Such statements are indicative of an implementation focus. Low-level teachers perceive that what they are doing is not effective and they confront their lack of efficiency, organization, and management.

Additionally, as Table 9 shows, all low-level teachers seek to restructure their lessons’ activities or strategies. Unfortunately, low-level teachers struggle to propose workable solutions to the problems they face in their instruction. For instance, some solutions presented are vague, “Something I would change is to have the kids have the objects and have them first go through and
just explore with them" (Lois, 2:21). While exploration in science can be an effective strategy, exploration is certainly not effective in every instance. Lois proposes this "exploration" idea for most problems she faced. In her mind, as long as the students are active and exploring they will learn. Such vagueness, and even misconceptions of how children learn, will not help improve her classroom instruction.

At other times, low-level teachers proposed solutions that did not adequately address the problems faced. For instance, Kelly knew her lesson on the revolution of planets around the sun and the rotation of the planets on their axes was unsuccessful; however her solution was to find a Website that showed the "planets actually moving... because [she] think[s] that would be like the biggest, if they could actually see that" (Kelly, 5:11). Kelly does not consider the level of science content she is teaching and the appropriateness of this for 3rd grade students. In her mind, having them see and hear the same information in a different way should help them learn the material. Further, low-level teachers suggested teaching their lessons with fewer students, multiple activities, or better activities. In their specific cases, these solutions do not penetrate the underlying problems each teacher faced in her lessons.

**Finding 10b: Mid-level teachers modify specific aspects of their lessons so students better attain the objectives of the lesson.**

Teachers who demonstrate mid-level instruction consider efficiency and organization as they reflect on their lesson effectiveness. For instance, Kay said, "They were kind of getting stuck on one question so it was hard to keep them moving" (Kay, 14:16). Keith questions the repetition he noticed in his lesson. Comments such as these are still focused on lesson efficiency and organization, yet these comments indicate less concern than the confronting comments made by the lower level teachers.

Additionally, mid-level teachers confront their lessons in more sophisticated ways. For instance, Kay confronts what she read in her math curriculum and articulates why she changed the materials for the activity:

Because the suggestion in the book was just to use the five frame and see it using two different colored blocks. But, I figured that they would be more caught up on who had which cubes and which blocks and that they wouldn't see it so much as being two parts because they would just concentrate more on the pattern and how they arranged them. (Kay, 15:12)

Further, Tricia comments, "Sometimes I have to ask myself is it more important to get to everything or is it more important to spend a lot of quality chunks of time on certain things" (Tricia, 3:28). These
comments go beyond mere implementation. These teachers are beginning to question curriculum and traditional ways of teaching. They confront their teaching by considering the changes that need to be made in order to more positively impact students.

Mid-level teachers proposed workable solutions and looked to tweak specific items within their lessons so that students would better attain the objectives of the lesson. For example, Kay realized during her lesson that she needed to provide her students with manipulatives in order for her math activity to be successful for all her students. Additionally, Tricia mentioned that perhaps a think-pair-share would have helped her students to create questions. The solutions proposed were specific and feasible.

Table 9. Levels of teacher reflection concerning lesson materials, strategies, and activities.

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<tr>
<th>Implementation</th>
<th>Category</th>
<th>Name</th>
<th>Describe</th>
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Note. Each number represents the number of times within the teacher’s interview the teacher reflected on the topics of lesson materials, activities, or teaching strategies.

Finding 10c: High-level teachers confront activities and strategies that do not promote meaningful learning.
The high-level teachers articulate concern for students’ understanding as they confront their use of activities, strategies, and materials. They ask questions of their own practice that indicate they seek deep and meaningful change in their instruction. Chris says:

Then I also look at, Did I use strategies that help those kids retain anything? Or did my presentation only get them to participate? And there’s a big difference there. They can sit and they can participate and look like they are learning. I have to ask myself, did they? What did they take with them? (Chris, 9:8)

This question exemplifies the high-level teachers’ desire to keep growing and improving. Neither teacher is willing to settle for a well-managed classroom. Both want their students to leave their classroom more successful, understanding scientific ideas in a way that is relevant and meaningful for their lives. Such fine-tuning of effective practice is what leads to exemplary instruction.

Brady demonstrates a critical look at education more generally, as he critiques the activities colleagues implement. Brady questions:

But if I did, I want them to observe earthworms today and I want them to notice if there is a difference in their length if they constrict. So what? Why do they need to know that? Or I want them to have a race with their earthworms. These are just some of the things I saw out there as I was searching for things. So what? Why do I care if we have an earthworm race? (Brady, 8:71)

Brady confronts activities that, in his mind, have no purpose. They may be fun for students. They may be used by other teachers. They may demonstrate particular facts about earthworms. But the activities do not promote the learning of scientific concepts. They do not promote the kind of inquiry and learning that Brady strives to create in his classroom. Brady goes on to say:

I don’t have to do much more than explicitly teach in a way that is thought-provoking and gets kids to think and do what I am doing and be myself and not do foo-foo big things that are going to muddle learning. I mean that’s what those things do. THEY DO! If you do an art project with something it’s muddling their learning. They are getting, Oh, this art project is so much fun. And not that you can’t have fun learning, that’s the thing. I think it is a big misconception with teachers that it has to be cute and fun for learning to happen and that’s not true. (Brady, 8:76)

Brady confronts the “fun activity” syndrome that seems to be so prevalent in elementary school teaching. Most of the teachers in this study describe how they search for fun activities. They do not consider the purpose of the activity as much as whether the students will enjoy it. However, Brady seems to look at the purpose of what he is doing first, understanding that if the unit connects with students’ needs and interests, they will be engaged. He seeks to create experiences that make the learning clear for his students.
Finding 10d: High-level teachers articulate a vision for instruction and consider students’ interests and understanding to propose new directions for instruction.

Furthermore, the high-level teachers also restructured lessons utilizing a sense of vision for what could be possible. However, they looked beyond the lesson itself, to the curriculum, the students’ interests, and the students’ understanding to propose new and different directions of instruction. For instance, Brady is seeking ways he can “set up experiences for [students] to really take what they already know and challenge that thinking so it grows into what they need to know based on the district standards.” (Brady, 7:33). Additionally, Brady seeks to help everything he does in his classroom connect with what students already know. He looks for ways to apply several comprehension strategies throughout his lessons because it is powerful to “make a mental image when you are trying to solve a math problem” (Brady, 8:58). Further, Chris proposes changes in the curriculum that would better connect with the interests and backgrounds of his students. Thus, the high-level teachers are seeking to restructure their activities, strategies, and materials to better fit with students’ prior knowledge and students’ interests while still attaining the standards and direction set forth by their school districts.

Finding 11: Teachers at high and mid-levels of effective instruction are more likely to utilize theoretical knowledge to explain their assessments of students’ understanding.

As shown in Table 10, all teachers describe and explain students’ understanding and the assessments used to determine their understanding. However, only half the teachers in this study express more sophisticated levels of reflection. Teachers on the high and mid end of effective instruction are more likely to utilize theoretical knowledge to explain their assessments of students’ understanding. Three teachers, Brady, Kay, and Becky, spoke about constructivism, while Chris and Alex referred to literature sources to explain assessment. Jill, a low-level teacher, seems to be the one anomaly in this data set. In all three cases where she said something related to theoretical understanding, Jill used roughly the same phrase, “They would be developmentally ready for that” (Jill, 13:17). Additionally, she said:

I don’t have a great grasp, but um I found it interesting to see some kids put one more and knew exactly without counting how many they had where other kids had to count, 1, 2, 3, 4, 5, 6. So I can see the gaps as far as developmentally where they are in math. (Jill, 13:7)

In Jill’s math lesson she utilized Piagetian tasks to assess students’ mathematical understanding. Therefore, it seems reasonable that she would make use of developmental learning theory as she explained students’ understanding revealed through these assessments.
Finding 12: Teachers who are more effective seek more formative and individualized assessments, and question the validity of current assessments.

The qualitative differences between teachers' reflections coded as “confronting” and “restructuring” are subtle. Overall, the distinctions between these categories are not independent as teachers become more effective in their reform-based teaching practices. However, as teaching becomes more effective, a gradual increase in sophistication occurs, characterized by teachers who seek more formative and individualized assessments. Further, more effective teachers question aspects of students' understanding, and assessment seemed to be taken for granted by less effective teachers. This section will begin with less sophisticated reflections and move toward those reflections that reveal deeper thought and sophistication.

Table 10. Teachers' reflections concerning student assessment and students' understanding.

<table>
<thead>
<tr>
<th>Implementation</th>
<th>Category</th>
<th>Name</th>
<th>Describe</th>
<th>Explain</th>
<th>Theorize</th>
<th>Confront</th>
<th>Restructure</th>
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Note. Each number represents the number of times within the teacher's interview the teacher reflected on the topics of student understanding or student assessment.

Inability to track student understanding. At first Table 10 seems to show inconsistencies. For what reasons would Jill, a low-level teacher, confront and restructure student assessment to the extent
shown? This particular teacher confronts her assessments of student understanding in a manner that indicates her dissatisfaction with her ability to assess student learning. In one lesson, Jill’s objective was to assess her kindergarteners’ understanding of math concepts using Piagetian tasks. As Jill reflects on this math lesson, she confronts her inability to track student understanding:

That’s pretty much what I got from the assessment because with the second activity I wasn’t able, I didn’t record much. And I just said what it was and only one I marked. You said David, I think you are probably right. Who grasped that and who didn’t? (Jill, 13:23)

Jill realized after the lesson that she really did not know what some of her students understood. As a result, during the small group assessments she did not track and mark student understanding in a beneficial manner. Further, Jill confronts her implementation of the Piagetian tasks as she did not ask questions, such as, “Why do you think that?” Such questions help students’ elucidate their thinking. It is this thinking, not necessarily the “right” answer that is informative in developmental assessments.

Compounding Jill’s inability to assess student understanding, she confuses student behavior with student understanding. She focuses her attention on students’ proper behavior; thus when students exhibit off-task behaviors in lessons, she often assesses the lesson as a disaster due to student behavior, rather than utilize student understanding. She says:

But when I went and watched them, some were doing that and some were not. And so like then I have to think, Did they get it? Do they understand what sorting is? Or do they get it and they are choosing not to? You know what I mean? And so I guess that is probably what makes me feel like it is flop. (Jill, 12:57)

Dependence on written assessments. Low-level and mid-level teachers focus on the logistics of student assessment and confront whether the formal assessment of student understanding, such as homework, worksheets, or journals, were utilized effectively. For instance, Kelly, a low-level teacher, says that she does not know what her students understand because they did not take a pencil-paper assessment. She goes on to suggest that her students should have written a journal entry so she could gauge their understanding (Kelly, 5:38). Additionally, Nancy, a mid-high-level teacher, articulates similar thoughts. If she teaches her students something in math, she expects that concept to be on the written homework questions for the day. If the concept is not on the homework, she should not teach it. Interestingly, what is conveyed through their statements is a dependence on written work to assess students’ understanding. Formative assessments, such as students’ questions, comments, and responses in class, and other in-class non-written assessments are not mentioned.

Individualized assessments. Both Becky and Alex, mid-level teachers, seek to restructure how they work with individual students to help them understand better. Simultaneous with this
individualized instruction, the teachers work to assess student understanding. The mid-level teachers show they look for formative means to assess students’ understanding and they do not rely solely on written work, but can glean a lot of information from students as they interact, ask questions, and demonstrate their knowledge through performance-based tasks.

*Confront student assessment.* Linda, a mid-level teacher, conveys a more sophisticated level of reflection concerning student understanding as she confronts standardized tests. She describes how she teaches her students tricks and tips so they can pass the state exam, yet she understands that such strategies are only band-aids that mask students’ lack of understanding (Linda, 1:8, 11). Chris, a high-level teacher, also confronts student assessment, yet he does so at a slightly more sophisticated level. The pressing question for Chris is: How do I really know what students understand and retain? While Linda knows her students can pass a state exam without having an understanding, Chris conveys he knows his students can in some sense fool him on a daily basis. He recognizes the difference between participation and understanding. Further, he seeks to determine how he can conduct formative assessments on a daily basis, particularly when his students speak languages other than English and often work in small groups.

*Confront student understanding.* Linda and Alex, both mid-level teachers are concerned with students’ understanding. They both confront their lessons and ask: Did they get it? Do they understand? Both of these teachers want their students to understand and utilize this to reflect on their lessons. Additionally, Brady, a high-level teacher, confronts more superficial student understandings. He articulates he wants his students to explain their thinking, in addition to understanding math or science concepts. Brady explains students’ understandings of money:

> And that was hard for the higher kids in the room that had it. Because there were a few that thought they had them all and they were trying to explain it but they were saying things like, they were just going through all of them instead of saying, “I know I have them all because I went through and took one by one and transferred the amounts.” They weren’t able to articulate that and explain their reasoning. I think that is another step in the puzzle, being able to fully understand how they know they have it. (Brady, 8:20)

Brady wants his students to go beyond skill-based understanding or factual understanding and really comprehend information and make connections. One way he knows they have done this is if they can elaborate and explain their thought processes. The fundamental question Brady asks throughout his reflection is: How am I going to get them to think? This question is the driving force behind the restructuring of student assessments, and all teaching decisions to promote student conceptual understanding.
Finding 13: Only those teachers exhibiting the most effective instruction reflected on their teaching behaviors referring to theoretical knowledge.

The teachers exhibiting high-levels of reform-based instruction also utilized theoretical understandings to explain specific teaching interactions with children. As shown in Table 11, both Brady and Chris explained their use of questioning utilizing constructivism. Not just any question is appropriate. They ask questions that require students to consider what they have already done, or already know. Additionally, Brady utilizes educational reading to support his neutral responding patterns. He says:

I read Rita DeVris work, Moral Classrooms, Moral Children, and that really opened up my eyes because that taught me the basis of how do I get kids to think. Because if I can’t treat the kids in the room in a way that allows them to think because I’m saying good job or no, then they are going to be afraid to think. (Brady, 8:103)

This book helped Brady think through how he should respond to his students in ways that help keep them thinking. He very clearly articulates how ineffective praise and reward systems, while used by other teachers, are not consistent with the literature he has read or his perceptions of learning theory, such as constructivism.

Finding 14: Teachers at all levels of instruction identify problems and articulate solutions concerning their teacher behaviors, however, the content of these reflections differs with teaching effectiveness.

Finding 14a: High-level teachers reflect on how specific teaching behaviors help students to think more deeply.

Chris and Brady seem to embrace the ambiguity of teaching behaviors. They both focus on the strategies they can implement as teachers that will promote thinking in their students. For instance, Brady says, “I always ask myself, ‘How can I get kids to think through that? Am I just going to tell them it or am I going to have them think through it?’” (Brady, 8:150). Brady recognizes that there are times when he will need to tell his students something. But, in a particular teaching moment, he would rather question his students or get them to talk to one another as he sees that as more productive for the kinds of goals he promotes in his classroom. Further, Chris describes how he reflects on his questioning:

When I’m especially in discussion and I’m sitting in that chair. My mind is going so fast and I know what I’m going to talk about but I’m looking for the right words. I don’t think there’s a lapse. I don’t think the kids necessarily see that happening but I am always looking for the right words. I’m trying to avoid the yes/no, the short
answer. They still come out. But I’m always trying to word it to put the onus of the learning on them. I want them to think about it in a way that I’m not providing them with an answer. I’m guiding them, but I’m not giving. (Chris, 9:43)

Additionally, Chris reflects on how his teaching has changed over the years. He says, “Before I felt I had to be the one in control. I had to know what was going on whereas now I can sit back and say, Well, talk with a partner, talk with the people at your table.” (Chris, 9:54). For both of the high-level teachers, there is a sense that the plan of the day is structured, yet flexible enough to allow for student digressions, student questions, and student interest. Both see the importance teacher questioning plays in scaffolding and connecting future learning to past learning experiences, as well as eliciting students’ understanding. Importantly, the high-level teachers’ behaviors are closely linked with student outcomes and theoretical explanations.

