TEACHERS' KNOWLEDGE OF FORMATIVE ASSESSMENT INITIAL INSTRUMENT VALIDATION STUDY

by

Amanda L. Bremner

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Amanda L. Bremner

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The following individuals read and discussed the dissertation submitted by student Amanda L. Bremner, and they evaluated her presentation and response to questions during the final oral examination. They found that the student passed the final oral examination.

Keith Thiede, Ph.D.	Co-Chair, Supervisory Committee
Michele Carney, Ph.D.	Co-Chair, Supervisory Committee
Jonathan Brendefur, Ph.D.	Member, Supervisory Committee
Richard Osguthorpe, Ph.D.	Member, Supervisory Committee
Roger Stewart, Ph.D.	Member, Supervisory Committee

The final reading approval of the dissertation was granted by Keith Thiede, Ph.D., Co-Chair of the Supervisory Committee and Michele Carney, Ph.D., Co-Chair of the Supervisory Committee. The dissertation was approved for the Graduate College by John R. Pelton, Ph.D., Dean of the Graduate College.

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ABSTRACT

Formative assessment research indicates that use of formative assessment positively impacts student achievement. Teachers ought to be provided professional development in formative assessment in order to make it an integral part of their classroom practice. Just as teachers need to assess student knowledge prior to instruction, teacher knowledge of formative assessment needs to be assessed in order to guide the professional development teachers receive. However, no instrument exists that assesses teacher knowledge of formative assessment. An instrument to assess teacher knowledge of formative assessment was created and piloted. The results of the pilot study indicated the instrument had modest reliability. The instrument was then administered to a large sample (n = 102) and a confirmatory factor analysis was conducted. As a result of the analysis, initial validity was established on an 11 item instrument for use in measuring teachers' knowledge of formative assessment.

Keywords: formative assessment, validation study

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CHAPTER ONE: INTRODUCTION

Introduction

Formative assessment has been shown to provide teachers with information needed to move student learning forward (Frohbieter, Greenwald, Stecher, & Schwartz, 2011). Through the use of formative assessment, teachers can come to better understand and know what their students know. Black and Wiliam (1998) reviewed hundreds of formative assessment studies and found typical learning gain effect sizes of .4-.7 in these formative assessment experiments. In addition, Hattie (2009) reported an average effect size of .9 through the use of formative assessment in a synthesis of meta-analyses related to student achievement. Beyond the overall effect of formative assessment on student achievement, components of formative assessment, such as feedback, have demonstrable effect on student achievement as well. When a manageable amount of feedback is provided to students, in a manner that can be used to improve their performance, student achievement gains are evident (Eckert, Dunn, & Ardoin, 2006; Kluger & Denisi, 1996). Sizeable student achievement effects are desirable in education in an effort to help students learn and progress to meet increasingly demanding standards. In order to help teachers make use of the formative assessment learning benefits, teachers need professional development. This professional development needs to be designed to meet teachers' needs, which can be accomplished through the use of a measure that assesses teachers' knowledge of formative assessment. The purpose of this study was to develop

and validate a measure to assess teachers' knowledge of formative assessment to be used in providing tailored professional development.

Background

Formative assessment is a process or activity planned to obtain information to be used to adjust instruction or learning activities by the teacher and/or student (Popham, 2008). For example, a teacher may plan an activity to determine whether students are able to identify and order the four seasons. The teacher could individually ask students to name the four seasons. Students who successfully name all four are ready to move on to ordering the seasons. The teacher could name a season and the students show which season comes before or after that season. This could be done repeatedly until enough evidence is gathered that indicates to the teacher which students are able to order the seasons and which students are not yet able to order the seasons. Based on these two activities, the teacher may decide to adjust her next lesson or plan small group instruction. One group might have instruction designed to help students who still need to identify the four seasons. Another group could include an activity to practice ordering the seasons for students who need further practice. For students who have shown mastery of both learning targets, the teacher could have them do an extension activity or may begin instruction based on another learning target. All of this, from planning the learning target to assessing students and adjusting instruction, is part of formative assessment.

Specific components of formative assessment include establishing and clarifying learning targets, monitoring student learning, providing feedback or adjusting instruction, self-assessment, and peer-assessment (Wiliam, 2011). First, teachers must establish learning targets for each lesson or activity and be able to explain the learning targets to

students. Learning targets are what the teacher intends for students to learn during a lesson or activity. Teachers need to find ways to make the intended learning clear to students and ensure students understand. Second, teachers must monitor students' learning. Monitoring student learning involves teachers gathering information about students' learning specific to the intended learning targets. Teachers can do this, for example, through questioning, observing students while they work, or reviewing students' submitted work. The goal of monitoring is to see evidence of students' progress toward the learning target. Third, teachers must provide feedback to students that will help students adjust their learning as needed. Feedback provides students with information about their learning to help them adjust and continue to progress. Feedback can be provided to students individually, in small groups, or to the class as a whole. Feedback also includes teachers adjusting their instructional plans in response to monitoring of student learning toward the learning targets. Self-assessment involves students monitoring their own learning, and peer-assessment is comprised of students providing feedback to one another.

An integral component of formative instruction is the need for continuous monitoring of student learning. This monitoring begins prior to teaching and continues throughout the teaching process (Fullan, Hill, & Crevola, 2006). Too often, however, this does not occur because, as Fullan et al. (2006) stated, "instruction follows the curriculum rather than the learner" (p. 63). For the sake of learning, instruction must be focused on meeting the needs of learners, not just teaching the curriculum start to finish. This is best accomplished when teachers assess student knowledge prior to beginning a

teaching unit, so they can plan for students' learning needs based on information about what students know and still need to learn.

Take for example a teacher who wants to find out how her students solve multi-digit multiplication problems before beginning a unit. She could have the students solve four problems and show their work for each one. When reviewing the students' work, prior to planning the unit, the teacher may discover that the majority of her class relies on the standard algorithm to solve problems. Through this preassessment the teacher can come to recognize the need to gather more information to see whether students know other ways to solve multi-digit multiplication problems, and choose not to use those methods, or know only the standard algorithm and need instruction in other methods. Additionally, the preassessment may help to identify patterns in the errors students make, which the teacher then can use to group students for instruction. The teacher can use her preassessment to help her plan for instruction, but also to help her know what other information she needs to gather about students, so she can provide targeted instruction based on students' needs. Continuous monitoring of student learning allows teachers to make adjustments needed to positively impact student achievement.

Problem Statement

Formative assessment has the potential to produce substantial learning gains for students; therefore formative assessment professional development ought to be provided for teachers. Just as it is important to assess student knowledge prior to instruction, assessing teacher knowledge is important to delivering effective professional development, specifically, as it relates to this study, teacher knowledge of formative assessment should be measured when teachers are provided with formative assessment

professional development. In studies where teachers received formative assessment professional development, teacher practice changed as a result (Harrison, 2005, Kirton, Hallam, Peffers, Robertson, & Stobart, 2007). Teachers developed ways to use information they learned about students, through formative assessment, in order to help their students achieve intended learning outcomes (Black & Wiliam, 1998; Stiggins & Dufour, 2009; Torrance & Pryor, 2001). It is important for teachers to have accurate knowledge of formative assessment to put it into practice. Assessing teachers' knowledge of formative assessment will help to ensure the professional development instruction is meeting the needs of the teachers, so they change their practice and are able to use information they learn to help students progress. However, no instruments exist to measure teachers' knowledge of formative assessment.

Purpose of the Study

The purpose of this study was to develop and provide initial validation of an instrument to measure teachers' knowledge of formative assessment, which will be used to assist in the creation of more effective professional development. Specifically, the instrument is designed to measure teachers' knowledge of three components of formative assessment: establishing learning targets, monitoring student progress toward the learning targets, and providing feedback or adjusting instruction.

Research Questions

This study was designed to answer the following questions:

1. Is the Teacher Knowledge of Formative Assessment (TKFA) instrument represented by a factor model that includes the three expected factors of learning targets, monitoring, and feedback?
2. Is there a relationship between the three factors — learning targets, monitoring, and feedback — such that they load onto a larger construct of formative assessment?

Research Hypotheses

The research hypotheses were:

1. The items on the TKFA instrument designed to assess teacher knowledge of sharing and clarifying learning targets will load onto the factor of learning targets.
2. The items on the TKFA instrument designed to assess teacher knowledge of monitoring student learning will load onto the factor of monitoring student learning.
3. The items on the TKFA instrument designed to assess teacher knowledge of providing meaningful feedback to students will load onto the factor of feedback.
4. The three constructs of learning targets, monitoring, and feedback are related to each other but represent independent constructs (i.e., the factor structure is best represented by a first-order factor model).
5. The three constructs of learning targets, monitoring, and feedback are related to each other because each construct is a part of the larger

construct of formative assessment (i.e., the factor structure is best represented by a second-order factor model).