Table 11. Teachers’ reflections concerning teaching behaviors.

<table>
<thead>
<tr>
<th>Implementation Category</th>
<th>Name</th>
<th>Describe</th>
<th>Explain</th>
<th>Theorize</th>
<th>Confront</th>
<th>Restructure</th>
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</thead>
<tbody>
<tr>
<td>Low</td>
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<td>5</td>
<td>13</td>
<td>4</td>
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<tr>
<td></td>
<td>Lois</td>
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<td></td>
<td>Kelly</td>
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<td>Mid-Low</td>
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Note. Each number represents the number of times within the teacher’s interview the teacher reflected on the topic of teacher behavior.

Finding 14b: Teachers at the low and mid-levels of implementation focus on giving directions and explanations clearly.
Low and middle-level teachers focus on teacher-telling and direction giving in their teaching reflections. For instance, Jill says, “I think I would have reminded them that when they go into their seats and use the manipulatives that it is not a time to play” (Jill, 12:16). Lois considers how she should have changed the words she used, “I wanted them to get more into weight, like heavy and light and they didn’t ever describe that as an attribute. Maybe that was the wrong way to say “feel” and then associating that with the kind of feelings because I think a lot of kids put those two together” (Lois, 2:8). Additionally, Cora explains, “I think I said something backwards at one point…. I wished I would have just stopped right there and just said, no, let’s say 5x4 … it wasn’t the time to bring that up” (Cora, 10:23). Keith comments, “I didn’t give very clear directions” (Keith, 16:46). Further, Kay says, “Maybe I could of said it a little more clear…. I didn’t tell them exactly what I wanted” (Kay, 15:35). Becky explains, “I’m trying to figure out how they would understand it so that way I can better portray it to them” (Becky, 4:27). Nancy admits, “We normally put all that stuff away before we get into reading and that’s something that should have been done first thing. That was one of my mistakes today. They should have put that away first thing and honestly, it just slipped my mind” (Nancy, 11:50). Rather than change core behaviors such as questioning, responding, or wait time, many of the low and middle level teachers fixate on giving better directions and telling students information in a clear and concise manner.

Interestingly, the mid-level teachers describe and explain how they question and respond to their students, yet they demonstrate incomplete and inconsistent ideas about teacher behaviors. For instance, Nancy explicitly discusses her questioning:

I think that’s probably one of my biggest things, is I’m really big on questioning. And even like, over there on the wall I have Bloom’s taxonomy there. The kids know that. Because that’s one of the things we talk about at the beginning of the year. I tell them that I try not to use yes/no questions. I try to get you to think harder and to think better. That’s what I tell them. They know that and they expect that of me. (Nancy, 11:42)

Even though Nancy finds questioning important and wants students to think through things, she also places emphasis on teacher telling in her classroom. She explains why teacher telling is so important:

I can tell that I’m not saying it in a way they can understand it. And I’ll just say it in a different way. That’s probably why I talk so much, it seems like, because I am reiterating things. I’ve got 19 kids in here. They are all going to hear one thing I say in a completely different way so I’m going to have to say it 19 ways to get everybody to understand it. (Nancy, 11:47)
Even though Nancy wants to get her students to think through things, she doesn’t notice that telling students something 19 different ways might not be the most effective way to promote student thinking. Nancy does not pick up on this discrepancy in her thinking.

**Finding 14c:** *When mid and low-level teachers confront their teaching behaviors, they often do so in ways that are not as effective for improving practice.*

At times, low and mid-level teachers were specific in their reflection on teaching behaviors. For instance, Cora considers, “if I’m always calling on the same students” (Cora, 10:28), “going to the same parts of the floor” (Cora, 10:30), or if “I leave kids hanging. They’ll ask me something and I’ll say I’ll get back to you and I forget to get back to them” (Cora, 10:51). Additionally, Keith addresses his voice level and tone of voice. He wants to project and use the right kind of tone with his students (Keith, 16:47). These considerations address specific teacher actions. Yet, improving these aspects of teacher behaviors, while important, may not necessarily create more effective instruction. These specific reflections do not consider what is being said, or why the behavior is important.

Interestingly, Jill, a low-level teacher, comments, “When I think about my own teaching I don’t know if I am the best questioner. Am I leaving enough wait time?” (Jill, 12:142). Further, she questions, “Am I asking questions that are really thought-provoking or am I just giving them easy yes/no, red/blue you know easy questions (Jill, 12:143). Jill is being specific and she is attending to the basics of effective teacher behaviors; however, this reflection epitomizes her lack of awareness of her own behaviors. Jill is not sure if she is leaving wait time. Jill is not sure if she asking effective questions. Importantly, Jill is not implementing any systematic strategies, such as audiotaping, to determine her effectiveness in these areas of her instruction. While she is asking questions about her practice, importantly, she did not articulate that she is in pursuit of an answer. Yet, at least Jill is asking questions of her own practice during her post-lesson reflection.

At other times, mid-level teachers articulate rather naïve views of teaching behaviors. Such limited understanding does not accurately support the improvement of teaching behaviors. For instance, Alex, a mid-level teacher, discussed how he questions students during math whether their answer was right or wrong because he doesn’t want to give away the “right” answer. Further, he says, “You can’t tell them how to solve it. I kind of gave them some clues or else some of them would be completely at a loss of where to start” (Alex, 6:8). Alex seems caught in the extremes of instruction—teacher telling is “bad” while questioning is “good”—not realizing that there is a time and place for both in effective instruction. Mid-level teachers are more likely than low teachers to focus on their questioning, yet they do so in inconsistent ways. Furthermore, the focus placed on teacher telling and
direction-giving causes questions to arise concerning the true importance of questioning in the classroom.

When mid and low-level teachers looked critically at their questioning or responding, they often confronted their practice in a global and vague way. For instance, Becky says, “I find myself leading the kids more than I would like to on some questions” (Becky, 4:59). Jill suggests, “I could maybe step away from feeding them the answer and helping them think more” (Jill, 12:26). Additionally, Linda says, “I try to come over there and give them a quick fix, but it just doesn’t feel right” (Linda, 1:5). Here Linda is referring to her interactions with students who are struggling to understand. Her quick fix may be teacher telling, or it may be a teacher question. Whatever it is, she senses it is not as effective as it could be. Interestingly, it is not clear through these vague comments what the teachers are exactly reflecting on in their practice. Nor is it clear if they know what to do to change their questioning or responding skills in order to demonstrate more effectiveness.

Generally, the low and middle level teachers describe and explain the questions used but fail to acknowledge problems or seek change in their use of questioning or responding. Some teachers say in their interview that they perceive their teaching behaviors were effective. For instance, Jill says, “How many do you think it is? But I mean I was asking them; Why do you think? How did you picture it? How did you see it? I think the questioning and that was beneficial” (Jill, 13:29). Further, Tricia says, “I think that I asked some pretty good open-ended questions with them” (Tricia, 3:40). When asked about her effectiveness as a teacher, Cora exclaimed, “How I taught? GREAT! I feel very confident with how I teach and I don’t really feel like I had a problem” (Cora, 10:25). If the teachers perceive that their questioning and responding patterns were effective, it then makes sense they would not mention these behaviors when they confront and restructure their teaching.

**Finding 15:** Lower level teachers focus more on how teaching and their students make them feel, while more effective teachers place more importance on how they think about their students and teaching, in general.

Comparisons of Tables 12 and 13 show all teachers describe how they feel about aspects of their teaching, yet teachers who teach more consistently with reform-based initiatives also explicitly discuss the understandings they have of content, curriculum, or students. Jill, a low-level teacher, and Keith, a mid-low-level teacher, confront both their feelings and understandings. Additionally, a few other mid-level teachers, and both high-level teachers confront or seek to restructure aspects of understanding. Notably, three low or mid-low teachers do not discuss teacher thinking or understanding at all. The general lack of reflection concerning the teachers’ understanding of teaching
or students, along with the description and explanation of teachers’ feelings leads the researcher to conclude that lower level teachers focus more on how teaching and students make them feel, while more effective teachers place greater importance on how they think about their teaching and students.

**Finding 15a:** *Mid and low-level teachers express many feelings concerning teaching; however, low-level teachers express more negative feelings.*

Low-level teachers articulate many negative feelings towards teaching. They feel overwhelmed, frustrated, frazzled, exhausted, and lonely. These teachers have very real behavior management problems in their classrooms. Thus, they focus on this area of their teaching and interestingly, how students behave often dictates how the teacher then feels about the day. Jill clearly articulates:

> I am really frazzled. I am still thinking about Abigail who got sent out. I am thinking about Kyle and how frustrated I am with him. ... I think I focus a lot on behavior. Which isn't necessarily the best assessment, but it is what affects my emotions the most. You know what I mean. I can get very easily frustrated when they are not doing what they know they should be doing and what I know they have the potential to do. (Jill, 12:51-52)

These feelings of frustration lead the teachers to not particularly enjoy their jobs on certain days. Yet on the days when things go well, the teachers say they do enjoy teaching and enjoy their students. Jill says, “If the kids were really good then I'll be like this is a great profession and this is great for me and I'm enjoying this” (Jill, 13:71).

The mid-level teachers still focus on how they feel. They say things similar to the low-level teachers; they love teaching, love kids, yet can get frustrated and very tired. Linda discussed the student behavior problems she had the previous school year and said, “Last year it was like I had to show up because I knew that if I didn't get through that year I knew I would never teach again. This year its like, they deserve it. They are really fun” (Linda, 1:61). We see a continuation of the idea that when students behave well, the teacher enjoys the students and enjoys the job. In addition, when students misbehave, the teacher can easily begin to question whether the time and effort spent on teaching is worth it. Furthermore, Cora describes her feelings towards her students:

> I love 3rd grade. I just love them. I taught 6th grade last year and I think it just makes me love 3rd grade that much more. I like their excitement. I like their love for their teacher. They just are so good to me. They are so good for my self-esteem and I tell them that all the time. (Cora, 10:41)
Table 12. Teachers' reflections on own feelings and characteristics

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<th>Implementation</th>
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*Note. Each number represents the number of times within the teacher’s interview the teacher reflected on the topic of the teacher’s feelings, interests, and characteristics.*

This quotation exemplifies that the students still impact how the teacher feels. However, these teachers are able to corral student behavior more effectively and thus at the end of the day feel better about their students and better about teaching in general. One notable difference in the feelings of these teachers is that they make comments that convey teaching has become easier. They are more confident in their teaching, more relaxed in the classroom, and generally more comfortable. Teaching doesn’t seem so difficult when student behavior is managed well.

**Finding 15b:** *High-level teachers are driven by past educational experiences, personal interest, and passion.*

The high-level teachers also articulate affective comments, but rather than enthuse about how they love their students, they explain how their past educational experiences, passion, and interests motivate them to improve their instruction so their students have a better educational experience. Further, their affective passion and interests are often intertwined with their own understanding of teaching and learning.
Interestingly, both teachers speak of the disinterest they had in school and how they do not want that for their own students. Further, both teachers speak of things that were done to them and how they felt they had no choice or ownership in their own education. When they found themselves in situations where they could make choices, both teachers realize they began to really learn and become interested in their own education:

I think the major thing for me that has influenced has been my own personal interest. Science has always been fascinating to me but, interestingly, as a student I somewhat feared science, like in elementary, middle school, high school. But once I got to college level I took science classes that interested me. Whereas I think in my school career there were prescribed things that I had to do. Which we kind of talked about. And that wasn’t interesting to me. So when I could make those choices I realized that science as a whole isn’t a bad thing. So the interest level keeps me going. (Chris, 9:40)

Table 13. Teachers’ reflections on teacher understanding and thinking concerning students and teaching.

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Note. Each number represents the number of times within the teacher’s interview the teacher reflected on the topic of the teacher’s understanding and/or thinking about education.
So now, as a classroom teacher, Chris utilizes the interest he has for his subject matter and for learning to keep improving what he is doing in the classroom. He says:

And I am somewhat competitive with myself too. I always and this science position has made me more so. Because I have three sections of Kindergarten. Three sections of first grade. Three sections of most grade levels. So when I have a class come in and I teach a lesson for the first time at a grade level I judge myself the hardest. I often say I short-changed those kids. By the time I’ve taught it for the third time I’ve worked out so many more kinks. So it it may sound silly but I do. It is a challenge for me to always improve on what I do and to see what they can do better. (Chris, 9:42)

As Chris reflects on his lessons, he is personally challenged to keep getting better. But he doesn’t do this just to improve his own teaching. In the end, he is concerned that students get the best education possible; he challenges himself to provide his students with better educational experiences.

Brady, like Chris, utilizes his past educational experience to provide the fuel for the passion to teach effectively. He describes his former schooling experience in a negative manner. He sums it up by saying, “When someone was telling me how to do everything, and telling me what to do, and when to do it, I wasn’t a responsible learner” (Brady, 8:78). Because of this perceived negative K-12 educational experience, Brady is determined to teach his students differently than he was taught. His past schooling experience gives him a reason to teach differently, whatever the cost:

That’s kind of like my guiding passion that I don’t want students to think that a teacher is just someone that tells them what to do, how to do it, when to do it. I’m not saying that I’ve never done that, cause I do do that even yet because I think there are times when you absolutely have to. But I think that has really shaped me into the teacher that I am. It is a personal experience. (Brady, 8:79)

Mid-level teachers also articulate the need to improve their teaching. However, they do not voluntarily mention their prior schooling experience. Instead, they often convey they think about education a lot and a sense of perfectionism drives them to do things better. Additionally, a few teachers mention the fear they have for their job if they do not do things well:

Part of it is I have always been a high achiever and I would hate to stink at anything. I would just hate it. I would rather not be doing it than ... I just can’t stand to go home and feel like I left things unfinished. Or didn’t do things right. (Linda, 1:60)

One thing that becomes apparent when talking with most mid-level teachers is their drive to become more effective teachers. Perhaps the low-level teachers also want to be effective, but they do not explicitly make references to this. The high-level teachers want to teach differently than the way they were taught and this fuels their personal interest and passion to provide students with quality
educational experiences, while the mid-level teachers seem more focused on doing things “right” according to how school has always been done, or in alignment with how their colleagues teach.

**Finding 15c: High-level teachers articulate sound teaching rationales.**

High-level teachers not only demonstrate effective teaching strategies, they also articulate that such moves are often deliberate and thoughtful. For instance, Brady speaks of the passion he has to really understand what he is doing and why he is doing it that way. The rationale behind a decision is just as important as the decision itself. As he describes the way he thinks about his teaching, he is describing what he perceives “good” teaching is generally:

> That good teaching always includes why, that it’s, the teacher has taken time to think, and then it’s crafted in a way that meets students’ needs. That’s learning. That it’s differentiated. That it’s multitasked. That you really thought through everything. You haven’t just shot at things. We’re going to do this and this and this and this. That there’s a big picture, there’s a sense of something that and its not going to happen on day one, then on day two, or on day three. But it’s going to happen over 180 days. (Brady, 7:56)

Brady further articulates his thoughtfulness towards teaching and how he uses thinking to improve his teaching:

> But there are times I am always thinking that What if? And Why? That has really developed recently. Because I’ve really been asking myself as I’ve gone through the National Board process, Well, so what? Like, it is cleaning up my teaching, definitely. There are times when I’m like, I did this last year but why? Why did I do it? So I think those are important things. I think thinking like a teacher is the most important thing. (Brady, 8:80)

Essentially, Brady forces himself to consider the meaning behind every decision he makes in his classroom. Through this reflection, he considers the big ideas of the lesson and curriculum. He considers the main goals he has for his students. He states that his main goal is “teaching kids to really think or getting them to think” (Brady, 8:157). This idea of vision-casting is important to Brady and he explains how he thoughtfully considers his curriculum, not just to find big ideas in science, in social studies, or in math, but to also find the big ideas that encompass all of his curriculum. Interestingly, Brady realizes that as he teaches, he must force himself to consider his teaching rationale because as he becomes more expert-like he finds that his explicit understandings are becoming tacit. He laments, “There’s things that I think I do so naturally now. Two years ago I might have known this is why I do this. This is why. But unless someone specifically asks me, I really no longer know why. See I’m falling...” (Brady, 8:133). The idea that his rationale is becoming tacit
disturbs Brady. He is not pleased to notice this automaticity and tacit nature concerning his own thinking.

While high-level teachers can articulate what they should be doing and why they are doing it that way, mid-level teachers often convey a sense of confusion about best practice. Keith, a mid-low-level teacher, mentioned that he wanted to become a master teacher. When asked what a master teacher would look like, he said:

I don’t know yet. I still you know there’s you see the teachers on TV, the Golden Apple winners and all that thing. You know the thing about those teachers when you see them on TV is they’re themselves and they are unique. They are not all cookie cutter style teachers. They have their own style that works for them. I don’t know what that will be for me in the long run. I don’t know what will be the niche, the thing that I will hit that really makes me effective. That really gets those kids learning and being motivated and excited about this. (Keith, 16:69)

Though Keith, and the other mid-level teachers, desire to be master teachers, they are not exactly sure what that looks like. They think about teaching incessantly. They want to do things well. They have the motivation and drive. But what exactly are they striving towards? What should they be doing?

Through teachers’ comments, it becomes apparent that the rationale for teaching decisions is not exactly clear. They may very well do things that “work” in their classrooms. Their teaching may, at times, look very effective. But the reasoning behind their actions and decisions can be rather vacant. For instance, Nancy was one of the most effective classroom teachers in the middle level. Through our conversation she often said things that indicate she doesn’t have a good grasp on why she does what she does. But she knows that what she does seems to work for her students and for herself. She compares what she does now to what she did her first year of teaching:

I mean little things have changed, but it is pretty much the same structure. And so I think honestly that was a lot of luck. I really don’t know why I do it I just have done it and it has always worked so I just keep doing it. (Nancy, 11:57)

Kay was another teacher who performed at the top level within the middle level. Her teacher behaviors were often very consistent with the literature on effective praise, effective questioning, and effective wait time. As an observer, I particularly noticed her use of appropriate praise. The so often heard phrase of, “Good Job” was strikingly absent from her kindergarten classroom. When asked in the interview why she did not globally praise her students, Kay, in a stunned and rather stilted way, replied, “I don’t know ... actually ... I guess I wasn’t aware that I wasn’t.... Um. ... I don’t know, actually” (Kay, 15:53). It appears as though the teachers in this category can, at times, implement effective teaching strategies but may lack the rationale to defend what they are doing in the classroom.
This lack of a solid rationale may lead to poor decision-making. For instance, Nancy had her 3rd grade students learn about bacteria. Even though colleagues questioned her teaching of this material, Nancy utilizes a misunderstanding of learning to justify her teaching decision. Through hands-on activities, like growing bacteria on agar plates, Nancy was convinced her students would learn:

They actually get to see it. I think that is something that is pretty important for third grade. Because I remember when I first started doing it, I remember some people saying, “I can’t believe you’re growing bacteria. They won’t be able to understand that.” I thought, “Are you kidding? They will actually be able to see it. To see what can happen if you touch something and see what grows from it.” (Nancy, 11:109)

Nancy articulates a misunderstanding of how students learn. Additionally, Kay articulates a situation where she simply didn’t consider the kinds of instruction needed for her students to learn. During math instruction, Kay did not plan for each individual child to use manipulatives to aid in kindergarteners task of creating groupings. They had used manipulatives as a whole class and Kay says as they transitioned to individual work, she “just kind of assumed that since we worked on it with the butterfly that they would get it. But [they didn’t]” (Kay, 15:9). She further admits, “I didn’t really think about the fact that some of them would still need the hands-on part of it to help them really get it” (Kay, 15:3). This conveys that while teachers in this category can utilize strategies effectively at times, there are still aspects to their teaching they haven’t thoroughly considered. In the midst of the lesson, they will realize they forgot an important consideration—such as math manipulatives for concrete learners.

Interestingly, low-level teachers discuss how they feel about teaching and their students, but rarely do they mention anything about what they as teachers understand or how they think. When comments are made related to teacher thinking or teacher understanding, it is generally a vague comment that indicates the teacher needs to keep learning or doesn’t really have rationale for what they are doing in the classroom. For instance, Jill says, “Like honestly some of the activities in the book I’ll get them together or I’ll teach them but I don’t know if I have the best grasp on why am I doing this or what is this. Maybe I have an idea. But still I could have a better grasp of where am I going in the long run” (Jill, 13:67).

**Finding 16:** Almost all teachers in this study confront aspects associated with their school’s culture.

Table 14 shows almost all teachers confront their working conditions. Teachers, regardless of teaching implementation level, commonly confront the time they have to plan or carry out lessons. Further, teachers confront the pace at which their lessons were implemented, with most teachers
complaining that lessons took too much time. Low and mid-level teachers also confront room organization and their preparedness for lessons. Additionally, all low-level teachers and three mid-level teachers seek solutions to their lack of time and organization.

Interestingly, as teachers describe and explain their working conditions, they often discuss their involvement in district committees, professional development opportunities, interactions with parents, and the other “extras” that are part of their teaching responsibilities. Additionally, 9 of the 13 teachers discuss how elementary teachers switch grade levels and 8 of the 13 have done so in their short teaching careers. Teachers speak of simply surviving during their first year of teaching. Further, 3 of the teachers discuss the anxiety of job insecurity.

Table 14. Teachers’ reflection on workload, parents, colleagues, and school culture.

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*Note.* Each number represents the number of times within the teacher’s interview the teacher reflected on the topic of the teacher’s understanding and/or thinking about education.

Summary of Findings—Research Question 1

This study responds to Kagan’s (1990) concern about the lack of information linking reflection to practice, and provides evidence that such a relationship exists. Teachers demonstrating
more effective math and/or science instruction reflect on their teaching in ways that are different, and more sophisticated. This relationship is most evident in the use of theory. Only the highest implementation teachers spoke of theory and educational literature and their use in personal teaching practices. In addition, these teachers clearly articulated areas of their teaching that need improvement—creating lessons that match students’ interests, prior knowledge, and experiences in ways that motivate them to understand the big ideas of science and math. These teachers also sought to assess students accurately on a daily basis through formative and individualized assessments and were aware of the difficulties in making each lesson relevant and accessible for all students in their classrooms. The most effective teachers focused on providing effective instruction for their students and realized that often meant their instruction looked different than what they experienced as a student, or what students experienced in colleagues’ classrooms. Furthermore, the most effective teachers criticized aspects of colleagues’ teaching practices that they considered ineffective.

In contrast, the least effective teachers in this study rarely referred to learning theory or educational literature when explaining their teaching practices. Instead they utilized their feelings or the affect of their students to create lessons students would enjoy. These teachers fixated on classroom management and often determined the success of a lesson based on the behavior of students. Additionally, the least effective teachers clearly articulated the activities, strategies, and lessons that didn’t “work,” yet articulated a dependence on outside authorities, such as administrators, colleagues, or curriculum guides, to plan units and lessons. Further, they often felt bewildered or frustrated because they knew their teaching had problems, yet they failed to create lasting solutions to the problems they faced in their teaching. Notably, the absence of theoretical reflections indicates these less effective teachers may not fully understand how to change their teaching practice so as to be more effective.

The teachers rated as moderately effective articulated reflections that showed more sophistication than the least effective teachers, yet they often articulated less sophistication than the most effective teachers in this study. Those teachers at the mid-high-level were more likely than those at the mid-low-level to refer to theoretical knowledge bases when explaining their teaching practices. Yet, the mid-high teachers did not articulate as many problems with their instruction and consequently did not reflect on ways to improve their instruction as often. Additionally, these teachers articulated a desire for a high degree of control in the classroom. They desired for students to behave and follow the directions of the lesson. Because these teachers were more effective in implementing teaching activities and strategies, they seemed more content with their teaching practices. These teachers desired for things in their classroom to be done the “right” way. Notably,
the mid-high teachers did not seek to re-examine the curriculum or vision for instruction. They sought to implement instruction so as to fit with the *status quo*.

**Findings—Research Question 2**

Research Question 2: To what extent do self-assessment practices taught in a teacher education program transfer to classroom teacher practices?

During the science methods course, preservice teachers were taught to analyze their own teaching behaviors, such as questioning, responding, wait time, and the importance of non-verbal communication using an assessment tool called the SATIC coding guide (Abraham & Schlitt, 1973). They were taught to determine their effectiveness by comparing their practice to their developing research-based framework. Preservice teachers were taught three steps to self-assessment: (1) accurately describe the teaching events and behaviors exhibited currently, (2) accurately identify the desired state of effective teaching, and (3) identify areas in current practice not in alignment with the desired state and create concrete strategies to improve teaching practices. Descriptions of the current and desired state and decisions to improve practice should be informed with literature on effective practice. With increasing emphasis placed on self-assessment in teacher education, this study can clarify how teachers use the research base and self-assessment strategies taught in science methods to identify and improve their practice.

During the science methods course, emphasis was placed on utilizing several factors to determine overall teaching effectiveness. The science methods course advocated the use of multiple indicators of effectiveness, including self-assessment, administrator or colleague observations and feedback, and students’ conceptual development over time. Preservice teachers were further taught the disadvantages of using external feedback or student achievement as sole indicators of teaching effectiveness. Rather, administrator or colleague feedback and student achievement should be used in conjunction with teachers’ own self-analysis, not in place of it. The findings presented here convey that some aspects of self-assessment practices taught in the science methods course transferred and others did not.
Finding 1: Most teachers utilize their students to determine their effectiveness as a teacher. More effective teachers focus on student understanding, while less effective teachers attend more consistently to students' behavior and affect.

Finding 2: Teachers discuss the importance of their teaching behaviors, yet they seldom use this to determine their own teaching effectiveness.

Finding 3: All but the most effective teachers use their teaching portfolios to report their current practice, rather than use the portfolio to induce teacher change.

Finding 4: Less effective teachers use colleagues as models for instruction.

Finding 5: The most effective teachers did not use their colleagues to assess their own teaching.

Finding 6: Less effective teachers do not have a clear sense of the desired state of effective teaching.

In the section that follows, each finding will be described in further detail, including supporting evidence from interview transcripts and observations.

Finding 1: Most teachers utilize their students to determine their effectiveness as a teacher. More effective teachers focus on student understanding, while less effective teachers attend more consistently to students' behavior and affect.

As reported in Table 15, most teachers use students' understanding to assess their teaching effectiveness. Additionally, many teachers also determine whether their teaching matches students' interests and promotes positive affect. Some teachers tend to use students' behavior and thinking as indicators of teaching effectiveness. Less common, yet still used by some teachers, are the relationships built with students, test scores, the independence of students and students' future success in school and life. While teachers utilize their students to assess their own effectiveness, these findings indicate that the criteria teachers use to make this assessment vary.

Of importance to this study is the extent teachers utilize what they were taught in their science methods course. These teachers were taught to utilize students' progress in learning, along with other indicators such as self-assessment of teaching behaviors and, to a lesser extent, colleague or administrator feedback. As shown in Table 15, the most effective teachers predominantly utilize student interest, student understanding, and student thinking to determine their effectiveness as teachers. In contrast, the least effective teachers predominantly utilize students' affect and behavior to assess teaching effectiveness. The teachers in the middle also articulate a reliance on student behavior
Table 15. The manner in which teachers use students to determine their teaching effectiveness.

<table>
<thead>
<tr>
<th>Name</th>
<th>Relationships (on task, engaged)</th>
<th>Student Behavior (on task, engaged)</th>
<th>Student Affect &amp; Interest</th>
<th>Student Thinking</th>
<th>Student Work Related to Learning or Understanding</th>
<th>Students Meet Test Objective Scores</th>
<th>Students are independent learners</th>
<th>Students' Future Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jill</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lois</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Kelly</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Cora</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Keith</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Linda</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Becky</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Alex</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Kay</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Nancy</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tricia</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Brady</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chris</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

*Note.* An "X" denotes that the teacher articulated how they use such an indicator to determine their teaching effectiveness. Brady explicitly expressed problems with using test scores as indicators of teaching effectiveness, and therefore chose to utilize other indicators.
and student affect, in addition to a focus on student understanding to determine their effectiveness. Therefore, the more effective teachers tend to utilize student data in a manner consistent with that taught in their science methods course. The least effective teachers are more likely to utilize data from their students that does not indicate much about student learning or effective teaching. Unfortunately, they assess their teaching effectiveness using superficial indicators of students’ on-task behavior and affect without much consideration for the real learning that should take place in the classroom.