CHAPTER TWO: REVIEW OF LITERATURE

Introduction

The review of literature consists of five parts. As formative assessment has been defined a number of ways, it is important to begin by defining formative assessment and describing its key components. Additionally, there are many professional development programs that seek to increase teachers' knowledge of formative assessment and thereby improve teacher practice. The key components of formative assessment and the content of the professional development programs both assist in defining dimensions to be included on an instrument to measure teachers' knowledge of formative assessment. Therefore, I will define the contents covered in leading formative assessment professional development programs. I will next review the literature linking these five components of formative assessment to student achievement. I will then review literature related to teachers' knowledge and the role prior knowledge plays in subsequent learning, which provides a rationale for assessing knowledge before teaching and makes a case for developing an instrument to measure knowledge of formative assessment. Finally, I will describe the existing instruments used as indicators of teachers' knowledge of assessment and discuss the shortcomings of these instruments as measures specifically of formative assessment.

Defining Formative Assessment

The term formative assessment was initially used by Benjamin Bloom based on Michael Scriven's term formative evaluation (Guskey, 2010; Popham, 2008; Scriven, 1967). However, it wasn't until Black and Wiliam (1998) published their meta-analysis that the term formative assessment became widely used. Black and Wiliam (1998) defined formative assessment "as encompassing all those activities undertaken by teachers and/or by students which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged" (p. 7). In 2006, the Council of Chief State School Officers (CCSSO) clarified this definition: "Formative assessment is a process used by teachers and students during instruction that provides feedback to adjust on-going teaching and learning to improve students' achievement of intended instructional outcomes" (Popham, 2008, p. 5). Though part of the committee that created the CCSSO definition, Popham desired a more succinct definition and offered, "Formative assessment is a planned process in which assessment-elicited evidence of students' status is used by teachers to adjust their ongoing instructional procedures or by students to adjust their current learning tactics" (Popham, 2008, p. 6).

All three definitions are quite similar and can be broken down as follows. Formative assessment is:

1. A process or activity,
2. planned to obtain information,
3. to be used to adjust instruction or learning activities,
4. by the teacher and/or student.

Formative assessment can take many forms including, but not limited to, classroom assessments, benchmark and interim assessments, teacher questioning, response cards, and exit passes (Wiliam, 2011).

Components of Formative Assessment

Given the comprehensive nature of formative assessment, many researchers have described its integral components (Chappuis, 2009; McManus, 2008; Wiliam, 2011). These components include: clarifying learning targets, monitoring student learning, providing feedback and adjusting instruction based on monitoring, providing opportunities for self-assessment, and providing opportunities for peer assessment (see Figure 1). I will describe each below.

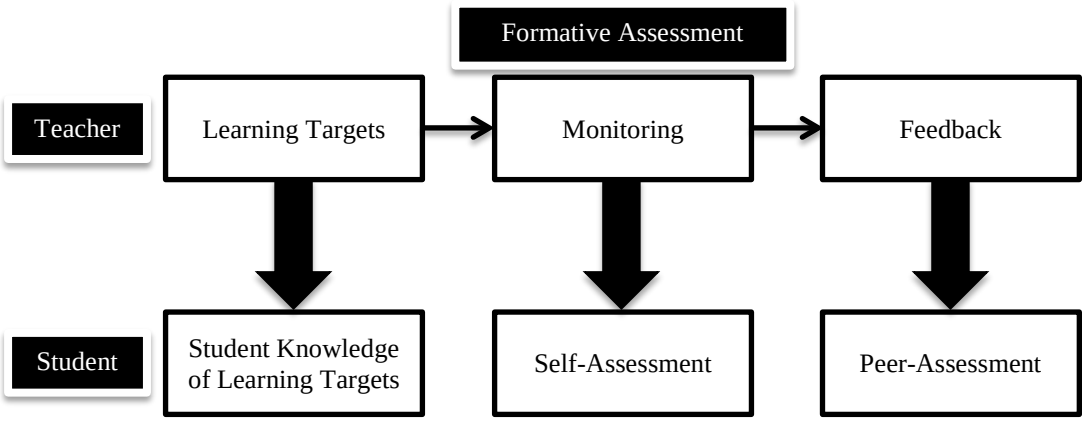

Figure 1. Formative Assessment Defined

Learning Targets

A clearly defined learning target provides a vision for teachers as they plan instruction. This vision should be shared with students so that they understand what they are supposed to be learning as well (Seidel, Rimmele, & Prenzel, 2005). Dylan Wiliam, one of the authors of seminal published work regarding the benefits of formative

assessment (Black & Wiliam, 1998), explained that the first formative assessment strategy is, “Clarifying, sharing and understanding learning intentions and criteria for success” (Wiliam, 2011, p. 46). This is similar to the Assessment Training Institute’s (ATI) first two strategies of assessment for learning (their name for formative assessment), “1. Provide a clear and understandable vision of the learning target and 2. Use examples and models of strong and weak work” (Chappuis, 2009. p. 12). Not only must a teacher share the learning target, but they must also help students understand how to successfully reach the target. Using models of work clarifies to students what success looks like as well as what it does not look like. The CCSSO formative assessment collaborative added one more layer to understand the necessity of clear learning targets as an intricate part of formative assessment when they noted that “Learning progressions should clearly articulate the sub-goals of the ultimate learning goal” (McManus, 2008, p. 4). When teachers establish learning targets, sub-goals help to break down the targets for students so that they can work toward those goals in manageable and meaningful ways.

Monitoring Learning

Monitoring student learning is the method by which teachers find out how their students are progressing in relation to the learning target. It is essential for teachers to gather information about student learning in order to provide feedback that can assist the student in moving forward, adjust instructional plans, and make plans for additional instruction. Shepard (2006) stated, “For teachers to be effective in supporting student learning, they must be constantly checking for student understanding” (p. 627). Wiliam (2011) describes monitoring learning as, “engineering effective classroom discussions, questions, and learning tasks that elicit evidence of learning” (p. 46). Essentially, he is

describing good teaching practices. Teachers plan and carry out lessons that, in the process of executing the lesson, will allow the teachers to see what their students are learning. Teachers will be able to examine the match between what the students are learning and the learning targets. Monitoring student learning may well be the heart of formative assessment. It is here where teachers gather the information that allows them to understand their students' learning, what they already know and can do, misconceptions they may have, and gaps that exist in their understanding and skills. Learning targets are a necessary precursor to monitoring and the next component, feedback, is action taken based on monitoring. Yet it is in monitoring student learning that teachers gather the information that allows them to adjust instruction and continue to help students reach the learning goals. Without accurate monitoring of student learning taking place, the rest of the formative assessment process falls apart. On a cautionary note, though monitoring is central in formative assessment, presumably it cannot stand alone. Unless a teacher does something with the information, it is merely informative rather than formative.

Feedback

Based on what teachers learn about students while monitoring their learning, they provide feedback to students and adjust instruction. Accurate monitoring is essential for effective feedback. Feedback, as used in schools, can be defined as "information communicated to the learner that is intended to modify his or her thinking or behavior to improve learning" (Shute, 2008, p. 153). When teachers are gathering information about student learning related to the learning goals, they need to act on the evidence and use it to provide feedback to students that will assist them in continuing to move forward in

their learning (McManus, 2008). ATI explained this crucial feature, and admonished teachers to, "Offer regular descriptive feedback" (Chappuis, 2009, p. 12). Both the quantity and quality of feedback influences the effectiveness it can have on student learning. It is through feedback that information regarding the student's performance or understanding is shared in a way that is intended to improve learning (Shute, 2008). Feedback can be provided to students individually, in small groups, or to the class as a whole. Feedback also occurs when teachers modify instructional plans based on student learning needs. This includes creating instructional groups and changing lesson plans and lesson designs in order to meet students' learning needs. Throughout this study, the term feedback is used to represent both information communicated to students about their performance and adjustments to instruction. Feedback is about teachers using students to drive their instruction rather than strictly content to be covered.

Self-Assessment

Self-assessment allows students to own their learning (Wiliam, 2011). Students should keep track of their learning, share their learning with others, and be self-reflective about their learning in relation to the learning targets (Chappuis, 2009). Self-assessment provides students opportunities to think about what they are learning (McManus, 2008).

Peer-Assessment

Peer-assessment involves students discussing work together, providing feedback to each other, and assisting one another in meeting learning goals. Students are able to be instructional resources for each other (Wiliam, 2011). Students comparing and

discussing work is a benefit to each of them as they progress toward the intended learning targets.