**Student understanding.** Of those teachers who express they use student understanding for self-assessment, it should be noted that what teachers mean when they say “student understanding” differs according to the effectiveness of the teacher. As reported in Finding 12 for research question one, more effective teachers seek more sophisticated assessments in order to determine what students understand. Additionally, more effective teachers seek to understand students’ conceptual understanding, not merely their memorized understanding. In contrast, low and mid-low-level teachers are often concerned with whether their students “get it” or “meet their district’s objectives.” They look at the responses of students in order to determine what they understand; however, the teachers’ responses indicate they often look for students to merely mimic or repeat the language heard in class. Alex provides an example of how a superficial student’s response helps him assess his effectiveness as a teacher:

> Or the kid who will say it and I know it is from what I’ve taught because it’s almost the way I put it. An example would be, What’s the bottom number of a fraction? The D-D-D-D-denominator is D-D-D-D-D-Down. Because that’s the noise I make. Then I’ll say, Well, maybe another teacher did that. But, they weren’t doing it before I said it. So if they use some dorky thing I made up. Or then I see they are getting something out of it. It’s hard. I try to think of ways to make them, to help them remember. (Alex, 6:31)

Additionally, Nancy, a mid-high-level teacher expresses how her students’ questions indicate whether they “get it.” This then helps her determine whether she needs to say the information in a different way so her students can then give her what she is looking for:

> The kids. I really go for, like their level of questions back to me is almost an indicator if they are getting it or not. If they are asking questions that they should know the answers to I can tell that I’m not saying it in a way they can understand it. And I’ll just say it in a different way. (Nancy, 11:28)

**Student interest and affect.** Less effective teachers were more apt to utilize student affect while more effective teachers were more likely to utilize students’ interests to determine teacher effectiveness. For instance, Chris explains why he utilizes student interest as an assessment indicator, “Student interest is certainly an aspect you have to consider. If they are not interested the success
level is going to be diminished" (Chris, 9:22). Chris uses student interest as a self-assessment indicator because he believes students will learn more if they are interested in the lesson. In contrast, Keith, a mid-low-level teacher articulates how student affect is a more valuable indicator for him than what his students understand:

If the kids are talking positive about it, talking positive about math, I think that’s one of the strongest indicators. Maybe they won’t get all the concepts when we take the quiz. We take the quizzes in here instead of tests. We take shorter amounts of information than taking one test um you know maybe they’ll score 70% on the quiz or 60% on the quiz but if they are talking positively about the math and feeling like they have a better grasp on it then they’ve had before. (Keith, 16:23)

Additionally, Tricia, a mid-high-level teacher, explains she uses her student’s enthusiasm in class as an indicator of her effectiveness because she believes student excitement shows students want to learn and will be more motivated to learn:

Oh, I think that one of the ways I can tell is that the kids are excited about what they are doing and that they are talk about it and they’re pumped up about it and they ask questions about what they want to learn. They read about what we are studying. Because I think one of the biggest parts of my job is to get them excited to learn and just want to be here because from there they kind of I mean I kind of feel like they take it off on their own. (Tricia, 3:49)

Student behavior. Low and mid-level teachers often articulate how they use student behavior to determine their effectiveness as teachers. They consider their teaching more effective as students are more engaged and on-task during lessons. For instance, Linda says:

Part of it is kind of my gut. If I look around the room and I see a bunch of kids that are kind of doing this or messing around and not engaged, then I figure there is something wrong with the way I taught it. (Linda, 1:27)

Similarly, Nancy, a mid-high-level teacher articulates how she assesses herself based on student behavior:

I mean earlier when we were, I could tell I was losing them when we were talking about, writing stuff out. I could just tell because people were playing with things. And even during reading. Reading today didn’t go as well as I thought it would. Because there were kids fiddling with pencils … I saw they were doodling on it and they were ripping it and things like that. Off task behaviors like that. So that’s what I do. I do a lot of off task assessments. (Nancy, 11:28)

Commonly, teachers attribute the engagement and on-task behavior of students to the activities used within the lesson, rather than looking at their own teaching behaviors. Becky articulates this impact of activities:

I guess I look at how I’m planning my lessons. Like are the lessons I plan engaging for the students? This is only my second year so last year I spent a lot of time
looking up and trying to get activities that would be really beneficial and engaging for them. So I look at that and see if I need to spend more time looking for activities like that. (Becky, 4:35)

Interestingly, neither of the most effective teachers in this study articulated that student behavior or engagement was an indicator of teaching effectiveness. Rather they utilized students' thinking, understanding and the matching of student interests with instruction as assessment indicators.

**Less common assessment indicators.** Most teachers said they used student understanding, work, thinking, affect, interest, or behavior to determine their effectiveness as teachers. Two teachers articulated they use their relationships with students to determine their effectiveness as a teacher. For instance, Lois, a low-level teacher, said:

> And then just I guess my relationships with the kids. I mean I look if I have a good relationship with the kids I think they are going to learn more regardless of what our activities are. I think we have developed a pretty good community. We conduct class meetings every day and talk about issues that we have and we problem solve and that kind of thing. So, a lot of it’s how the kids are responding to me and then in turn I look at how I respond to the kids and that kind of thing. (Lois, 2:36)

Additionally, a few teachers indicated their use of test scores to determine their teaching effectiveness. Alex provides an example, “Well, test scores tell me something. It is disappointing, well not disappointing, but you kind of feel like you didn’t do a very good job if they didn’t do very well” (Alex, 6:29). Alex and Keith also articulated that the only way a teacher could know they were effective was to look at students’ success in subsequent classes and later in life. Keith says:

> How do I determine whether I'm an effective teacher? I think that’s something that comes with time with the students. You see students that end up being successful in math. Successful in the program they are in currently, so this math. But more so in the future because our goal here is to increase their ability to do these things and problem-solving skills and you know and the future you know this is only my second year here. So I'm kind of getting some feedback from the teachers in 7th grade, finding out what areas the kids were strong in. What areas in general did they have problems? And then seeing if they make some of those leaps through 7th and 8th grade. Are they successful through high school math? It would be something you would need to track over time. (Keith, 16:29)

Even though almost all teachers say they attend to students’ understanding or learning in order to determine their teaching effectiveness, evidence substantiates the conclusion that low and mid-level teachers tend to look for declarative knowledge and mimicked understanding when assessing for student understanding, while more effective teachers assess their performance based on students’ conceptual development over time. Further, evidence supports the conclusion that less
effective teachers often utilize more superficial student indicators, such as students’ affect or behavior, to determine the effectiveness of their teaching.

**Finding 2:** Teachers discuss the importance of their teaching behaviors, yet they seldom use this to determine their own teaching effectiveness.

In some form, all teachers articulate they look at themselves. As shown in Table 16, almost all teachers analyze the directions they give students and the ways in which they explain information to students. But the degree to which teachers analyze aspects of their practice as taught in their elementary science methods course is quite variable. As shown in Table 16, all high and mid-high-level teachers articulate they think about their questioning. Two mid-low-level teachers and one low-level teacher articulate the importance of questioning as well. Most of the teachers who discussed the importance of teacher questioning also articulated their intended avoidance of dichotomous questions that lead to a yes or no answer. For instance, Kay says, “I try to also think about my questions as I go. If I’m using a lot of ifs, no questions or if I’m actually having them think about it” (Kay, 14:27).

Additionally, Nancy says:

> I think that’s probably one of my biggest things is I’m really big on questioning. And even like, over there on the wall I have Bloom’s taxonomy there. The kids know that. Because that’s one of the things we talk about at the beginning of the year. I tell them that I try not to use yes/no questions. I try to get you to think harder and to think better. That’s what I tell them. They know that and they expect that of me. (Nancy, 11:47)

Further, some teachers discuss how they would respond to students. At times responding is praise, but in other cases teachers can respond to a student comment with a question, as described by Alex:

> I think it is really important to question. It is just something I like and something I think is important. You see it in the mental math. I’ll question them no matter if they get it right or wrong. Sometimes I’ll catch them giving them the “Oh, yeah, you’re right. I won’t say that but I’ll say, … How did you get that? … Like I don’t want to give it away if they are right or wrong. I want them to verify it. (Alex, 6:41)

Only three teachers mentioned their responding: one high-level, one mid-high, and one mid-low-level teacher. Additionally, only two teachers referred to their wait time. Jill, a low-level teacher questioned if she had any wait time, while Tricia, a mid-high-level teacher, described her use of wait time:

> And I gave them a good chance to talk instead of being the one that did most of the talking. I also like how you know a lot of times as a teacher you just want to comment on everything. Like with the what I know part, some of those things I felt
like I wanted to make a comment on but I just wanted it to be their time to talk about what they know and not have any adult or teacher interaction with them at all and just have that be something they are saying. ... I tried to refrain from saying anything. (Tricia, 3:41)

Table 16. Teachers' assessment of self and the tools they say they use to do so.

<table>
<thead>
<tr>
<th>Name</th>
<th>Focus on self</th>
<th>Self-assess for effectiveness</th>
<th>Concrete Strategies</th>
<th>Video/Audiotape</th>
<th>Teaching Portfolios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jill</td>
<td>Wait time</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lois</td>
<td>Non-verbals</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kelly</td>
<td>Voice tone</td>
<td>vague</td>
<td>Audio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cora</td>
<td>Voice level</td>
<td>Write questions</td>
<td>In lesson plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keith</td>
<td>Non-verbals</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linda</td>
<td>Voice tone</td>
<td>vague</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Becky</td>
<td>Leading questions</td>
<td>Leading debates</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>Alex</td>
<td>Responding</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kay</td>
<td>Non-verbals</td>
<td>Yes-questions</td>
<td></td>
<td></td>
<td>yes</td>
</tr>
<tr>
<td>Nancy</td>
<td>Questioning</td>
<td>Yes-questions</td>
<td>Questioning stems on wall</td>
<td>Video</td>
<td>yes</td>
</tr>
<tr>
<td>Tricia</td>
<td>Questioning</td>
<td>Yes-questions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brady</td>
<td>Questioning</td>
<td>vague</td>
<td>Questions on wall</td>
<td>Video</td>
<td>Yes, for National Board Certification</td>
</tr>
<tr>
<td>Chris</td>
<td>Questioning</td>
<td>Yes-questions</td>
<td></td>
<td>Audio</td>
<td></td>
</tr>
</tbody>
</table>

Additionally, three mid-level teachers discuss their nonverbal behaviors. They look for whom they call on and where they walk in the room. They also express concern over the annoying mannerisms they might display as they teach:
I move around too much or you know I just go to the same spots on the floor. (Cora, 10:27)

Annoying behaviors. You know those little things that would probably annoy me if I was a student and the teacher was always doing it. (Cora, 10:29)

Thinking about my, what I'm doing with the kids. As far as if I'm doing weird things, you know, the quirky things you do. (Kay, 14:51)

Even though several teachers in this study articulate the importance of several teacher behaviors, seldom do these same teachers utilize an assessment of their teacher behaviors to determine their own teaching effectiveness. For instance, Table 15 shows that only three teachers described concrete strategies they use to improve aspects of their teaching behaviors. Further, only four teachers have audio- or videotaped themselves teaching. Of the four teachers who have taped, only three used the taping to look at their questioning or responding interaction patterns. Keith explained that he uses the audiotape to assess superficial teaching behaviors such as voice projection and tone. Additionally, he assesses the clarity of his directions and listens for off-task noise (Keith, 16:45).

When teachers were asked how they determined whether they were effective teachers, very few actually mentioned looking at their own teaching practices. Only three teachers, Chris, Nancy, and Kay, specifically mentioned their teaching behaviors. Kay describes how she determines if she is an effective teacher:

Well, I look at, does it look like my students are understanding what they are supposed to be doing right now. If after I get done with directions are they all just sitting there or are they able to start doing what I asked them to do right away. Their interest level will tell me something too. Because, I try to also think about my questions as I go. If I'm using a lot of ifs, no questions or if I'm actually having them think about it. (Kay, 14:24)

Additionally, Keith and Brady refer to the teacher in a more vague manner. For instance, when asked how he would know if he is an effective teacher, Brady responds:

Well, it is probably not a test score. Although numbers, there are some tests that we give that are very number oriented and they are very clear cut. Those are indications to me that there is a problem. But I think it goes further into finding out well what is the problem and how can I make it develop. Then noticing what changes have they been able to do over time. So it is really just knowing the child. Knowing the child as much as you can. If I don’t know them as a mathematician or if I don’t know them as a reader then I’ll never know the changes that they’ve made. A test score is so I mean there’s so many variables with the test score that like I mean yeah, it indicates something but it doesn’t tell me the real picture. So, to assess my own teaching really what can they do independently? How have I scaffolded it down so
they can now independently do it without me asking any more. That they yearn to want to do that. That is the real true indication that my teaching has affected their lives. (Brady 8:92)

In this statement, Brady conveys that he looks at himself, but the real indicator of his effectiveness is what he sees his students do and say, not necessarily his own teaching skills and abilities. Yet, he does mention his role vaguely when he discusses his ability to scaffold the learning situation so students can learn to do the tasks independently.

The teachers in this study spent several weeks studying and analyzing teacher behaviors during their science methods course at the university. Additionally, they were taught to use analysis of their teaching interaction patterns to self-assess their teaching effectiveness. It appears that for ten of the thirteen participants, the importance of at least one aspect of their own teaching behavior has transferred to their classroom teaching practices. However, when explicitly asked how they determine their own teaching effectiveness, only five of the thirteen teachers in this study explicitly articulated they evaluated their teaching interactions with students. Four of these five teachers also demonstrated more effective classroom teaching practices during the lesson observation. What seems perplexing is that several teachers think about their own behavior but do not use this information to judge their own effectiveness. Perhaps several of the teachers do not perceive their own performance to be a valid indicator of their effectiveness. Despite this sobering finding, it is encouraging to see four teachers utilize the concrete strategy of taping. All four of these teachers are in their fourth year of teaching and ironically, all were in the same science methods class at the university.

**Finding 3:** *All but the most effective teachers use their teaching portfolios to report their current practice, rather than use the portfolio to induce teacher change.*

All beginning teachers in Iowa are now required to compile a teaching portfolio. This portfolio is part of the requirements for a teacher to obtain and keep a professional teaching license. While the teaching portfolio was not part of the science methods class, the self-assessment skills taught in the course perfectly match the self-assessment intent of the portfolio requirements. Unfortunately, the teachers in this study conveyed their lack of self-assessment as they discussed the creation of their teaching portfolios.

The teachers for whom this portfolio is required were quick to say the portfolio helped them assess and reflect on their teaching. However, the manner in which the teachers then discussed their portfolio compilation raises questions about the validity of the portfolio and the value for using this as
a tool to improve teaching effectiveness. For instance, teachers often spoke of “meeting a teaching standard:”

I’m constantly trying to think of which things I did could meet certain teaching standards. What could I do that could meet a standard? When I do an artifact for that like you have to summarize why you picked it and then you have to reflect on it. So every time I do one of those I’m reflecting on why I did something, and I usually do how it went for me and what I would change, and how it affected my kids. (Kay, 14:53)

Yeah, and then you have this portfolio to show that you meet all the state standards and all this and that. That’s actually pretty good because it, like when you’re in your first year you are kind of nervous to talk to parents you’re kind of nervous to do this. But then one of them is communicates or collaborates with parents. I don’t know what it is. So then you have to go out and do it because you have to have a page on it. And then you find out its not that bad and that just helps because it gets you to do things that you may be hesitant to do. (Alex, 6:91)

In some cases, the portfolio may force teachers to do things, such as communicate with parents, in ways they might not have if they did not have to do it for their teaching portfolio. Interestingly, the teachers never mention how the portfolio has helped them improve their classroom teaching practices. Rather, they focus on the ways they compile information to show they are doing what state and district officials expect of them:

But it really was an easy thing to do because I found I was already doing all the stuff that I was supposed to be doing. With the whole 8 standards and all the 42 criteria, when I finally got a chance to go through it all I was like, well, I am doing that and here’s the evidence for that. (Nancy, 11:59)

I had something to fill every category. That’s about it. Some of those were kind of hard to put in there. I mean how do you get along with your staff? I mean that is kind of hard to prove with paper. You know? I don’t know. Some of them were kind of hard to find evidence for. I had evidence—I just had to go look for it. I definitely, there were things I knew I was doing but I didn’t know how to prove it, I guess. (Becky, 4:45)

I kind of said, it is just like scrapbooking. It is just a way of putting my thoughts down. It is putting it in a neat, you know its on-line ... it brought back great memories of things I had taught. ... But that really forced me to compile all my stuff and take pictures and you know keep information from students, keep papers from students, show a sample and just, it just makes me look more professional and that’s what I like about it. (Cora, 10:38-39)

If teachers view their teaching portfolio as a scrapbook—a product they put together at the end of the year in which they showcase all the fun and interesting things they have done with their students, students’ parents, and their staff—little evidence exists that using a portfolio caused them to reflect
deeply on issues related to effective teaching. The teaching portfolio, as described by these beginning teachers, seems more like a reporting tool than a form of teacher self-assessment.