Formative Assessment Professional Development

The five components of formative assessment can and should be shared with teachers through professional development. Teacher practice has been shown to change as a result of professional development in and the use of formative assessment (Harrison, 2005; Kirton et al., 2007). Teachers develop ways to use information they learn about students, through formative assessment, to move students' learning forward (Frohbieter et al., 2011). This practice does not appear to be wide-spread, however. In writing about formative assessment, Shepard (2006) stated, "The ideal assessment practices described here, based on research, are consistent with the practices of particularly adept, expert teachers, but they do not necessarily reflect typical assessment practices. In fact, the majority of practicing teachers have limited knowledge of formative assessment strategies and continue to think about assessment as being primarily for the purpose of grading" (p. 627). Shepard recommends additional research in professional development and teacher learning focused on formative assessment.

There are two main commercial providers of formative assessment professional development, the Assessment Training Institute (ATI) and Keeping Learning on Track (KLT). I will describe each of these programs. While these programs are grounded in the research on the benefits of formative assessment, and based on formative assessment theory, there seems to be a dearth of research on the effectiveness such professional development has on teacher use of formative assessment and its link to student achievement.

ATI offers two-day trainings designed for leaders of professional development. At these trainings, attendees learn assessment for learning (ATI's term for formative assessment) strategies for classroom use. The workshop is designed to allow participants to return to their schools and lead others in assessment for learning professional development.

The professional development begins with general assessment instruction in which the five keys to quality classroom assessment are outlined (Chappuis, Stiggins, Chappuis, & Arter, 2012a). Next, the difference between assessment for learning and assessment of learning (summative assessment) are fleshed out. Seven strategies of assessment for learning are taught to answer three questions: (1) Where am I going? (2) Where am I now? (3) How can I close the gap? The strategies are:

1. Provide students with a clear and understandable vision of the learning target.
2. Use examples and models of strong and weak work.
3. Offer regular descriptive feedback.
4. Teach students to self-assess and set goals.
5. Design lessons to focus on one learning target or aspect of quality at a time.
6. Teach students focused revision.
7. Engage students in self-reflection and let them keep track of and share their learning. (Chappuis, 2009, p. 12)

The staff development is designed with activities for teachers to try in their practice. Reflective journaling is integrated throughout the professional development. The designers recommend that the staff development be elective for teachers rather than imposed upon them. This is understandable for as Heritage (2007) stated, "Teachers

must view formative assessment as a worthwhile process that yields valuable and actionable information about students' learning. If they do not, formative assessment will be seen as "yet another thing" that is being externally imposed on them" (p. 143). Without the appropriate attitude, no amount of instruction will yield the positive results possible for students.

The ATI professional development was designed as workshops for teachers, yet the designers do not believe workshops are sufficient. In addition to participating in the workshop portion of the professional development, teachers must commit to examining and changing their practice. Learning teams are recommended for maximum benefit. ATI outlines a long-term time commitment of two or three years to learn and implement assessment for learning in classrooms and five years to develop general assessment literacy district-wide. Effective professional development should lead to lasting change in classroom practice. ATI offers several recommendations for schools to consider before launching into this learning team model of professional development (Chappuis, Stiggins, Chappuis, & Arter, 2012b).

KLT is built around Dylan Wiliam's five key strategies of formative assessment:

1. Clarifying and sharing learning intentions and criteria for success.
2. Engineering effective classroom discussions, questions, and learning tasks.
3. Providing feedback that moves learners forward.
4. Activating students as instructional resources for one another.
5. Activating students as the owners of their own learning. (Wiliam, 2011)

According to the KLT website, these strategies are unified by one big idea, “students and teachers continuously using evidence of learning to adapt what happens in the classroom” (NWEA, 2012).

This program is also designed to train leaders who then train teachers. The leaders go through a two-day professional development. They then train teachers using 16 modules over the course of two years. The five strategies of formative assessment are interwoven in the modules. The program includes teachers setting action plans to try out the components they are learning. I was involved in a research study at a school where teachers were participating in KLT professional development. One teacher equated the action plans to homework. The teachers use the information they learn and try new things in their classroom (Personal communication, January 29, 2013). Another teacher remarked that KLT is making a world of difference, “Slowly but surely becoming part of our minute by minute life” in the classroom (Personal communication, January 29, 2013).

As is evident, both programs train leaders to train teachers, are designed as long-term professional development, include action components, teacher discussion, planning, and reporting back on progress. In addition to these commercially available formative assessment professional development programs, there are states and districts with their own formative assessment training plans. The Rhode Island Department of Education developed online modules to be used in combination with facilitated school practice, designed to provide formative assessment training for teachers (RIDE, 2013). There are five modules to be completed and practiced over the course of one school year. The elements present in the two commercial programs are also present in the state training, including reading selections from the authors of the commercial programs, Dylan Wiliam

and Rick Stiggins. In England, the Mathematics Assessment Resource Project also offers on-line formative assessment professional development modules (MARS, 2012). Similar elements are present in these modules as well.

Professional development in formative assessment is available. The essential elements appear to be commonly promoted. What seems to be lacking is individualization. Though it may be believed that few teachers implement formative assessment, I have found through working with teachers that most teachers have some level of understanding of it and many teachers attempt to employ formative assessment, to some extent. A key assertion of this study is that formative assessment professional development should take into account present teacher knowledge, understanding, and use of formative assessment and be tailored to fit the needs of the teachers. Torrance and Pryor (2001) used this approach as they created action-research based professional development in formative assessment. They began the professional development by discussing with teachers their ideas and beliefs about learning and assessment and then supported the teachers in investigating their own classroom practice.

From the literature on formative assessment, it becomes apparent that teachers need to have some general assessment knowledge to be able to separate out formative assessment from other assessment types (e.g., summative, interim, diagnostic; Chappuis et al., 2012a). Teachers need an understanding of what formative assessment is and how to implement it. Implementation involves learning objectives, monitoring, feedback, self-assessment, and peer-assessment. The first three elements are critical. Without implementing those well, teachers will not be able to effectively promote student self-assessment or peer-assessment for they are founded on a teacher's ability to define

learning targets, monitor student progress toward those targets, and provide meaningful feedback to help students move forward.

Linking Formative Assessment and Student Achievement

Many have claimed vast benefits of formative assessment in improving student achievement (Black & Wiliam, 1998; Frohbieter et al., 2011; Fuchs & Fuchs, 1986; Hughes, 2010; Marzano, 2010; Stiggins & Dufour, 2009; Wiliam, Lee, Harrison, & Black, 2004). In Black and Wiliam's review of hundreds of studies, they found effect sizes of .4-.7 with the use of formative assessment (1998). However, Bennett (2011) questioned the merits of these findings since it was based on studies with a wide range of topics. "That research includes studies related to feedback, student goal orientation, self-perception, peer assessment, self assessment, teacher choice of assessment task, teacher questioning behaviour, teacher use of tests, and mastery learning systems. That collection is simply too diverse to be sensibly combined and summarised by a single, mean effect-size statistic (or range of mean statistics)" (Bennett, 2011, p. 11). In light of Bennett's contention, I will review studies linking each of the five components to student achievement.

Learning Targets

The terms learning target, learning intention, learning goal, and learning objective are often used interchangeably. Though arguments can be made for the differences in the terms, they are related to learning targets and will be reviewed in this section. Clearly defined learning targets serve as goals for student learning. Establishing learning goals is critical for student learning because, as Locke and Latham (1990) stated, "Goal setting

theory assumes that human action is directed by conscious goals and intentions" (p. 4). It follows that teacher actions will be directed by consciously determined goals. The tasks they set for students, lesson designs and activities within lessons, will be influenced by learning goals. For each lesson delivered and activities planned, a teacher must have a clearly established goal so that both the teacher and the students understand the reason for the lessons and the intended outcome. For example, "students will be able to identify the differences between renewable and nonrenewable resources," may be set as the learning target for a lesson and the activities within it. The teacher's actions in the lesson will be directed at teaching renewable and nonrenewable resources in a manner that will enable students to be able to identify the differences between them as an outcome of the lesson. If instead a teacher starts teaching about renewable and nonrenewable resources without a specific focus, students may learn something about such resources but not be able to identify the differences when the lesson and activities conclude. Thus, it is critical for teachers to establish and clearly define learning targets for their teaching.

Although there is little extant literature establishing an empirical link between learning target and student achievement, the literature on goal setting suggests that learning targets should influence achievement. In particular, a robust finding from this literature is that challenging and clearly defined goals lead to better performance (Locke & Latham, 1990). Specifically, difficult goals lead to higher performance than general urging to do one's best. Difficult goals clearly indicate the behaviors required for success in attaining the goals. Latham and Baldes (1975) conducted a study of logging operations in which truck drivers were given a specific, difficult performance goal — to get the trucks to 94% net weight loads. In the past, the drivers were urged to do their best

in maximizing the total weight of logs they carried. This time series design study led to a substantial increase in performance. Truck drivers were not provided with any incentives or punitive measures as a result of their performance, they were simply given a specific, difficult goal. In a study of chess playing, Campbell and Ilgen (1976) assigned players chess problems of varied difficulties with easy, moderate, and difficult goals. They found performance in the high-goal condition was significantly greater than for the easy or moderate goals. Furthermore, the high difficulty tasks had an additive effect on overall performance. Although these studies did not involve classroom learning, knowing that challenging and specific goals has positive performance effects across many areas (for a meta-analysis, see Locke & Latham, 2002), it follows that this may hold in education as well.

In a study conducted in high school physics classes (Seidel et al., 2005), lessons were videotaped and rated to determine goal clarity and coherence of the lessons. Over the course of one school year, a positive effect on students' competence was evident in classrooms with high goal clarity and coherence versus classes with low goal clarity and coherence. Setting clear and challenging goals indicates a teacher's expectation for student learning and a belief that students can achieve the goals. Literature on teacher expectations provides support for the idea that teacher expectations influence student achievement (e.g., de Boer, Bosker, & van der Werf, 2010; Jussim & Eccles, 1992). Teachers ought to have high expectations for students, which can be made evident by establishing challenging goals and helping students to achieve those goals. Teacher expectations alone have been shown to have positive effects on student learning. Rosenthal and Jacobson (1966) studied the effects of teachers' expectations of their

students. The researchers administered an I.Q. test to all students at an elementary school. Teachers were told that this test was used to predict intellectual gains. In each of the 18 classes, 20% of the students were randomly selected and teachers were told these students' scores indicated they would make unusual academic gains during the year. After eight months, school-wide results showed the selected students made significantly greater gains in I.Q. score than the non-selected students. These results suggest teachers' high expectations for students resulted in higher student achievement growth.

It is through establishing learning goals, and clarifying the expectations for achieving these goals, that the process of formative assessment begins. Teachers' abilities to monitor student learning, provide feedback, and adjust instruction hinges on learning targets that are clearly defined, challenging, and attainable.

Monitoring Learning

With learning goals in place, teachers must monitor student progress toward those goals. Monitoring occurs through various types of questioning to elicit students' understanding as well as through all-pupil response techniques (e.g., writing answers on individual whiteboards, thumb checks, and exit tickets). Monitoring student learning is critical because it informs teacher instruction. Teachers need to monitor student learning to know which students are achieving the objectives so those students can be given activities to challenge them and push their learning even further. Teacher monitoring leads to identifying which students are struggling so the teacher can plan reteaching and intervention. Monitoring student learning also leads to identifying student misconceptions so these can be cleared up.

As with learning targets, there is minimal existing research linking teacher monitoring of student learning to student achievement. However, the literature on metacognitive monitoring provides evidence that, across a number of domains, learning is affected by monitoring accuracy (for a review of this literature, see Dunlosky, Hertzog, Kennedy, Thiede, 2005). For instance, Thiede, Redford, Wiley, and Griffin (2012) compared reading comprehension across seventh and eighth grade students who differed in monitoring accuracy. They found students who more accurately monitored their comprehension made better decisions about which texts to restudy, and this produced higher levels of reading comprehension (see also Thiede, 1999; Thiede, Anderson, & Therriault, 2003).

Effective monitoring of learning is important. Students need to be able to monitor their own learning to help them make better decisions about what to study. So to, teachers must be able to effectively monitor their students learning in order to make decisions about how to focus instruction. Teachers who are able to accurately monitor their students' learning will make better decisions on what to reteach and focus classroom instruction on than those teachers who less accurately monitor student learning. Accurate monitoring of student learning should result in improved student learning outcomes.

Teacher monitoring occurs by constantly gathering information about students learning, every day, throughout the day. Ruiz-Primo and Furtak (2007) conducted a study involving 3 teachers and 76 students. Videos of the teachers' instruction were examined for evidence of assessment conversation, defined by the authors as a teacher eliciting a question, students responding, the teacher recognizing the response, and the teacher using the information collected to support student learning. Ten observations of

each teacher were completed. The researchers found many instances of teachers using part of the assessment conversation, but not following through. For example, a teacher would ask a question, students responded, and the teacher recognized the response but did not use the information collected. Some of the conversation only went through the first two steps. In classrooms where teachers consistently used the assessment conversation cycle, student performance was higher.

Frequent testing is another way to gather information about student learning. In a meta-analysis on frequent testing, Bangert-Drowns, Kulik, and Kulik, (1991) reported on the effect sizes from 39 studies involving frequent testing of students. Overall, they found average students who were frequently tested performed better than 59% of the average students who were not frequently tested. In one study, students who were given 23 tests in a 15 week period saw an increase in achievement of .49 standard deviations compared to a control group. In a study of the cost effectiveness of school reforms, Yeh (2008) determined that giving two to five reading and math assessments per week was more effective in raising student achievement than all other 29 comprehensive school reforms he reviewed. Effect sizes of rapid assessment systems were modest (.27 for reading and .39 for math), yet significantly greater than attempts at raising students achievement through class size reduction, high-quality preschool, or other popular reform efforts. Frequent assessing of students, as a way for teachers to monitor student progress related to learning intentions, has a positive impact on student performance.

Through monitoring student learning by questioning and using class activities, teachers are able to more accurately assess their students' knowledge and abilities. They

will be able to adjust instruction and provide feedback aligned with the needs of their students that will help all students achieve desired learning outcomes.

Feedback

As teachers monitor student learning, they need to take action based on what they find out about their students' learning. Feedback is a response to monitoring. A teacher takes in information and then does something with it. Teachers provide feedback to students all the time. When students answer a question, teachers typically respond by saying something such as "correct" or "that's not quite right." Teachers return papers to students with incorrect responses marked and the number correct or percent at the top of the paper. Feedback could also be called 'response.' Teachers respond to things students do. This response is often evaluative, as just noted, but it can also be informative and corrective. Informative feedback helps learners to know how they are doing in relation to a learning target. When a student can name examples of renewable and nonrenewable resources, the teacher can inform that student of his/her ability to *identify* resources and then provide more instruction to move the student toward the learning goal of *explaining* the differences. If the student incorrectly identifies resources or inadequately explains the difference, the teacher can help correct the error through questioning or directing the student to review certain materials in order to help the student discover and correct the error for him or herself.

The connection between feedback and student performance has been studied in great depth. Researchers have demonstrated the use of feedback as a powerful tool to improve student performance (Eckert et al., 2006; Chase & Houmanfar, 2009; Wiliam, 2011). In a meta-analyses, Hattie and Timperley (2007) report the effect size of feedback

on student achievement as .73. Effective classroom feedback can help students develop into self-regulated learners (Butler & Winne, 1995; Labuhn, Zimmerman, & Hasselhorn, 2010), become better at judging their current performance levels and, thus, know what is necessary to help them move forward in their learning (Chappuis, 2009). Eckert et al. (2006) investigated the effects of feedback on elementary students' oral reading fluency. Struggling readers were given a series of reading probes. For one set, they were told the number of words they read correctly on the previous probe and shown a graph of their reading fluency performance. On another set of probes, the students were told the number of words they read incorrectly and shown a graph of their prior error rate. All students made significant gains in oral reading fluency in at least one of the conditions, with most making improvement in both conditions. Providing students with feedback of their oral reading fluency, both words read correctly and number of errors, led to an increase in overall oral reading fluency.

However, not all feedback improves learning. In a meta-analysis on feedback interventions, Kluger and Denisi (1996) found in one-third of the cases they studied, feedback interventions led to decreased student performance. This occurred when feedback was given that did not allow the learner to use it in a way that closed the gap between where the student was and the goal. Thus, feedback on graded assignments, when students do not have the opportunity to improve their grade, does not help increase learning. Without a chance to modify their work after feedback, students become demotivated, which can result in reduced effort on future tasks. The same effect has been observed when students receive too much feedback. In one study (Duijnhouwer, Prins, & Stokking, 2012), 82 students enrolled in a nine-week graduate course were divided into

four classes, a feedback condition group and feedback control as well as a reflection with feedback condition and feedback-only reflection control, with a 2 (feedback) X 2 (reflection) factorial design. As a course requirement, all of the students completed a writing assignment that comprised 60% of their final grade. In the feedback group, students received feedback from the teacher along with several possible improvement strategies. The feedback control group received feedback, but no improvement suggestions. In the reflection group, students answered a question about how they planned to use the feedback they were given to make improvements on the next draft or final copy of their papers. In the reflection control , students answered a question about how they perceived the feedback. The groups were compared on final draft performance. No main effects were found, but there were significant interaction effects. It appears that the use of feedback or reflection correlated to high performance on the final draft, but feedback and reflection actually lowered performance. With too much feedback, students feel like failures, or feel they are not capable enough to do what is required. Students' self-efficacy is reduced, which can lead to lower levels of future effort.