Brady, one of the most effective teachers in this study, compiled his teaching portfolio for National Board Certification. In contrast to the other less effective teachers, Brady’s portfolio became a tool that helped him reflect on his teaching practices and consider ways he could teach more effectively. Brady explains why he went through the National Board Certification process:

Why am I really doing it? You know what I’m saying? This is becoming a headache at times. I didn’t set out to do this because it was stressful—it was a lot of work, and I got a little bit more money. I did it to really improve my teaching and to take my teaching to another level. (Brady, 7:50)

Because Brady underwent the National Board process to improve his teaching, he is willing to put in the effort and time to utilize his teaching portfolio as a tool to improve his practice. He says:

But there are times I am always thinking, What if? and Why? That has really developed recently. Because I’ve really been asking myself as I’ve gone through the National Board process, well, so what? Like, it is cleaning up my teaching, definitely. There are times when I’m like, I did this last year but why? Why did I do it? So I think those are important things. I think thinking like a teacher is the most important thing to teach in college that I think is missed. (Brady, 8:64)

In contrast, the less effective teachers viewed their teaching portfolio as a project to be done to keep their job, not as a reflective tool to assess their teaching and create change in their teaching practices. Clearly, for Brady, his portfolio helped him consider deeply the issues he faced in his classroom.

**Finding 4: Less effective teachers use colleagues as models for instruction.**

Low and mid-level teachers articulated that they evaluate their own teaching based on what they see colleagues do and they use the conversation and feedback from their colleagues to change their own instruction. Often, as these less effective teachers discuss how to improve their instruction, they focus on the activities and strategies they see others use and express a desire to incorporate such activities in their own classrooms.

As shown in Table 17, two low-level teachers and two mid-level teachers sought to compare their teaching to that of their colleagues. Through such comparison, these teachers then determine their effectiveness as a teacher. Jill expresses her desire to know how she compares to other teachers:

I was thinking, you don’t have a way to know how you are doing and how you are doing compared to others. (Jill, 12:110)
While only four teachers expressed a need to compare themselves to others, most low and mid-level teachers articulated the need to observe other colleagues in order to determine their own teaching effectiveness.

I mean I would love to go and watch four or five other first grade teachers in their classrooms sometime this year just to see, what am I doing? Am I doing it right? (Lois, 2:52)

I feel like I evaluate myself better when I watch other people teach and I can come back and say, “Oh, that’s a good idea. I could use something like that in my classroom.” I think that’s probably been actually more beneficial than the [administrator’s] observations themselves. (Becky, 4:48)

Through such comments teachers elucidate their insecurity in self-evaluation. They want to compare themselves to something, but rather than choose research-based teaching, they select the colleague down the hall. These teachers do not distinguish between colleagues that are more or less effective than others. This reliance on colleagues is heavily intertwined with the teachers’ perceptions of teaching and of experienced teachers.

Elementary teaching colleagues can provide several levels of support for the beginning teacher. First, as Kay exemplifies, beginning teachers perceive experienced teachers know what is most effective and further, they trust experienced colleagues to provide effective solutions for the problems faced in their classrooms:

I go to them. That’s who I go to if something doesn’t go well. I just go straight to them and say, “What can I do?” And so they are a big help. That’s where I go before I go to like reading anything or other things. I go to them. (Kay, 14:36)

This reliance on colleagues could be out of convenience, but throughout the interviews, the less effective teachers in this study placed a great deal of faith in the effective counsel of experienced colleagues.

Experienced colleagues possess a “bag of tricks,” including activities, strategies, and management tips that beginning teachers covet. Beginning teachers speak often and fondly of colleagues who give them access to this information. For instance, Alex described his colleague, Mrs. Hansen, and how through 30 years of teaching experience, she’s had more opportunities to help students understand particular math concepts. He readily admits that Mrs. Hansen has more options in her bag of tricks than he does and so he seeks her advice so he is better equipped to teach math (Alex, 6:81). Further, the teachers discuss how they glean tips and tricks through interactions at professional development workshops. Nancy says:

I honestly couldn’t tell you how I knew to do it that way, I just did it that way and so I think really a lot of things that I learned from was going to the master’s classes and
seeing things to do. ... And just listening to other people and doing and seeing what other people are doing and taking that and maybe changing it a little bit. (Nancy, 11:14-15)

Table 17. The manner in which teachers utilize colleagues to self-assess teaching effectiveness.

<table>
<thead>
<tr>
<th>Name</th>
<th>Feedback From Others</th>
<th>Assess Self by Observing Others</th>
<th>Compare Self To Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jill</td>
<td>Uses it</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Lois</td>
<td>Uses it</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Kelly</td>
<td>Uses it</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Cora</td>
<td>Uses it</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keith</td>
<td>Uses it</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Linda</td>
<td>Uses it</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Becky</td>
<td>Uses it</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Alex</td>
<td>Uses it</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Kay</td>
<td>Uses it</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nancy</td>
<td>Uses it, but also</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Critiques the quality of advice given</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tricia</td>
<td>Uses it</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Brady</td>
<td>Critiques the quality of advice given.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gives feedback to others.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chris</td>
<td>Critiques the quality of advice given.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gives feedback to others.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Low and middle-level teachers also glean tips and tricks through observing other classrooms. It appears that beginning teachers compare the activities, materials, and strategies they use with their students to those of more experienced teachers. They then consider emulating what they have seen in colleagues’ classrooms. Jill describes how observing colleagues helps her teach:

When you watch a teacher that’s has been teaching longer, it is intimidating and it makes you reflect—I should be doing this more. Look how organized her class is. Oh, I should be doing this. ... Or they had a morning message up that the kids would come in and read. ...After going to Seattle I came, not every morning, but often I would have a morning message up, that would say like, “Good morning. Today we are going to PE at 2:30 and library at 1. We will have an assembly at 3. Please get,”
then I would give them a direction to do before the bell rang. “Please get a book and color it at your seat.” And so a lot of the observations have just been stealing ideas. (Jill, 12:117, 119)

Low and middle level teachers focus on activities and strategies. As they consider what would make their own teaching more effective, their mind immediately thinks of how they should use better activities and strategies with their students. In their minds, as they find better activities, they will become better teachers.

Finding 5: The most effective teachers did not use their colleagues to assess their own teaching.

Obviously, Brady and Chris also communicate with their colleagues. But the two high-level teachers do not depend on their colleagues to help them improve. Chris describes how he and his colleagues really do not have conversations that engage each other to improve:

So, I think being able to be in a place where everybody has a common interest, the conversations are very different. If I went into the teacher’s lounge here, people don’t have the commitment to science because they are not accountable for science. So I can go in there and talk about it and they will hear me. They will listen to me, but I don’t know if they are hearing me, that’s what I should say. They listen to me but I don’t know if they hear me. Because its not real to them, its not something that they do. They talk about math or they talk about reading. I’m listening to them but I may not be hearing them. So I think its kind of like that turn table situation. If its not something we are completely invested in we’ll honor that other person we’ll hear what they are saying but we won’t always you know give it the full attention that it probably deserves. (Chris, 9:82)

While Chris discusses the disinterest his colleagues have for what he does, Brady confronts what he sees as mediocrity in his colleagues. Unfortunately, he finds that his current situation does not promote the kind of change he wants to see in his own teaching:

The first three years I was really, like I was looking for a new job every year because I felt like in this building, where I am at this time, I am not being pushed. Like I really wanted to be pushed. I wanted to grow. I wanted to strengthen my teaching. It never really happened. Leadership problems. Lots of things right in this building. ... Very rarely am I pushed to another level through my colleagues. (Brady, 8: 122, 125)

Through these comments, Brady and Chris demonstrate that in order to improve their own teaching they need to look outside their school building and not rely on their colleagues. Neither teacher discussed how colleagues, administrators, or other outside experts influenced their teaching to any considerable degree.
Interestingly, both Chris and Brady discuss how they influence their colleagues. Teachers in their buildings, along with other teachers they know, come to them and ask for advice. Brady describes how they help other teachers improve their teaching:

I totally made her rethink her reading. We sat in a coffee shop all day and she got it figured it out. Really all I did was just question her and make her think again because she wasn’t thinking anymore. …Same way in math, I was helping a colleague in 1st grade with her math teaching and she afterwards said, “I don’t know what you did? I don’t remember you saying anything.” But, she is teaching totally different this year in math. (Brady, 8:154, 155)

**Finding 6:** *Less effective teachers do not have a clear sense of the desired state of effective teaching.*

Perhaps low and mid-level teachers rely on their colleagues to determine their own teaching effectiveness because they are unsure of what they should be doing. Low and mid-level teachers speak hesitantly about effective teaching. They convey they are unsure what effective teaching looks like. For instance, Jill says, “I know that there are better ways of teaching [math] but I’m not sure what the better ways are” (Jill, 12:44). Alarmingly, Jill later describes how no one knows what effective teaching should look like:

But I think teaching too is always going to be challenging because there’s always new ideas that are coming out and better ways to teach it. And so even if you feel like you have a good routine there’s always something you are able to do to make it better. And so I know teaching I’ll never get there. You know I’ll never get to this point that its all just amazing because, I’ll get closer to that, but this teacher that’s my mentor, she’s been teaching 20 years and I know she knows a lot about what she’s doing. She has a better grasp on this age than anyone else I know. Like even she is stressed out like me and even she is trying to figure out how she should most effectively teach her math. Its always changing so. (Jill, 13:101)

Finding 15c from Research Question One also contains evidence that less effective teachers struggle to articulate what it is they should be doing. If teachers do not have a clear sense of the desired state of teaching, it seems reasonable that they would then struggle to incorporate self-assessment in their classroom teaching practices.

Unfortunately, this finding indicates that the primary intent of the science methods course did not transfer for low and mid-low-implementation teachers. They appear to have forgotten the extensive research-based framework they developed that articulates a clear vision of effective teaching and how to implement such practices with children.
Summary of Findings—Research Question 2

Even though all the teachers in this study were taught to utilize self-assessments, in addition to the feedback from effective colleagues and administrators and students’ learning, the less effective teachers in this study relied on indicators of students’ declarative knowledge, interest, affect and behavior, along with colleagues’ feedback and activities to determine whether they were teaching in the “right” way.

The most effective teachers in this study used indicators of student understanding and interest, along with an assessment of their own teaching behaviors to determine their teaching effectiveness. Interestingly, the most effective teachers in this study did not use their colleagues to assess their teaching. Rather, they spoke of how they helped their colleagues improve their instruction.

Ten of the teachers in this study articulated the importance of some aspect of their teaching behaviors; however, only five then articulated how this is used to assess their teaching effectiveness. While the importance of one’s teaching behaviors transferred in a piecemeal fashion for most teachers, only five of the teachers indicated they use this information to assess their own teaching.
CHAPTER 5. DISCUSSION AND CONCLUSIONS

Summary of Research Purposes

The goal of this study was to identify the levels of explicit reflection-on-action and criteria with which teachers self-assess their teaching, and to compare these levels and criteria to classroom practices. These reflections and practices were then compared to the participants’ preservice preparation to determine the extent to which strategies taught transfer to classroom practice. To investigate these issues, this study utilized classroom observations and interviews. The participants were teachers relatively new to the field of elementary science and/or mathematics teaching. The interview included an examination of the criteria teachers consider, as well as the reasoning and reflection they use to make sense of the assessment criteria. By understanding the possible influences of teacher self-assessment and reflection on effective teaching practices, we may understand better what strategies are important for teachers’ professional development, and for inclusion in both inservice and preservice teacher education programs. In addition, we will better understand what aspects of self-reflection taught in the science methods course remain with participants as they become teachers.

Discussion of Research Findings

One of the objectives of the science methods course, specifically, and the education program, more generally, at Iowa State University is to instill in preservice teachers a sense of professionalism, which includes self-evaluation, so they will continue to improve their teaching long after they have left the university (Connor, Huey, & Killmer, 2003). Teachers constantly reflect and use this reflection to change teaching practices (Richardson, 1990b). Thus the question is not whether teachers reflect on their teaching practices and change their teaching over time, but to what degree do teachers reflect and change to be more consistent with effective teaching strategies?

Based on the findings of this study, self-assessment techniques taught explicitly in the science methods course (i.e., systematic assessment techniques, the use of a research-based conceptual framework, and the importance of self-assessment in conjunction with informed colleagues and administrator feedback, and student conceptual development over time) do not transfer to elementary teacher’s classroom practice in a coherent fashion. Instead the transfer of self-assessment
strategies appears disconnected and even disregarded, at times. Even though strategies did not wholly transfer to teachers' practice, differences in the sophistication of reflection and the systematic use of self-assessment strategies were noticed between the most and least effective teachers in this study. This section serves to elaborate these differences further.

The Conforming Nature of Teachers' Self-Assessment

The majority of teachers in this study did not assess their teaching in ways that will likely advance their teaching to be more congruent with national reform efforts and effective practices in education. While all teachers reflected on their teaching in ways considered to be confronting and considered possible solutions for the problems they faced in their classroom, those teachers who exhibited the least effective instruction also, unfortunately, reflected upon their practice in more superficial ways. The least effective teachers in this study often articulated a need to control student behavior and determined lesson effectiveness by assessing students' feelings, student behavior, student interests, teacher feelings, and the use of "good" activities. Additionally, these teachers also articulated dependence on outside authorities, such as curriculum resources, administrators, or colleagues, to determine their plan for, and assessment of, their instruction. Such superficial analysis and evaluation of one's teaching is highly consistent with the literature base describing novice teachers (Borko & Livingston, 1989; Clarridge & Berliner, 1991; Hogan et al., 2003; Kagan, 1992; Klein & Hoffman, 1991; Leinhardt & Greeno, 1986).

The middle level teachers in this study demonstrated greater effectiveness with classroom management, classroom routines, and basic lesson design and implementation; unfortunately, the degree to which these teachers sought to confront and restructure their classroom practice dwindled. Perhaps the middle level teachers, particularly the mid-high teachers, perceive they are effective teachers and thus see no need to confront and change their teaching practice to any considerable degree. These teachers can compare their current instruction with that of their earlier years and know they are better classroom managers, assert more control, and teaching feels easier than when they first started. However, the mid-high-level teachers focus so intently on control, order, and routine that perhaps the flexibility and artfulness needed to implement scientific and mathematical inquiry and problem-solving methods is stifled by the overwhelming sense that things must be done right and done efficiently. Thus, the mid-high-level teachers have taken research-based strategies, such as the learning cycle or hands-on inquiry, and conformed them to a more traditional model of elementary school instruction, rather than changing their practices to embrace more reform-based teaching practices. Because mid-high-level teachers do not recognize that their need for control in all situations
inhibits their ability to use inquiry authentically, it is not likely their teaching practices will change for the better. Perhaps the mid-high-level teachers have reached a "plateau"—a place where they sense they are stable and comfortable—thus working to further change their teaching practices seems unreasonable or unnecessary.

*The Confronting Nature of Effective Teachers' Self-Assessments*

The two most effective teachers in this study chose to confront and restructure their teaching practices in ways more congruent with the literature on expert teachers (Borko & Livingston, 1989; Hogan et al., 2003; Klein & Hoffman, 1991; Sabers et al., 1991; Westerman, 1991). Even though they also managed their classrooms effectively, these teachers chose to look beyond such superficial aspects of teaching and asked difficult questions concerning the understanding students created from learning situations, the assessment of students' understanding, the impact of students' learning on their everyday lives, the learning of individual students within the class, and the design of instruction that fostered meaningful learning for all students, not just some.