Students need a manageable amount of feedback so that they can make use of it. According to Wiliam (2011), "what matters is the mindfulness with which students engage in the feedback" (p. 111). Students need to be thinking about the task they are working on. Providing too much and/or too specific feedback limits students' abilities to use that feedback in a way that leads to improvement (Day & Cardon, 1993; Simmons & Cope, 1993). When a teacher gives large amounts of very detailed feedback, the teacher has completed the thinking for the student. For example, marking incorrect items on a test and indicating the correct answer leaves the student nothing more to think about.

When teachers provide feedback within the parameters shown to achieve maximum benefit, it has a powerful, positive impact on student achievement.

Self-Assessment

Students are the center of the entire educational process. Formative assessment cannot only be about what the teacher learns about students, it must also include what students can learn about their own learning. Students need to understand what they need to learn, how they are progressing, and what steps need to be taken to achieve identified learning targets. It is through self-assessment that students gather information to monitor their own progress and help determine next steps for their learning. Rather than being passive recipients of learning, students should be active agents in their pursuit of learning.

One method for engaging students in self-assessment is having them track their own learning progress. In fourteen studies, teachers had students track their progress on assessments. All the teachers in the studies taught a second class, with the same content, in which students did not track their progress. Students recorded their score on a chart after each assessment to provide them with a visual representation of their progress. In these studies, the average effect size found from students tracking their own progress was .92 (Marzano, 2010). An important note from the studies is that the assessments charted together must cover the same learning goal since students are tracking their progress toward a specific learning goal.

There are a number of ways students can track their learning and thus begin to see where they are in relation to learning targets (Chappuis et al., 2012a). Teachers can assist students in this process helping them to more accurately monitor their own learning.

McDonald and Boud (2003) examined the effects of self-assessment training for 256 high school students. Teachers were taught how to instruct their students in self-assessment. Academic achievement data indicated significant benefits for those who received the self-assessment training with effect sizes from .27 for science to .54 in humanities, compared to those who do not receive the training. Through active involvement in their own assessment, positive student outcomes result.

Peer-Assessment

Peer-assessment is closely tied to self-assessment. It serves as another way for students to understand their own progress in relation to learning goals. Feedback is also closely related, with the feedback occurring student to student rather than teacher to student. Peers assist one another in their attempts to understand material that needs to be learned. They rephrase things for one another, which can aide in clarifying teacher statements (Nicol & Macfarlane-Dick, 2006). At times, peers take on the role of the teacher and at other times the roll of the one being taught. Acting in a teaching role helps students articulate their own understanding and thus improve their own performance (Liu & Carless, 2006). However, as Black and Wiliam (1998) reported, “It is often difficult to disentangle the peer-assessment activity from other novel activities in work of this kind, and impossible in general to ascribe any reported gains to the assessment component” (p. 29). Nonetheless, it continues to be defined as an essential component of formative assessment, showing a high likeliness of being associated with student learning.

In a meta-analysis on writing instruction, Graham and Perin (2007) reviewed seven studies in which effect sizes were found for students assisting each other in the writing process. The average weighted effect size of these studies was .75, showing a

large, positive impact of peers working together. In one of these studies, 28 ten and eleven year old students received instruction in a structured system for peer-assisted writing. The students were matched on gender and pre-test scores, and then put in pairs with a more able writer and a less able writer. Other students were matched but not paired to serve as a control group for comparison. Over the course of six weeks, the paired students collaboratively produced five pieces of writing. The control students produced the writing individually. In a comparison of pre and post-treatment writing, all students showed statistically significant improvement in writing. The paired students exhibited statistically significant difference in gains over the non-paired students with the less able writers from the paired group achieving the greatest gains (Yarrow & Topping, 2001).

Additional claimed benefits of peer-assessment are based on cooperative-learning research and the benefits for student achievement associated with that (Wiliam, 2011). In a meta-analysis of peer-assisted learning (PALS) interventions, Rohrbeck, Ginsburg-Block, Fantuzzo, and Miller (2003) found positive effects on student achievement associated with the intervention. Moreover, they determined that the greatest gains in student achievement were made when students selected goals, awards and how to administer those rewards. This shows that autonomy in peer work allows for higher achievement than when the teacher directly manages the peer-learning conditions.

Peer-assessment, like the other four components of formative assessment, has the potential to improve student learning. The student learning benefits described by Black and William (1998) are possible when teachers learn how to effectively incorporate the elements of formative assessment into their teaching practice.

A summary of the empirical research and theoretical literature of the first three components — learning targets, monitoring, and feedback — is presented in Table 1. These components are the focus of this study.

Table 1 Summary of Formative Assessment Components Literature

Construct	Measured Aspect of Construct	Empirical Evidence	Theoretical Basis
Learning Targets *what teachers intend for students to learn*	Teacher establishes learning target for lessons and activities and shares these with students	Seidel et al. (2005)	Wiliam (2011, p. 51) Chappuis, Stuggins, Chappuis, Arter (2012a, p. 28)
	Teacher helps students know how to reach the learning target by clarifying expectations for success	Locke and Baldes (1976)	Wiliam (2011, p. 51) McManus (2008, p. 4)
	Teacher makes efforts to ensure students understand the purpose and success criteria for lessons and activities		Hughes (2010, pp. 219-220) Chappuis, Stuggins, Chappuis, Arter (2012a, p. 29)
Monitoring Student Learning *gathering information about students' learning specific to the learning targets*	Teacher knows to focus on evidence that will indicate progress toward learning targets	Thiede et. al. (2012)	Wiliam (2011, p. 71)
	Monitoring activities vary in structure and may be quick or long in duration, formal or informal, occur through conversation, observation, or written work	Yeh (2008)	Black and Wiliam (1998, p 31-34)
	Teacher has system for recording information learned through monitoring to use in later planning	Ruiz-Primo and Furtak (2007)	Chappuis, Stuggins, Chappuis, Arter (2012a, p. 298)
Feedback or Adjusting Instruction *providing students with information about their learning to help them adjust and adjusting instructional plans in response to monitoring of student learning toward the learning targets*	Teacher understands when to provide feedback to students (immediate vs. delayed)	Simmons & Cope (1993)	Shute (2008, p. 179)
	Teacher understands the type of feedback to give to move student learning forward (specific vs. vague)	Eckert et al. (2006) Duijnhouwer, et al. (2012)	Wiliam (2011, p. 111)
	Teacher understands feedback should be aligned to the learning targets or lesson and activities		Wiliam (2011, p. 130) McManus (2008, p. 4)
	Teacher knows to adjust learning plans based on student responses		Chappuis, Stuggins, Chappuis, Arter (2012a, p. 302)

Why Teacher Knowledge of Formative Assessment Matters

It is necessary to have information about teacher's knowledge of formative assessment because knowledge is a precursor to use. Knowing what someone already knows helps scaffold what someone needs to learn (Ausubel, Novak, & Hanesian, 1968, p. 172). General knowledge becomes a framework on which new knowledge and learning can be built (e.g., Bartlett, 1932; Bransford & Johnson, 1972). For teachers to be able to effectively use formative assessment, they must first have a foundation of knowledge about it. We should avoid teaching details of formative assessment practice until we know teachers have an adequate knowledge base in the broad concept of formative assessment. Then, as teachers attempt to enact the elements of formative assessment in their teaching practice, they will be able to build connections from what they know about formative assessment to how they use formative assessment. For instance, if professional developers start with the assumption that teachers understand formative assessment and begin teaching implementation techniques, the teachers who do not have basic understanding will struggle to make connections between what they are doing and how it fits into the larger picture. They will fail to see the relevancy of the techniques and will likely be unsuccessful in implementing them in a way that leads to student learning. This is an easy trap to fall into. When I led professional development on formative assessment, teachers indicated they were very familiar with the ideas. Yet, when I observed teachers and talked to them individually, I discovered their knowledge base was not as strong as they believed. One teacher I observed carried around a clipboard and made notes while her students worked. After the observation, we discussed this practice. She said she used a clipboard all the time, but previously only

noted behavior. On this occasion, she tried to make more academic notes. When I asked her what she learned and how she planned to use the information, she replied that she really did not know what to do with the information she gathered (observation notes, October 9, 2012). If this gap in the teacher's knowledge had been revealed earlier, instruction and guidance could have been provided as part of the professional development that would have enabled her to be more successful as she worked to make formative assessment part of her classroom practice.

In addition, ascertaining one's current knowledge allows for an appropriate level of support to be given. Tobias (1976) describes the interaction between instructional support provided and achievement. He describes a study in which those with low relevant abilities benefited the most from high instructional support, whereas those who began high in ability benefited most from a lower level of support. In fact, high levels of support for those with high knowledge in the area had a diminishing effect on their post-treatment achievement. This suggests that tailoring formative assessment professional development based on teachers' knowledge is not only helpful for those who have low beginning knowledge, but also essential for teachers who have high beginning knowledge. There is no reason to provide unnecessary support and instruction to teachers, particularly if it could interfere with their ability to utilize formative assessment well.