The reflection and assessment of the most effective teachers in this study often conveyed dissatisfaction with the quality of colleagues' instruction, the quality of administrator feedback, or the general importance placed on the improvement of teaching abilities within their school culture. These teachers were not satisfied to conform to the kind of the instruction they saw around them. They were not content with just having a job and "getting by." They want their instruction to be purposeful and meaningful for all of their students. The most effective teachers in this study demonstrated critical analysis of the teaching and learning that occurred in their own classrooms, and often of the kind of teaching and learning they saw occur in neighboring classrooms. Great care and responsibility was taken by these teachers to learn more about effective teaching, and to step out and change their teaching, when necessary, to conform to research-based practice and confront traditional elementary science education.

*Criteria for Teaching Effectiveness*

Research on teachers' self-assessment indicates that teachers most often utilize student behavior, feelings, and understanding to determine teaching effectiveness (Dunkin et al, 1996; Jackson, 1968; Jones & Airasian, 1995; MacLeod, 1988; McLaughlin, 1991). The results of this study concur; teachers often utilize students' behavior, participation, interest, and affect to determine teaching effectiveness. The teachers in this study also utilized student understanding to assess effectiveness, and similar to other studies, more effective teachers are more likely to utilize student
conceptual learning that occurs over time as an indicator of success (Jones & Airasian, 1995; MacLeod, 1988).

Additionally, research reports that teachers commonly utilize the critiques of outside authorities to determine teaching effectiveness (Dunkin et al., 1996; Jones & Airasian, 1995; MacLeod, 1988). In this study, teachers more frequently referred to the suggestions given or the activities shared by colleagues. The less effective teachers commonly compared what they did to what their colleagues did. As the teachers’ practice more closely looked like their colleagues, they considered their teaching more effective. Teachers did not have a chance to be observed by others often, but they did, at times, have opportunities to observe other teachers. Several teachers in this study articulated how as they observe others teach, they compare their teaching to the model in front of them and make adjustments accordingly.

The literature describing the criteria teachers use to assess their teaching generally notes the absence of a teachers’ critical analysis of self. Teachers either do not mention themselves at all (Jones & Airasian, 1995) or they assess their performance based on how they feel (MacLeod, 1988). The less effective teachers in this study often reflected on how they felt and used this as an assessment indicator. However, 10 of the 13 teachers in this study made mention of specific teaching behaviors in their post-lesson reflections. Only five of these teachers then specifically mentioned they use their own behavior to determine their teaching effectiveness. This indicates the teachers in this study consider aspects of their teaching behaviors, however, the knowledge base and implementation of these teaching behaviors is most likely disconnected. The science methods course emphasized the importance of effective teacher-student interaction patterns. Thus, it appears that for several teachers in this study, pieces of this knowledge base transferred to their teaching practices.

*The Piecemeal Implementation of Self-Assessment Strategies*

Even though 10 of the 13 teachers in this study articulated the importance of at least one aspect of their teaching interactions, only 5 of these teachers utilized concrete strategies to determine the effectiveness of teaching interactions. It appears that pieces of the research knowledge base has transferred and teachers can articulate specific teaching strategies that are effective for student learning, yet, for several teachers in this study, systematic study of such teaching practices was not utilized. Teachers do not often consider videotaping or audiotaping classroom teaching a viable strategy to improve classroom teaching (Wildman & Niles, 1987); therefore the use of audiotape or videotape by four teachers in this study is highly encouraging and appears to indicate the transfer of one aspect of the science methods course.
Theoretical Rationales for Teaching

The teachers in this study who more frequently articulated theoretical justifications for teaching decisions were the same teachers who implemented math and/or science teaching strategies more effectively. This research finding should be interpreted cautiously as one of the least effective teachers did articulate theoretical rationales minimally. Additionally, the extent to which the most effective teachers articulated theoretical rationales was not considerably higher than those teachers who exhibited less effective instruction. Given the narrative and tacit nature of teachers' knowledge bases on one hand (Munby et al., 2001; Schön, 1983), and the importance given to articulated rationales on the other hand (Clough, 2003; Clough & Kauffman, 1999; Fullan, 1994; Penick, 2003; Richardson, 1990b; Shulman, 1986), it is encouraging that for some of the teachers, aspects of this theoretical knowledge base, which was emphasized in the science methods course, can still be articulated and applied to classroom decisionmaking.

While the conclusions created from this study support the researchers who posit the importance of the articulation of theoretical rationales for teaching decisions (Clough, 2003; Clough & Kauffman, 1999; Fullan, 1994; Penick, 2003; Richardson, 1990b; Shulman, 1986), it is not clear whether teachers begin to articulate theoretical rationales as a result of their increasing effective instruction, if teachers need to understand and articulate the theoretical justifications to implement teaching strategies effectively, or if the two aspects of effective teaching—understanding and implementation of effective teaching—somehow increase in tandem. Therefore more research on these complex relationships is needed.

Teachers of Moral Purpose

Fullan (1994) articulates the need for all teachers to understand the sense of moral purpose that is at the center of effective instruction. Just as necessary as a well-developed knowledge base for classroom decisionmaking, teachers need to understand the purpose for which they are a teacher. The distinctions between the most effective teachers of this study and the least effective teachers often seem to be related to a sense of moral purpose. For instance, the most effective teachers are concerned with educating all students and providing a wholesome environment for children to learn, play, and develop as well-rounded human beings. They seek to change their instruction to better serve these noble ends of education. While the less effective teachers in this study often demonstrated that they could not effectively manage all the variables needed to promote these noble ends of education.
Therefore, their classrooms were often geared towards the least common denominator and the attainment of factual objectives rather than scientific inquiry.

The most effective teachers in this study appear to exemplify the kind of teachers Sarason (1993) speaks of, "Teaching is not and should not be for those unwilling or unable to be active agents of educational-institutional change. From the standpoint of the larger society, there is too much at stake to allow teachers to be passive participants in the dynamics and processes of change" (p. 19). The two most effective teachers in this study speak of how they teach differently than they were taught and how they desire to provide effective education, even though it looks different than their colleagues or what students and their may be accustomed to. They describe themselves as change-agents or renegades in a system that appears unchanged.

Possible Barriers to Self-Assessment

*Effective instruction is "student-centered."* Most teachers in this study were able to identify relevant classroom problems. In response to classroom problems, less effective teachers often blame the activity, the behavior of the children, the curriculum, the lack of resources, the time available, the day of the week—anything but their own interaction with students. Similarly, when lessons seem to be effective, these same teachers will attribute the success to the activity, the behavior of the children, the curriculum, the abundance of resources, the time, the day of the week—anything but their own interaction with students. The less effective teachers in this study referred to effective instruction as "student-centered" and then proceeded to describe a situation where students "learned on their own" without the assistance of a teacher. If teachers do not understand the critical role of the teacher in effective instruction, it is unlikely these same teachers will then systematically consider what they are doing as teachers within a lesson to determine the effectiveness of their instruction.

* A "colleague-based framework" for effective instruction. Teachers can help each other improve. Through peer coaching, and other collegial evaluation strategies, teachers can provide valuable information for determining one’s teaching effectiveness (Lemlech, 1995). However, the teachers in this study often referred to the “stealing of ideas” and “bag of tricks” colleagues possess. Thus, all but the most effective teachers in this study determined their teaching effectiveness by comparing the activities and strategies they used to what they saw their colleagues use, or what their colleagues said they used. There was no evidence the majority of teachers in this study considered the quality of their colleagues’ advice. They seemed to assume their colleagues were more effective teachers because they had been teaching for a greater number of years and seemed to provide an answer to all their questions and problems. The manner in which most of the teachers in this study
utilized their colleagues promotes the status quo and does not lead to effective self-assessment of one’s teaching practices.

The need to control students. The least effective teachers in this study struggled with classroom management and they knew it. As teachers became more effective, they still focused on controlling student behavior. Interestingly, the mid-high teachers in this study articulated the greatest need to control their students and sought to change their instruction the least. Perhaps these teachers did not critique their teaching to the degree of the other teachers in this study because they perceived they were effective—their students were well-behaved, gave “right” answers, and lessons were implemented as planned. This study suggests that such misapplied focus on classroom management and the micromanagement of every aspect of the classroom can lead to misapplied self-assessment. Further, this need for control made it unlikely that mid-high teachers could implement scientific and mathematic inquiry in the manner suggested by reform documents (NRC, 1996; NTCM, 2000).

Abstract nature of effective teaching. As preservice teachers, all the participants in this study created a research-based framework for teaching to guide teaching decisions. Based on the evidence collected in this study, more effective teachers were more likely to articulate this research-base in their reflections. Further, they often compared their teaching to this research-based standard. Less effective teachers unfortunately did not often articulate the theory base of teaching and therefore, were less likely to compare their teaching to this research-based standard. Instead, less effective teachers were more likely to use ambiguous or idiosyncratic criteria such as teachers’ feelings, students’ feelings, student behaviors, or a comparison to a colleague’s teaching to assess their teaching effectiveness.

Implications

Preservice Teacher Education

Given the small sample size of this study and the inherent complexities of learning to teach effectively, it is impossible to make broad generalizations. However, the findings of this study appear to highlight several tensions that occur within and between preservice teacher education and inservice teaching professional development. Preservice teacher education programs graduate novice teachers who are beginners in their field (Cushing et al., 1992); however, these novices are treated too often as though they should be able to think and act in ways similar to more expert and experienced teachers (Kagan, 1992). Consider novice or beginning teachers—because they are novices, knowledge is disconnected, thus things once discussed in their preservice teacher education program are forgotten
as they attend to more immediate needs and concerns, like behavior of students and the implementation of lesson plans (Hogan et al., 2003; Kagan, 1992). This is not surprising, given what is currently known about the nature of human cognition and the need to build cognitive networks beginning with personal and familiar experiences and knowledge. Yet, at all levels of teacher education, from preservice through inservice, teachers are often treated as though they should learn and then apply this learning through means research has shown to be ineffective for learners (Annenberg/CPB, 1998; Driver & Oldham, 1986; Goodlad, 1994; Posner, Strike, Hewso, & Gertzog, 1982; Stoddart et al., 1993). This study highlights the need for preservice and inservice teacher education to teach teachers in ways consistent with what is known about human learning.

Unfortunately, this study demonstrates that once beginning teachers “master” superficial and low-level issues of classroom management, they often don’t see a need to change their teaching practices. Such teachers appear to “plateau” at a level of teaching that not only feels comfortable for the teacher, but also conforms to what they see in their colleagues’ teaching. Perhaps teachers begin to “plateau” because they do not understand deeply the knowledge bases for effective teaching. Unfortunately, the less effective teachers in this study did not remember much of or they failed to articulate clearly the research base they supposedly learned while in their preservice teacher education program. Further, these teachers also articulated their uneasiness with strategies such as self-assessment because they did not know what effective teaching ought to look like.

How, then, should teacher education be structured? Most propositional teaching knowledge traditionally has occurred prior to any real teaching experience. Ironically, this contradicts much of what is known about effective teaching and learning (Ausabel, 1968; Piaget, 1964). Perhaps propositional knowledge and teaching experience need to occur in a more parallel fashion. For instance, perhaps teachers should begin with an initial license that assists with classroom management and pre-packaged science curriculum. Then, after two or three years of classroom experience, teachers would return to complete more theoretical work related to how children learn, self-assessment, the desired state of teaching, and the purposes of schooling. Perhaps teachers would feel so successful after the initial two years of experience that the return to study the theoretical knowledge bases of teaching would be rejected.

Perhaps a change in the structure of preservice education is not needed for two of the teachers in this study were quite effective and three other teachers implement instruction that is often consistent with effective teaching. Of concern, however, are the three or four teachers at the lowest implementation levels in this study. They give no indication of getting better, particularly the fifth-year teacher. What could have been done differently to assist these teachers in their development?
Teacher Attributes

Perhaps the most effective teacher education is not at all related to the structure of the program, and instead has more to do with individual teacher characteristics such as a sense of moral purpose, motivation to learn, willingness to implement new ideas and take risks, or ability to reason abstractly. If this is the case, perhaps teacher education would be better served to determine those characteristics needed to be effective teachers and recruit, educate, and retain prospective teachers accordingly. For instance, what if it is found that effective science teachers need to think abstractly to implement guided scientific inquiry with children in a classroom. Evaluations of preservice and inservice teachers to determine abstract reasoning abilities, then instruction to match where they are weak in reasoning, may help them handle the cognitive load of effective science teaching (Kegan, 1995). This study does not advocate the well-known cliché, “Teachers are born and not made;” however, if it is found that particular personal qualities are beneficial in classroom teaching preservice and inservice teacher education would be wise to consider how such information should inform current teacher education practices.

Further, perhaps not all elementary teachers should attempt to teach elementary science. Instead, elementary science specialists may be needed to provide the kind of science experiences we say all children deserve and need. Often the need for an elementary science specialist is centered in the issue of science content knowledge. However, only 2 of the 13 teachers in this study seemed to demonstrate the capabilities to teach science and/or mathematics in ways that incorporate scientific inquiry and mathematical problem-solving. Perhaps the complex combination of science content knowledge, pedagogical knowledge, pedogocial content knowledge, and other factors such as materials management, classroom management, and time, work together to make the the teaching of elementary science a daunting challenge for all but the best and brightest elementary teachers.

Theoretical Knowledge Bases

The results of this study indicate that less effective teachers lack understanding of the desired state of teaching and do not often base teaching decisions on the theoretical knowledge bases for effective teaching. How will these struggling teachers improve their practice if they solely rely on ambiguous and idiosyncratic feelings or behaviors for comparison to their teaching? While all of these teachers created a “research-based framework for teaching” (RBF) paper and orally defended it in their preservice science methods course, more systematic teaching of the need for research and the application of it to specific teaching problems appears to be necessary. Current use of the RBF paper
may be too abstract and considers teaching in an idealized sense. Perhaps preservice teachers would benefit more in the long-term if they systematically learned to search for research that applies to particular problems they face in their practica and student teaching settings.

**Systematic Self-Assessment Strategies**

It appears that the overt emphasis placed on systematic self-assessment using concrete strategies such as videotape or audiotape transfers to some teachers’ classroom practice. It is not clear why certain teachers use these strategies and others do not. However, this provides support for the continued use of such strategies in methods courses. Considering the research to substantiate the misperceptions that can easily occur in novice teachers’ evaluation of classroom situations (Hogan et al, 2003), this study supports the systematic use of videotape and/or audiotape more consistently throughout the preservice program, student teaching, and the preliminary years of teaching. Given the rather superficial assessment indicators that less effective teachers tend to use to evaluate their performance, more scaffolds are needed to attend preservice and inservice teachers explicitly to potentially critical areas of their teaching practices. What measures might be employed at both the preservice and inservice levels for teachers to see the need for such systematic self-assessment? How might administrators promote such strategies?

**Outside Authority Feedback**

Many of the teachers in this study seem to not understand how to consider outside authorities’ advice and feedback appropriately. Perhaps more consistent efforts should occur within the teacher education program to help preservice teachers learn how to appropriately use administrator and colleague feedback. It appears that in their dependence on watching others teach, these beginning inservice teachers do not have good mental picture of what effective teaching should look like. They then assume, sometimes wrongly, that their colleagues will show them what effective instruction should look like. How can we provide more modeling of effective instruction at the preservice and induction levels of teaching?