This is not to say that ensuring teachers possess knowledge of formative assessment means they will be proficient users of formative assessment. Learning and use often do not correspond (Bransford, Jeffery, Vye, & Sherwood, 1989). Yet knowledge is a necessary foundation for use. Shulman (1986) discussed knowledge

teachers must possess as well as categories of knowledge that fall within each knowledge area. He identified these knowledge areas as content knowledge, pedagogical content knowledge, and curricular knowledge. In subsequent publications, Shulman (1987) identified seven categories of knowledge teachers need in order to promote student learning. These categories are:

1. Content Knowledge
2. General Pedagogical Knowledge
3. Curriculum Knowledge
4. Pedagogical Content Knowledge
5. Knowledge of Learners and Their Characteristic
6. Knowledge of Educational Contexts
7. Knowledge of Educational Ends, Purposes, and Values.

Shulman (1986, 1987) also promoted assessing teacher knowledge in these broad areas. Tests for teachers must incorporate specialized knowledge teachers must possess to teach content in a way that is understandable for students, rather than only testing if teachers understand the content for themselves.

Teachers' knowledge of formative assessment falls within Shulman's category of general pedagogical knowledge. These are the broad principles of teaching that transcend subject matter. Looking back at the definition and components of formative assessment, it is clear that it is a practice for use across subject matters. Regardless of content, learning targets must be established, active monitoring of student learning and adjustment to instruction based on monitoring must occur, and students must receive some form of feedback or response from the teacher that helps them understand where

they are in relation to the learning target. Shulman's work ultimately comes to rest on the importance of pedagogical content knowledge and its role in student learning.

Pedagogical content knowledge merges knowledge of content with general pedagogical knowledge to delineate content knowledge necessary for teaching. Ball, Thames, and Phelps (2008) further developed the conception of pedagogical content knowledge specific to mathematics. Their research indicated subdomains within pedagogical content knowledge that directly related to knowledge of students, as it relates to students' understanding of the content, and knowledge of teaching, related to content. While this further development of Shulman's work is warranted, content-specific knowledge and its relationship to formative assessment is beyond the scope of this study, which seeks to assess teacher knowledge of the general pedagogical knowledge of formative assessment. An assessment of general teacher formative assessment knowledge has value as a starting place for formative assessment professional development that is general in scope. It may also prove useful in formative assessment professional development couched within content, but additional study of the interplay between general formative assessment knowledge and pedagogical content knowledge is necessary.

Available Instruments to Assess Teachers' Knowledge of Assessment

At this point, we must consider how we gather information about teachers' knowledge of formative assessment and use it to help teacher's make formative assessment an integral part of their classroom practice. Basically, professional development must utilize formative assessment to plan for, adjust, and meet the needs of teachers as they learn and develop proficiency employing formative assessment. While,

of course, basing professional development on research-based practices for adult learning and employing an effective professional development model. Yet, there do not seem to be any tools available that help determine teachers' knowledge of formative assessment. What is currently available includes self-evaluation of formative assessment beliefs and use as well as a general assessment literacy tool. I will briefly describe examples of these instruments.

ATI produced a self-evaluation survey for teachers to complete as part of their assessment for learning professional development. It includes six "I" statements, such as "I use examples of strong and weak work to help students understand key elements of quality response, product or performance" (Chappuis et al., 2012a, p. 51). Teachers rate themselves on a scale from one to five to indicate the frequency that they do each of the statements in their classrooms. In the professional development, these ratings are graphed for the group and used to determine group strengths and weaknesses in formative assessment use. Similarly, in a study designed to determine Wyoming teachers' assessment practices, teachers completed an assessment practices questionnaire (originally used in Bol et al., 1998) in which they indicated, on a five-point scale ranging from never to frequently, how often they used the assessment methods listed in their classrooms. In the second part of the questionnaire, teachers indicated how well prepared they felt in developing and administering a variety of assessment methods. In the third part, teachers indicated how confident they felt the assessments accurately reflected student achievement and progress. In addition to these scales, there were several open-ended questions teachers responded to, including writing definitions for formative and summative assessment, explaining the difference between them, and explaining whether

they use formative or summative assessment, or both, consistently in their classrooms (Gates, 2008).

Similarly, teacher values about formative assessment were investigated by James and Pedder (2006). They interviewed 558 teachers to determine the types of assessments they used in their classrooms and the value they placed on the various assessment types. The purpose of this self-report data was to investigate the link between teachers' values and their classroom assessment practices. The results indicate that values are not necessarily manifest in practice. While information about teacher values is helpful when providing professional development, it still does not provide information about what teachers actually know about formative assessment.

Determining teacher knowledge and understanding of formative assessment in some objective manner is needed to guide professional development efforts. Plake (1993) conducted a national survey to measure teachers' knowledge of assessment. This inventory was based on the 1990 Standards for Teacher Competence in the Educational Assessment of Students (American Federation of Teachers, National Council on Measurement in Education, & National Education Association, 1990). The first two standards address teachers' ability to choose and develop assessment methods appropriate for instruction. The fourth standard addresses teachers' use of assessment results when making decisions about students and planning, as well as developing curriculum and making school-wide improvement. While these standards incorporate elements of formative assessment, it is not the focus. Standard five is about grading procedures, which is not within the scope of formative assessment. Plake's assessment instrument has five items per standard. These subscales had low internal consistency reliabilities and

so the developers of the instrument do not recommend making interpretations based on the subscales (Plake, Impara, & Fager, 1993). This instrument will not assist in planning for tailored professional development in formative assessment because the focus is too broad.

Additionally, Mertler, Green, and Campbell (2005) created the Assessment Literacy Inventory based on Plake's tool. The purpose of this tool was to evaluate preservice teachers' classroom assessment competency. The test has five classroom assessment related scenarios. Seven items per scenario relate directly to the seven Standards for Teacher Competence in the Educational Assessment of Students. The Classroom Assessment Literacy Inventory (CALI), also based on Plake's tool, was used to assess preservice and in-service teacher's assessment literacy (Mertler, 2004). This 35 item tool included five items per standard as well. With this broad assessment focus, these instruments do not provide specific information about teachers' formative assessment knowledge either.

Formative assessment has been shown to positively impact student achievement. It seems to follow that this instructional resource must become a part of teachers' practice, which necessitates professional development. Learning theory indicates a need to activate prior knowledge so new learning can build upon it. To accomplish this in professional development, an instrument is needed that will assess teachers' knowledge of formative assessment. Currently, there is no instrument available to accomplish that task. Therefore, I developed an instrument to assess teachers' knowledge of formative assessment.

Instrument Validation

The two goals of an instrument validation study are to establish the validity and reliability of the scales of an instrument (or the instrument as a whole). There are different ways to conceptualize validity and reliability, which I will describe below.

Validity

Validity is a judgment that an instrument measures what it purports to measure. Kane further explained, "Validation involves the evaluation of the proposed interpretations and uses of measurements" (2006, p. 59). To begin the validation process, a clear statement of the proposed interpretations and uses of the instrument is required. Validation can then be separated into two stages, development and appraisal. This study is focused on the development stage of validation. For the development stage of validation, Kane (2006) outlined an iterative process to use when developing a test and the interpretive argument. First, the interpretive argument must be outlined and the test plan developed. The interpretive argument specifies how the test scores are intended to be understood and how they are to be used. Second, the test is developed. Third, while developing the test, the inferences and assumptions in the interpretive argument need to be evaluated. If weaknesses in the interpretive argument are exposed, then the first two steps are repeated until satisfied with the fit of the test and interpretive argument (p. 26).

Once the interpretive argument is established and the test is considered complete, then appraisal of the interpretive argument begins. Prior to this, during the development stage, the validation approach is confirmatory in nature. Kane explained it is appropriate to have a confirmationist bias in the development stage in order to develop the best possible test (2006, p. 25). During appraisal validation, a neutral or critical stance is

requisite to evaluate the interpretive argument (Kane, 2006, p. 26). This study is concerned with developing and confirming the interpretive argument of the measure to assess teachers' knowledge of formative assessment and will not extend into appraisal validation of the argument.

In the case of developing a measure of formative assessment, there are five theoretical constructs contained in formative assessment (learning targets, monitoring, feedback, self-assessment, and peer-assessment), three of which are measured by individual scales on the instrument. In addition to Kane's (2006) proposed interpretations and uses of measures validation procedures, there are three common methods to establish validity: content validation, criterion-related validation, and construct validation (Kimberlin & Winterstein, 2008; Messick, 1995; Morgan, Gliner, & Harmon, 2001). I will discuss each of them in order.

Content Validity

According to Allen and Yen (1979), the first concern in the development of any test should be to establish content validity. Content validity can be established through face validity (Allen & Yen, 1979), which is established by having individuals examine test items and determine whether the items appear to measure the construct intended to be measured. Thus, after constructing items for the various scales, individuals with content expertise review the items and verify that the items measure the intended construct (Morgan et al., 2001). When an instrument is designed to measure different constructs, establishing face validity can include a sorting task in which experts place items into categories that measure the different constructs. Face validity is established when experts

have a high degree of agreement regarding which items are measuring the different constructs.

Criterion-Related Validity

Criterion validity requires a criterion to use for comparison. For instance, say an instrument existed that measured overall knowledge of formative assessment and this instrument was excessively time consuming to administer. Criterion-related validity would be established by administering this existing instrument and the newly developed instrument and showing the scores are closely related. This may come in the form of predictive validity, using the score to predict performance on another measure that will take place in the future, or concurrent validity, which involves comparing scores on the new measure to scores on another measure taken about the same time. It is important to note that criterion-related validity can only be established if an instrument already exists that measures the desired construct, which is not the case for measuring knowledge of formative assessment.

Construct Validity

The general principles of construct validation provided the foundation for Kane's interpretation validation method (Kane, 2006). Though he argued that construct validation methods do not provide clear enough guidelines to evaluate the proposed interpretations and uses of the instrument, construct validation is nonetheless a method used to establish the validity of an instrument. Constructs are theoretically derived objects that cannot be directly observed. Items on a scale are used to measure (or operationalize) a construct (Cronbach & Meehl, 1955). That is, scores on a scale are used

to infer scores on a construct or latent variable. One way to establish construct validity is to conduct a factor analysis with data collected on the instrument. This factor analysis should show that items designed to measure a construct are highly correlated to one another, and that items measuring different constructs are not highly correlated with one another (or are at least less correlated to one another than items measuring the same construct). A fairly large sample (n = 100) is needed to conduct a factor analysis (Gorsuch, 1983).

Reliability

In addition to establishing the validity of an instrument, it is important to show it is reliable. Reliability describes the consistency of a measure. Internal consistency reliability is the most commonly used measure of reliability (Field & Hole, 2003; Peterson, 1994). Computing the internal consistency involves dividing the items of a scale into two parts (e.g., odd numbered items and even numbered items), computing a total score across each part, and then calculating a correlation between the two total scores for a group of individual test takers. If each individual gets approximately the same score on the two parts of the test, the test is considered internally consistent. Cronbach's coefficient alpha is a split-half method of reliability in which data is split in every way possible to obtain an average correlation coefficient (Cronbach, 1951). Through this method, one is able to determine whether the items on a test relate to one another. Nunnally and Bernstein (1994) outlined the levels of reliability that are desirable. They remarked that in the early stages of construct validation, research a modest reliability of .70 is acceptable. At that point, revisions should be made to reduce measurement error so that reliability is about .80 on the final instrument. This level is

acceptable for most research. However, when test scores are used to make important decisions about individuals, reliability between .90 and .95 is suggested.

In an initial instrument validation study, it is important to establish both validity and reliability. Both are requisite to have a useable instrument. The next section includes the methods used to establish the validity and reliability of the instrument developed to measure teachers' formative assessment knowledge, which was needed to plan professional development.

With the definition of formative assessment delineated, inclusive of the component explanations, a measure of teachers' knowledge of formative assessment was created. This was necessary since there are no existing measures of teachers' formative assessment knowledge for use in professional development. A measure of teachers' formative assessment knowledge is important to have because empirical research has shown evidence of student learning through the use of formative assessment and theoretical research indicates potential benefits as well. Thus, teachers' formative assessment knowledge must be considered when providing formative assessment professional development as a way to help teachers develop their use of formative assessment in their classrooms.

CHAPTER THREE: METHODOLOGY

Introduction to Methods

An instrument to assess teachers' knowledge of formative assessment was developed with the purpose of using the assessment data to inform professional development decisions and delivery. When considering what needed to be included, the focus was on utilizing the components of formative assessment developed in the literature: clarifying learning targets, monitoring student learning, providing feedback and adjusting instruction based on monitoring, providing opportunities for self-assessment, and providing opportunities for peer assessment. While in the process of developing the instrument, I decided to include items assessing only the first three components. When considering the definition of formative assessment, it is evident that these components comprise the *process* of formative assessment, which is to obtain and use information. The information can be used by students and teachers (see Figure 1).

It is clear from the literature that learning targets are the starting place for formative assessment (Chappuis, 2009; McManus, 2008; Wiliam, 2011). All monitoring and feedback done as part of formative assessment link back to the intended learning that is established through the learning targets. It is requisite to know where you are going in order to know when you get there. Since learning targets are the foundation of formative assessment, it is critical for teachers to be knowledgeable about the need to have learning targets. In this study, it is assumed that teachers know they need to establish learning

targets. Therefore, the instrument is designed to measure teachers' knowledge of the need to share learning targets with students and how to make those targets clear to students so students know what they are responsible for learning. In addition, teachers' personal knowledge of learning targets is content specific. An assessment in this area is too broad. However, knowledge of the importance of establishing learning targets and how to make learning targets known to students is measureable on a general assessment.

Monitoring student learning is the method by which teachers come to understand where their students are in relation to the learning target. Through monitoring, teachers become aware of knowledge and skills gaps and can make plans to address those gaps. Teachers must have awareness of the need and ways to monitor student learning to reveal information about where students are in relation to the learning target.

As teachers monitor students, they provide feedback to students that will help move them forward in their learning or adjust instructional plans in response to student learning needs. These are the critical *process* components of formative assessment that teachers must know and understand in order to make use of it. These same processes can be used by students because they are *users* of formative assessment as well. Self-assessment involves students monitoring their own learning and peer-assessment allows for students to provide feedback to one another. While these components are needful, when making initial formative assessment professional development plans, determining teachers' knowledge of the *process* components takes precedence over their knowledge of how students can utilize the process of formative assessment. Teachers are the users that must understand formative assessment before they can assist other users, their students, in participating in the process. With informing professional development

activities in mind, the final version of the instrument includes items to assess the components of teachers ensuring students have knowledge of the learning targets, monitoring student learning, and feedback (see Figure 2). Items were written from the perspective of how they could be useful to inform formative assessment professional development activities. The next section will explain the development process that led to the final version of the instrument.

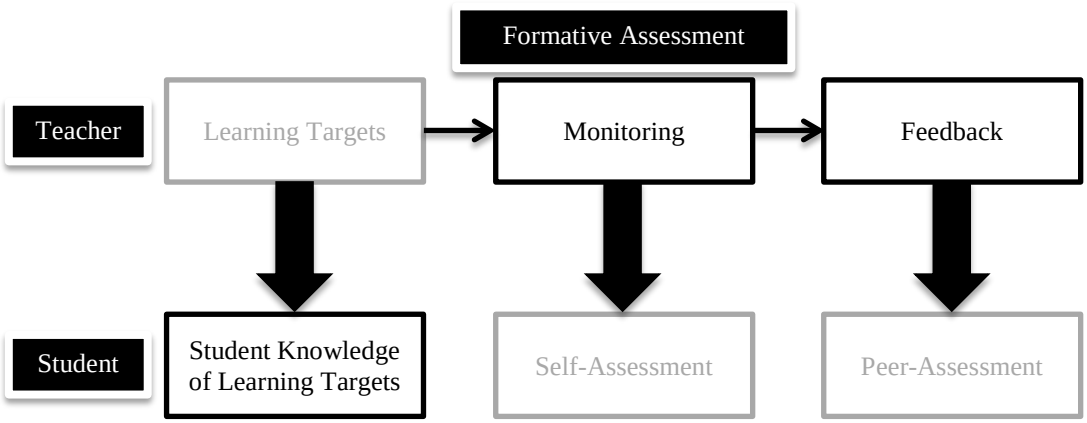

Figure 2. Formative Assessment Components Included in Measure of Teacher Knowledge of Formative Assessment

An iterative process was used to develop and refine the instrument, and the three sub-scales of clarifying learning targets, monitoring student learning, and providing feedback or adjusting instruction based on monitoring. Items were written and reviewed to establish face validity. They were then administered to teachers to examine the internal-consistency reliability of the sub-scales. It is important to note that the work described below served as preliminary work to construct a measure of formative assessment knowledge. The purpose of the present work was to confirm the theoretical structure through a confirmatory factor analysis to establish construct validity.