**Teacher Portfolios**

While is it recognized this is a small sample, it is discouraging to hear beginning teachers compare their teaching portfolios to a scrapbook. For beginning teachers continued development as teachers, it is necessary for teacher portfolios to be more than a reporting device; however, the findings of this study indicate that for most teachers in this study the portfolio was merely a
compilation of evidence that they are meeting the standards required of them by state and district officials. The concern is that teachers can spend a lot of time creating such a portfolio, and, if such a portfolio is not causing them to systematically reflect and assess their practice, then perhaps this time better served, particularly if the education system is concerned about the growth and development of beginning teachers. The danger in the current system is that teachers are showing how they are effective. They are showing and reporting all the ways they see that they attain the standards of effective teaching, yet classroom observations demonstrate that some teachers still have a long ways to go to really be effective teachers. Perhaps portfolios then impede any need for teacher self-assessment and change towards more research-based practices. Perhaps the beginning teacher portfolio needs to adopt more systematic measures that cause teachers to utilize taping strategies, coding and rating strategies, systematic self-assessment, and theoretical knowledge bases. Additionally, the current portfolio system focuses on 8 teaching standards that contain 42 criteria for effectiveness. Perhaps the beginning teacher needs to first concentrate on particular areas, then as competence is demonstrated and improvement is shown, other categories, still important but not vital for the day-to-day management of the classroom (i.e., communication with parents), can be added and addressed.

Recommendations for Further Study

1. This study reports that more effective teachers also more consistently articulate a research-based rationale for their teaching decisions, while less effective teachers do not articulate rationales to such a degree. There are several education programs across the nation implementing rationale papers and/or oral defenses with their preservice teachers. In what ways do graduates from other elementary education programs and secondary science education programs transfer their teaching rationales to their classroom practice? What are the relationships between the development of rationales and teaching effectiveness compared to more skills-based methods approaches?

2. The state of Iowa has implemented the use of teacher portfolios to determine teacher effectiveness. However, as used by the teachers in this study, this tool appears to be a reporting measure and not necessarily an effective tool to promote deep reflection and assessment of teaching practices. If teachers are merely looking for evidence to show they meet a standard and not necessarily analyzing their practice to promote teacher change in thinking or strategy implementation, it appears the time invested in the creation and
maintenance of a teacher portfolio might be better used. How can we promote deep and meaningful reflection in inservice teachers and subsequent change in practice?

3. In most cases, there is incongruency between what is advocated in methods and what is seen in practicum and student teaching placements. While self-assessment is advocated in science methods, what preservice teachers see in schools is often much more relevant to them. What would happen to the long term use of concrete and accurate self-assessment if preservice teachers were placed with inservice teachers who modeled extensive self-assessment and held practicum and student teachers accountable for the application of self-assessment practices in their own teaching?

4. Interestingly, the most effective teachers in this study were both male. To what extent are gender issues involved? Both expressed interest in pursuing doctoral degrees at some point in their career. Both actively seek out opportunities to grow personally and professionally. To what extent are such interests and academic pursuits indicative of effective elementary teachers?

5. It seems that to effectively implement the kind of instruction advocated in both the math and science reform movements, one needs to be able to handle multiple variables simultaneously and work within a high degree of complexity and ambiguity. To what extent is abstract thinking necessary to implement effective elementary science instruction? To what extent are the majority of teachers in our preservice elementary programs thinking at such a level? Kegan (1995) suggests abstract thinking can be taught. If elementary science teachers were explicitly instructed in ways to increase their abstract thinking capabilities, in what ways would their classroom practice change?
REFERENCES


### APPENDIX A. SELF-ASSESSMENT CRITERIA

<table>
<thead>
<tr>
<th>Grading for Science Methods</th>
<th>Formal Operational Teacher</th>
<th>Transitional between Concrete and Formal Operational Teacher</th>
<th>Concrete Operational Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grade = A</td>
<td>Grade = B</td>
<td>Grade = C</td>
</tr>
<tr>
<td>Research-Based Framework for Teaching Science</td>
<td>All student goals reflect the consensus reached in the science ed. community. Each goal is taken through the schematic using extensive &amp; specific research-based strategies. Reflection is extensive. *</td>
<td>Student goals reflect the consensus reached in the science ed. community. Has trouble at times taking goals through the schematic and applying research. Research and reflection are lacking in some areas.</td>
<td>Some student goals reflect the consensus reached in the science ed. community. Has difficulty taking goals through the schematic. Important research support is missing. Little attention to class &amp; relevant topics.</td>
</tr>
<tr>
<td>Contributions to Class Discussions</td>
<td>Constructive comments contributed each class without hindering other students from speaking. + influence on discussion.</td>
<td>Constructive comments contributed sporadically. Does not hinder other students &amp; creates a + atmosphere for discussion.</td>
<td>Mostly contributes when called upon. Sometimes takes discussion off task and contributions are sometimes not positive.</td>
</tr>
<tr>
<td>Attendance</td>
<td>Misses class only in a true emergency. Does not arrive late or leave early.</td>
<td>Misses two or fewer classes. Almost never arrives late or leaves early.</td>
<td>For any reason misses three or more classes. Sometimes arrives late or leaves early.</td>
</tr>
<tr>
<td>Attitude</td>
<td>Very positive attitude and always enthusiastic about teaching. Demonstrates a sense of humor and is always professional.</td>
<td>Positive attitude, cordial, and usually enthusiasm about teaching is evident. Most always professional.</td>
<td>No general attitude may be discernable. May exhibit cynicism, complaining, or anger. Often professional.</td>
</tr>
<tr>
<td>Case Study</td>
<td>Analysis is goal-directed and thorough, connecting elements of the schematic in a robust framework.</td>
<td>Analysis is fragmented but thorough. Connects many elements of the schematic, but misses some connections.</td>
<td>Analysis is fragmented and misses important connections. Pieces are memorized, but not connected to a coherent whole.</td>
</tr>
<tr>
<td>Exit Interview</td>
<td>Clearly articulates the important aspects of a research-based framework for teaching science. Shows understanding of complex interactions. Responses and examples are relevant and to the point.</td>
<td>Omits a few aspects of a research-based framework for teaching science. Understanding of complex interactions is unclear. Responses and examples are sometimes vague and not to the point.</td>
<td>Omits critical aspects of a research-based framework. Understanding of complex interactions not often evident. Responses and examples are often vague, not to the point, and portrays shotgun approach.</td>
</tr>
</tbody>
</table>

*RBF Paper: Cites many specific examples demonstrating a clear picture of the desired state of science teaching and what YOU will do in the classroom to make this a reality. Each student goal is taken through the schematic using extensive evidence showing a robust understanding of the fundamental issues in the teaching profession. A rationale paper should reflect contemporary learning theory, questioning, wait-time, responding behaviors, learning cycle, cooperative learning, highly interactive teaching, assessment, etc. Citations demonstrate additional research.
APPENDIX B. INFORMED CONSENT DOCUMENT

Title of Study: Self-Assessment Practices used by Elementary Teachers

Investigators: Andrea J. Madsen, M.S. and Joanne Olson, Ph.D.

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION

The purpose of this study is to investigate the influence self-assessment practices have on elementary teachers classroom practices. This project will provide empirical evidence on the effectiveness of self-assessment, enabling teacher education institutions and district professional development to structure their programs in a manner that will increase the likelihood of producing effective teachers. You are being invited to participate in this study because you are an elementary teacher who has recently graduated from Iowa State University.

DESCRIPTION OF PROCEDURES

If you agree to participate in this study, your participation will last for approximately one day, including a classroom observation and one semi-structured post-observation interview.

RISKS

There are no foreseeable risks to study participation at this time.

BENEFITS

If you decide to participate in this study there will be no direct benefit to you. It is hoped that the information gained in this study will benefit society by helping policy makers and teacher educators alike design and implement more effective preservice and inservice teacher education programs, thereby benefitting future teachers and their students.

COSTS AND COMPENSATION

You will not have any costs from participating in this study. You will not be compensated for participating in this study.

PARTICIPANT RIGHTS

Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled.

CONFIDENTIALITY

Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies such as the Department of Education and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, all participants will be assigned an identification number. This number will be used on all forms instead of their name. All data will be
kept in a locked room with access to data being granted to the researchers listed on this form. Consistent with research protocol, all data will be kept for seven years following the research study. If the results are published, your identity will remain confidential.

QUESTIONS OR PROBLEMS
You are encouraged to ask questions at any time during this study. For further information about the study contact Andrea Madsen, (515) 294-8931, ajmadsen@iastate.edu. If you have any questions about the rights of research subjects or research-related injury, please contact the Human Subjects Research Office, 2810 Beardshear Hall, (515) 294-4566; austingr@iastate.edu or the Research Compliance Officer, Office of Research Compliance, 2810 Beardshear Hall, (515) 294-3115; dament@iastate.edu

*****************************************************************************

PARTICIPANT SIGNATURE

Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You will receive a copy of the signed and dated written informed consent prior to your participation in the study.

Participant’s Name (printed): ____________________________________________

_________________________________ (Participant’s Signature) (Date)

INVESTIGATOR STATEMENT

I certify that the participant has been given adequate time to read and learn about the study and all of their questions have been answered. It is my opinion that the participant understands the purpose, risks, benefits and the procedures that will be followed in this study and has voluntarily agreed to participate.

_________________________________ (Signature of Person Obtaining Informed Consent) (Date)
APPENDIX C. LSC CLASSROOM OBSERVATION PROTOCOL

All information reported here is taken directly from the 2004-2005 Core Evaluation Manual (Horizon Research, Inc., 2004).

General Comments

The 2004-2005 Local Systemic Change Classroom Observation Protocol is designed to be completed by the certified observer conducting LSC core evaluation classroom observations. The instrument is intended to reflect current standards for exemplary practice, but not to prescribe particular instructional strategies. Observers should refer to the following documents for background information about current standards for classroom instruction: NCTM’s *Principles and Standards for School Mathematics* (2000) and NRC’s *National Science Education Standards* (1996).

Observers should assess instruction in light of the particular purposes of the instruction being observed. It is important to remember that ratings are to be criterion-referenced, not norm-referenced. Instruction should be rated based on its match to current standards, not rated highly because it is better than most other instruction you’ve seen in particular kinds of settings.

More information on the LSC Classroom Observation Protocol can be found on the website (http://www.horizon-research.com/LSC).

Section One: Contextual Background and Activities

In this section, the observer notes classroom demographics, purposes of the lesson, description of physical environment, and a lesson description.

Section Two: Ratings

In Section One of this form, you documented what occurred in the lesson. In this section, you are asked to rate each of a number of key indicators in four different categories, from 1 (not at all) to 5 (to a great extent). You may list any additional indicators you consider important in capturing the essence of this lesson and rate these as well. Use your “Ratings of Key Indicators” to inform your “Synthesis Ratings.” It is important to indicate in “Supporting Evidence for Synthesis Ratings” what factors were most influential in determining your synthesis ratings and to give specific examples or quotes to illustrate those factors.

Note that any one lesson is not likely to provide evidence for every single indicator; use 6, “Don’t know” when there is not enough evidence for you to make a judgment. Use 7, “N/A” (Not Applicable) when you consider the indicator inappropriate given the purpose and context of the lesson. Section Two concludes with ratings of the likely impact of instruction, and a capsule description of the lesson.

This section relies heavily on the observer’s synthesis and interpretation of what was observed in the classroom. The key indicators are a guide to elements of the instruction that should be considered in each of the four rating categories. Throughout this section, a key question to ask is “Was this lesson
likely to help move students in the desired direction?" Keep in mind that "moving thinking forward" does not mean that students must have a full understanding of the targeted concept or that the lesson necessarily comes to complete resolution. Students' understanding may be moved forward in different ways through different types of lessons. For example: Lessons might be designed for students to gain experiential awareness; to engage in open exploration; to practice skills; to review, reinforce, and apply emerging understanding; or to develop curiosity and questioning about a particular concept or phenomenon.

Each key indicator in each of the four rating categories may be rated 1-5, 6 (don't know), or 7 (not applicable). Ratings of "not applicable" should be made when the attribute described in the key indicator is not present, but its absence did not limit the effectiveness of the lesson. If the attribute is one whose absence negatively impacts the effectiveness of the lesson, it should receive a low rating. For example, if opportunities for "sense-making" were not designed into the lesson, and there clearly needed to be some time devoted to in-depth thinking (e.g., why different groups came up with different solutions to a particular problem, the implication of findings for subsequent work) then indicator 7 in design would receive a relatively low rating.

Note that even an excellent lesson would likely not rate highly on every applicable indicator, nor are the synthesis ratings intended to be an "average" of the individual indicator ratings. It is the observer's responsibility with knowledge of the purposes and context of the lesson and the experience of being there, to make a decision about how to weight these indicators to arrive at a synthesis rating for each category.

Some concern has been expressed about the potential bias toward "active and collaborative learning" conveyed by the key indicators of this form. While current national standards emphasize an active role for students, based on the belief (and some research evidence) that such strategies lead to greater student understanding, NSF's overriding goal is to have students learn important science and mathematics concepts. You may observe a fairly didactic, teacher-centered lesson that is geared to the needs and interests of the students, clearly engages them, and is likely to move their conceptual understanding forward; such a lesson could be rated a 4 or even a 5.

You may encounter situations where, for example, the strategies and materials are appropriate for the intended purposes, but in your judgment, the purposes of the lesson are not reflective of current standards. In such circumstances, indicator ratings should be made based on the teacher's intended purposes. Synthesis ratings and your supporting evidence would reflect the fact that the purposes were not consistent with current standards.
I. Design

The “design” of the lesson is not a reference to the “lesson plan,” but rather the structure of the observed lesson: what happened first, second, third, etc.; and how much time was allowed for each of these activities. This category generally encompasses the activities, the instructional strategies, the assigned roles, and the resources of the lesson. The key indicators provide detailed information on what aspects of the lesson to consider in rating the design.

Some notes on individual key indicators:

1. The term “investigative” refers to instruction in which students are working toward refining the answers to meaningful questions. There is not restriction on who posed the question—i.e., it could have been either the students or the teacher.

2. See the above clarification of the term “design.”

3. While classes may exhibit variations in extent of attention toward individual students’ experience, preparedness and/or learning style, this rating should reflect the predominant manner in which the strategies and activities addressed student needs.

6. The term “collaborative” refers to a design in which the students and teacher share/use each other’s knowledge, contributions and experiences.

7. In this indicator, “sense-making” is broadly defined to include time for thought/processing. It may occur in a variety of contexts: individually, in groups, or as a whole group activity, and at any time in the lesson: before, during, or after an activity, as part of the wrap-up, etc. Document, here, the extent to which the lesson included well-planned opportunities for “sense-making”; rating of quality and effectiveness may also occur elsewhere (e.g., in category III. Mathematics/Science Content, item 9).

9. “Formal assessments” might include tests or performance tasks. The point is to look at the message “test” are sending to students about what learning is important. Tests that assess deeper understanding would be rated highly on this indicator; tests that assess superficial knowledge of terminology and computation would often receive lower ratings.

10. While you may be able to rate this indicator based only on the classroom observation, in most cases a rating other than 6 or 7 would need to be based on information from the post-observation interview.
## Design

### Ratings of Key Indicators

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Not at all</th>
<th>To a great extent</th>
<th>Don’t know</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The design of the lesson incorporated tasks, roles, and interactions consistent with investigative mathematics/science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>The design of the lesson reflected careful planning and organization.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>The instructional strategies and activities used in this lesson reflected attention to students’ experience, preparedness, and/or learning styles.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>The resources available in this lesson contributed to accomplishing the purposes of the instruction.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>The instructional strategies and activities reflected attention to issues of access, equity, and diversity for students (e.g. cooperative learning, language-appropriate strategies/materials).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>The design of the lesson encouraged a collaborative approach to learning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>Adequate time and structure were provided for “sense-making.”</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8.</td>
<td>Adequate time and structure were provided for wrap-up.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>Formal assessments of students were consistent with investigative mathematics/science.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10.</td>
<td>Design for future instruction takes into account what transpired in the lesson.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

### Synthesis Rating

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Design of the lesson not at all reflective of best practice in mathematics/science education.</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
II. Implementation

This category refers to how the teacher carries out the basic structure of the lesson. The critical questions are “How effectively does the teacher implement the design?” and “Is the implementation of the lesson likely to move the students in that particular class forward in their understanding?”

Some notes on individual key indicators:

1. Note that in Section One, Part IV, observers are asked to document whether LSC-designated materials are used. If so, observers indicate the extent to which the teacher adhered to the instructional materials, and how adaptations affected the quality of the lesson design. In rating the indicator in this section, the observer should assess the extent to which the implementation reflected the spirit of the LSC-designated materials whether or not those particular materials were used in the lesson.

2. Instructional strategies that are most consistent with “investigative science/mathematics” portray the disciplines as dynamic bodies of knowledge generated and enriched by investigation. Strategies that are rated highly might build in and actively demonstrate those characteristics; those rated lower might negate or misrepresent the investigative nature of the disciplines.

3. Indicators of confidence may well depend on indirect or subjective cues. This indicator should be rated based on the activities/behaviors/interactions of the teacher in the class rather than information provided in pre or pose-interviews.

6. Data from a variety of sources could contribute to rating the extent to which the teacher was able to “read” the students’ level of understanding and adjust accordingly (i.e., types or levels of questions directed to particular students, etc.). Without sufficient information, observers should not hesitate to rate this indicator “don’t know.”

7. In rating questioning strategies, attend to whether the teacher’s questions are open-ended, as opposed to focused solely on one answer, and the extent to which the teacher probes for student reasoning and misconceptions. Key questions to guide the rating are “Does the questioning help the teacher understand student conceptions?” and “Is the questioning likely to help develop the conceptual understanding of students and move their thinking forward?”

8. Modifications of the lesson may or may not be apparent. Use both the observation and pre-post-interviews to make this rating, but keep in mind that some of the best teachers may not even be consciously aware of how they are modifying lessons. Follow the general guidelines established for ratings: “N/A” if the lesson was not modified and didn’t need to be; “don’t know” if it is not clear whether it was modified or not; or ratings from 1-5 as appropriate. For example if it was clear (e.g., from students’ questions, comments, performance) that students were not getting it and the teacher proceeded as planned with no change and had no appropriate rationale for sticking to the plan, you might rate it a 1 or 2; if the teacher clearly modified the lesson in process, you might rate it between 3 and 5 depending on the effectiveness of the modification.
## Implementation

<table>
<thead>
<tr>
<th>Ratings of Key Indicators</th>
<th>Not at all</th>
<th>To a great extent</th>
<th>Don't know</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The instruction was consistent with the underlying approach of the instructional materials designated for use by the LSC.</td>
<td>1 2 3 4 5</td>
<td>6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The instructional strategies were consistent with investigative mathematics/science.</td>
<td>1 2 3 4 5</td>
<td>6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The teacher appeared confident in his/her ability to teach mathematics/science.</td>
<td>1 2 3 4 5</td>
<td>6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. The teacher’s classroom management style/strategies enhanced the quality of the lesson.</td>
<td>1 2 3 4 5</td>
<td>6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The pace of the lesson was appropriate for the developmental levels/needs of the students and the purposes of the lesson.</td>
<td>1 2 3 4 5</td>
<td>6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The teacher was able to “read” the students’ level of understanding and adjusted instruction accordingly.</td>
<td>1 2 3 4 5</td>
<td>6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. The teacher’s questioning strategies were likely to enhance the development of student conceptual understanding/problem solving (e.g., emphasized higher order questions, appropriately used “wait time,” identified prior conceptions and misconceptions).</td>
<td>1 2 3 4 5</td>
<td>6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. The lesson was modified as needed based on teacher questioning or other student assessments.</td>
<td>1 2 3 4 5</td>
<td>6 7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Synthesis Rating

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>
III. Mathematics/Science Content

The content category includes both concepts and process skills in science and mathematics. Keep in mind that there is not one “right” formula—the balance of concepts and processes needs to be appropriate for the purposes of the lesson.

Some notes on individual key indicators:

1. When rating this indicator, consider the importance of the mathematics/science content independent of other factors, such as appropriateness for the particular students in the observed class.

2. Focus in this indicator on the developmental appropriateness of the mathematics/science content for this class regardless of its inherent importance in K-12 science/mathematics.

3. In rating this indicator, observers should be attuned to the qualitative connotation of “intellectually engaged” that goes beyond simply doing the task. Attention should also be directed to the proportion of students who appeared to be intellectually engaged. A rating of 5 should be made only if most students were deeply engaged.

4. Rate this indicator “N/A” if there was no teacher-provided content information.

7. If elements of mathematical/scientific abstraction were included when it was appropriate to do so, this item should be rated highly. If abstractions were included, but inappropriate for the students or lesson, the item should be rated 1 or 2. If mathematical/scientific abstractions were lacking and their absence limited the effectiveness of the lesson, the item should be rated 1 or 2. If mathematical/scientific abstractions were absent and their absence was inconsequential, the item should be rated “N/A.”

8. Connections to other areas of mathematics/science, to other disciplines, and/or to real-world contexts is an element of instruction that may facilitate student learning, but may not be necessary or even appropriate for particular lessons. Use the general rating guidelines: “N/A” if it was not a part of the lesson and its absence was not a detriment to student learning; a low rating if the absence of connections was a likely hindrance to student learning.

9. Rate the appropriateness of “sense-making” of mathematics/science content in this lesson, considering where the class was within the sequence of lessons in a particular unit. Information provided by the teacher in the post-interview may be useful here.
### Mathematics/Science Content

#### Ratings of Key Indicators

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>Not at all</th>
<th>To a great extent</th>
<th>Don’t know</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The mathematics/science content was significant and worthwhile.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>The mathematics/science content was appropriate for the developmental levels of the students in this class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>Students were intellectually engaged with important ideas relevant to the focus of the lesson.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>Teacher-provided content information was accurate.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>The teacher displayed an understanding of mathematics/science concepts (e.g., in his/her dialogue with students).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>Mathematics/science was portrayed as a dynamic body of knowledge continually enriched by conjecture, investigation analysis, and/or proof/justification.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>Elements of mathematical/science abstraction (e.g., symbolic representations, theory building) were included when it was important to do so.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8.</td>
<td>Appropriate connections were made to other areas of mathematics/science, to other disciplines, and/or real-work contexts.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>The degree of “sense-making” of mathematics/science content within this lesson was appropriate for the developmental levels/needs of the students and the purposes of the lesson.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Synthesis Rating

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mathematics/science content of the lesson not at all reflective of current standards of mathematics/science education.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Mathematics/science content of lesson extremely reflective of current standards for mathematics/science education.</td>
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</tbody>
</table>
IV. Classroom Culture

This category combines indicators directed toward the extent and nature of the engagement of students in the class, and provides an opportunity for an observer to comment on issues of equity and diversity that may have impacted the culture of the classroom.

Key indicators 1-4 should always be rated on the 1-5 scale; for indicators 5 and 6, the full rating scale (1-7) should be considered. Note that the synthesis rating should reflect the extent to which classroom culture interfered with or facilitated student learning.

Some notes on individual key indicators:

1. When rating this indicator, attend to the extent to which active participation was encouraged/valued. The nature and quality of the participation is addressed in other indicators, such as 5 and 6.

6. This indicator often carries a lot of “weight” in the synthesis rating since participation without intellectual rigor is not likely to contribute meaningfully to student learning.
### Classroom Culture

<table>
<thead>
<tr>
<th>Ratings of Key Indicators</th>
<th>Not at all</th>
<th>To a great extent</th>
<th>Don’t know</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Active participation of all was encouraged and valued.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. There was a climate of respect for students’ ideas, questions, and contributions.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Interactions reflected collegial working relationships among students (e.g., students worked together, talked with each other about the lesson).</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Interactions reflected collaborative working relationships between teacher and students.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The climate of the lesson encouraged students to generate ideas, questions, conjectures, and/or propositions.</td>
<td>1 2 3 4 5</td>
<td>6 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Intellectual rigor, constructive criticism, and the challenging of ideas were evident.</td>
<td>1 2 3 4 5</td>
<td>6 7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Synthesis Rating

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom culture interfered with student learning.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Classroom culture facilitated the learning of all students.</td>
</tr>
</tbody>
</table>
V. Capsule Description of the Quality of the Lesson

In this final rating of the lesson, consider all available information about the lesson, its context and purpose, and your own judgment of the relative importance of the ratings you have made. Select the capsule description that best characterizes the lesson you observed. Keep in mind that this rating is not intended to be an average of all the previous ratings, but should encapsulate your overall assessment of the quality and likely impact of the lesson. Please provide a brief rationale for your final capsule description of the lesson in the space provided.

Level 1: Ineffective Instruction
There is little or no evidence of student thinking or engagement with important ideas of mathematics/science. Instruction is highly unlikely to enhance students’ understanding of the discipline or to develop their capacity to successfully “do” mathematics/science. Lesson was characterized by either (select one below):

Passive “Learning”
Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher or textbook; material is presented in a way that is inaccessible to many of the students.

Activity for Activity’s Sake
Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity’s sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.

Level 2: Elements of Effective Instruction
Instruction contains some elements of effective practice, but there are serious problems in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is very limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully “do” mathematics/science.

Level 3: Beginning Stages of Effective Instruction (select one below)
Low 3    Solid 3    High 3
Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are weaknesses, ranging from substantial to fairly minor, in the design, implementation, or content of instruction. For example, the teacher may short-circuit a planned exploration by telling students what they “should have found”; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is somewhat limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully “do” mathematics/science.

Level 4: Accomplished, Effective Instruction
Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and the teacher implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is quite likely to enhance most students’ understanding of the discipline and to develop their capacity to successfully “do” mathematics/science.

Level 5: Exemplary Instruction
Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work (e.g., investigation, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and artfully implemented, with flexibility and responsiveness to students’ needs and interests. Instruction is highly likely to enhance most students’ understanding of the discipline and to develop their capacity to successfully “do” mathematics/science.
APPENDIX D. INTERVIEW QUESTIONS

I'd like to ask you questions pertaining to the lesson I observed today. Then we will transition into some professional development questions. I want you to know that this information will not be shared with anyone else at your school and in the final paper your name will never appear with any of your comments. I am not looking for "right" answers to these questions. I am interested in knowing what your experience as an elementary teacher has been like and want to gain an honest and accurate picture of your experience.

Questions Pertaining to Observed Lesson

1. What were your goals for the lesson I observed today?

2. How well do you think your students met those goals? What evidence do you have that makes you say that? What criteria are you comparing your students to?

3. How well do you think you taught for those goals? Again, what evidence do you have to support your comments? What criteria are you comparing yourself to?

4. If you could teach this lesson over, what, if anything, would you do differently? Why?

5. What kinds of questions are going through your mind about the lesson now that it is over?

6. How do you determine whether the lessons you teach are effective or not?

Questions Pertaining to Overall Self-Assessment

7. How do you determine whether you are an effective teacher?

8. How many times has an administrator observed your teaching? What was the experience like? How did you use your administrators' comments from the evaluation?

9. Has a colleague ever watched you teach? If so, how was this arranged? (Did the teacher invite someone in to watch him/her teach?) How do you use your colleagues' comments to improve your teaching?

10. How do you use your students to determine your teaching effectiveness?

11. How many times have you audiotaped or videotaped your teaching? What did you use the tapes for? What did you listen or look for on the tapes to improve your teaching? What other concrete things have you used to help improve your teaching practices? When you teach a lesson, what about yourself do you consider?
Questions Pertaining to Professional Development Issues

12. What professional development have you been involved in with your colleagues in your district? Describe your attitude concerning these professional development opportunities. What educational literature has your principal asked you to read? Did you read it?

13. What school-related leadership activities have you been involved in since graduation?
(see information about curriculum development, materials adoption, department chair roles, after-school clubs, involvement in workshops, taking additional classes, graduate degrees, etc.)

14. Describe your involvement in professional organizations, like NSTA?
   a. Do you read _________? (the major journal of the named organization?)
   b. How often do you read it?
   c. How many conferences have you attended?
   d. Have you ever presented at any of these conferences? (ask for elaboration)
   e. (If a teacher is involved in such organizations, also seek information about committee membership, reviewing for journals, publishing activities in such journals, using ideas from journal, networking with colleagues through the organization, etc.)

15. How many years have you been teaching?

16. Describe for me the moral and climate of your working environment. (Seek information that might hinder professional development)

17. How well do you get along with parents?

18. How well do you get along with colleagues?

19. How long do you think you will remain in the profession?
ACKNOWLEDGEMENTS

For the past four years I have been mentored by Dr. Joanne Olson. Words seem inadequate to express the depth of gratitude I have for all Joanne has invested into me as a graduate student, a teacher educator, a colleague, and as a friend. Her insight, expertise, and sound counsel throughout my graduate career, but particularly during this dissertation year, has been very useful and valuable to me. I am also thankful for the encouragement and moral support Joanne provided throughout my graduate school experience.

I have also worked extensively with Dr. Michael Clough. I am thankful for all the ways Mike shared his teaching expertise with me. I am indebted to Mike for all the ways he helped me to begin to see the complexities that occur in effective science instruction. I am grateful to the other members of my committee, Dr. David Owen, Dr. Mack Shelley, and Dr. Jim Colbert, for the expertise they shared with me throughout my graduate career and the insight they provided to this dissertation project.

I am grateful for the many people who have entered my life during this graduate school experience. Whether fellow graduate students or friends, they all have in some way impacted this study. I am particularly indebted to Crystal Bruxvoort, as she was my confidant throughout this dissertation experience. I am grateful to Emily Moriarity and Emily Bomgaars for their friendship, prayers, encouragement, and support.

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I must acknowledge this paper is a direct result of the gifts God has so graciously given me. He has blessed me with a mind capable to persist in the academic arena and a heart for the students and teachers who spend time in our public school system. I am grateful for the opportunities to know and teach high school and college students and look forward to the new opportunities that will arise through the completion of this dissertation.
Andrea Madsen grew up on a farm in western Iowa and graduated from Westwood High School in Sloan, Iowa in 1994. She attended Morningside College in Sioux City, Iowa where she was active in several music ensembles, Science Club, and worked as an undergraduate research assistant in organic chemistry and genetics. She student taught at West High School in Sioux City, Iowa and graduated in May of 1998. She then taught biology, chemistry and human anatomy for two years at Schaller-Crestland High School in Early, Iowa.

During the fall of 2000, Andrea enrolled as a graduate student at Iowa State University. While at Iowa State, Andrea taught two semesters of Biology 201/202 lab, seven semesters of C I 449, Science Methods for Elementary Teachers, and two semesters of C I 439, Science Methods for Early Childhood Teachers. Additionally, Andrea served as a camp counselor for the STAR Science camp program and assisted with elementary teachers professional development for the Science Cooperatives project. She also supervised secondary science student teachers.

In the fall of 2005, Andrea will return to secondary science teaching as she has accepted a biology and chemistry teaching position with the Norwalk Community School District in Norwalk, Iowa.