Instrument Development

Measures

This study was designed to develop an instrument that measures teachers' knowledge of formative assessment. Formative assessment has been defined with several component parts, explained previously. These components are psychological constructs and thus cannot be directly measured (Crocker & Algina, 1986). I sought to do as Crocker and Algina (1986) recommended by developing "a measurement instrument which consists of items representing behaviors that are specific, concrete manifestations of the constuct" (p. 231). Three constructs are included in the instrument. The first is clarifying and sharing learning targets. Teachers must establish and share learning targets with students in a clear, understandable manner. The second is monitoring student learning. Teachers must design lessons and activities in order to elicit evidence of their students' learning. The third is providing feedback that moves learning forward. A teacher must use what is learned from monitoring to give feedback to students or adjust instruction in order to help students continue to close the gap between current learning and the learning target.

Pilot Instrument 1

The sub-scales were initially assessed using open-ended questions, with eight questions assessing general knowledge of formative assessment, four items assessing knowledge of clarifying learning targets, four items assessing knowledge of monitoring student learning, six items assessing knowledge of providing feedback, five items assessing knowledge of self-assessment, and three items assessing knowledge of peer-

assessment (see Appendix A). Initial face vailidity was established by having a college of education faculty member, knowledgeable in formative assessment, review the items and compare them to the constructs they were intended to measure to ensure a match.

The open-ended instrument was administered to 24 students enrolled in a graduate-level course, in education, who had 1 to 24 years of teaching experience. They were asked to respond to questions as well as identify any confusing items on the instrument. Using the test-takers as item reviewers was an additional step in establishing face validity of the items (Allen & Yen, 1979, p. 96).

For each item, I wrote a correct response, detailing the elements necessary for a response to be scored as correct. The correct response rubric was reviewed by a college of education faculty member knowledgeable in the area of formative assessment. The responses of the participants were compared with the correct response and answers were scored based on whether they were correct, partially correct, or incorrect. The delineation of these scores varied based on the question. Five questions — one categorized as general, two feedback, one self-assessment, and one peer-assessment — were eliminated during this process because it became evident they were too vague. These five items resulted in a variety of responses with many possible correct responses that were not focused on formative assessment.

The remaining 25 questions, representing the five components of formative assessment, were reviewed again. At this point, the questions related to self-assessment and peer-assessment were eliminated. The instrument was too long and needed to be shortened. Rather than significantly reduce the number of items for each construct, the two constructs were eliminated. As shown in Figure 2, the elements of self-assessment

and peer assessment are intricately connected to learning targets, monitoring student learning, and feedback. Yet a teacher must understand the first three components before being able to make use of self-assessment and peer-assessment. Though self-assessment and peer-assessment are valuable components of formative assessment, teachers' knowledge of them are less important for initial professional development purposes. Coming to understand teacher's knowledge of the basic components of formative assessment — learning targets, monitoring student learning, and feedback — are most useful for professional developers to help them tailor their instruction and support in order to meet teachers' needs.

Pilot Instrument 2

The questions and responses were reviewed again. The questions with multiple responses which were not clearly right or wrong were eliminated. Three questions were then selected from each construct that best captured the essence of the constructs. Three general questions about the overall concept of formative assessment were also selected, resulting in a 12-item, free response instrument. This instrument was piloted with 96 elementary teachers, teaching kindergarten through fifth grade, using Qualtrics Survey Software (see Appendix B).

The responses on this 12-item instrument were each scored as correct or incorrect. The reliability was not strong for the constructs or the instrument as a whole (Cronbach's alpha = .464). There are several possible reasons for this. First, a free-response instrument is subject to rater error. As each item was scored, I inevitably made interpretations of the responses when deciding if it was correct or incorrect. Second, with only three items per construct, it was difficult to capture the essential nature of the

concept, while also ensuring the items were related to one another. Each item may have been assessing a different aspect of the construct making it more difficult to assess the reliability of the construct as a whole. Third, the instrument took a long time for participants to complete, typically 30-50 minutes. Participants could have easily tired as they wrote their responses and not answered thoroughly enough to merit a correct rating. At this point, the instrument was revised and the items were converted to a multiple-choice format.

Pilot Instrument 3

Incorrect responses from the free response results were used to develop distractors for multiple-choice items. More items were developed for each construct, resulting in a 20-item multiple choice assessment. Three items were about the general concept of formative assessment, five items about learning targets, six items about monitoring student learning, and six items about feedback (see Appendix C). This instrument was piloted with 16 students enrolled in a graduate-level math education course. Two of the instruments were returned incomplete resulting in some of the analysis being computed for 16 cases and other parts for 14 cases. Although a set of items was found that produced an overall instrument with good reliability (Cronbach's alpha = .804), the individual scales failed to reach acceptable levels of reliability. Therefore, items not highly correlated with other items within each scale were eliminated. Many items were revised and new items were written.

Pilot Instrument 4

The next version of the instrument contained one general question, eight learning target questions, nine monitoring student learning questions, and eight feedback questions. Face validity for these items was confirmed through a card sort activity. The 25 construct questions were given to three individuals, knowledgeable in the field of formative assessment, to sort based on which construct the question seemed to measure. There was perfect agreement on 24 of the 25 questions. One sorter remarked that one of the items related to both monitoring and feedback. Additionally, many of the items for the feedback construct used the word feedback in the question, making it very likely for these to be sorted as feedback items.

This instrument was completed by 23 teachers using Qualtrics Survey Software (see Appendix D). The teachers ranged in experience from 4 years of teaching to more than 25 years and included elementary school teachers, an instructional coach, a former teacher now working as an administrator, PE teachers, and high school teachers. Reliability for each construct was computed, which lead to removing items that were negatively correlated to other items.

The learning target questions were written to assess teachers' understanding that they need to establish learning targets and ensure the intended learning target is clear to students. After removing poorly correlated items, four items were analyzed. The results of the analysis for the four questions appear in Table 2.

Table 2 Learning Target Questions

Learning Target Questions	
Item 5	A teacher wants students to know what they are responsible for learning during a lesson and so she posts the learning objective on the board. Is this an effective way to share learning targets with students?
Item 6	A teacher does not like writing learning objectives on the board. Instead, she begins each lesson by telling students what they are going to be learning and shows them examples of high and low quality work related to the objectives. Is this an effective way to share learning targets with students?
Item 7	Two fourth grade teachers want their students to know the learning objectives for the lesson. One writes the objectives on the board and begins teaching. The other doesn't write the objectives but spends 5 minutes discussing the objectives with the class. Which is a better approach?
Item 9	A teacher wants her students to know the learning objectives for a lesson. She doesn't write the objectives on the board, instead she spends 5 minutes discussing the objectives with the class. Is this effective teaching?
	Alpha .709

The monitoring student learning questions were written to assess teachers' understanding that monitoring student learning should be linked to the learning targets, monitoring student learning can take a variety of formats, and that information should be collected in a manner that will be useful for adjusting instruction and providing feedback. After removing poorly correlated items, three items were analyzed. The results of the analysis for the three questions appear in Table 3.

Table 3 Monitoring Student Learning

Monitoring Student Learning	
Item 13	A teacher begins class with a multiple-choice question on the board. Students must justify their choice…What might the teacher have been trying to find out through the discussion?
Item 15	How can a teacher best keep track of student data learned through formative assessment?
Item 21	Which of the following would best help a teacher formatively assess students' ability to explain the significance of the state symbols?
	Alpha .704

The feedback questions were written to assess teachers' understanding that feedback should be aligned with learning targets and that the timing and specificity of feedback is determined based on what the teacher learns through the monitoring process. After removing poorly correlated items, four items were analyzed. The results of the analysis for the four questions appear in Table 4.

Table 4 Feedback Questions

Feedback Questions	
Item 23	A teacher shows her class how to measure angles using a protractor. During student work time the teacher watches one student struggling in her attempts to measure angles. Which of the following is the best next step for the teacher?
Item 25	A teacher puts a grade on every assignment to provide feedback to students about how well they understand what they are learning and let them know where there is room for improvement. Is this effective feedback?
Item 27	A student turns in a paper and the teacher notices two words are spelled incorrectly. What teacher response would provide the most helpful feedback for the student?
Item 30	A teacher wants her students to learn the structure of an argumentative essay. She teaches a lesson on the structure of an argument. On students' drafts she writes specific comments related to argumentative structure, but does not point out every spelling or grammar error. Is this effective feedback, why or why not?
	Alpha .571

These resulting 11 items were maintained for the fifth administration and additional conceptually similar items were written.

Pilot Instrument 5

The fifth pilot instrument included 30 items with 10 questions for each of the three constructs (see Appendix E). This instrument was completed using Qualtrics survey software by 19 kindergarten through ninth grade teachers with one to thirty years of teaching experience. Reliability was computed for each construct and poorly

correlated items were removed. The results for learning targets and monitoring did not improve from the fourth administration. The results for feedback, however, were quite different. The newly written items for feedback were grounded in research regarding specific aspects of effective feedback. The results of the analysis of four of these new items appear in Table 5.

Table 5 Feedback Questions from Pilot 5

Feedback Questions	
Item 41	A teacher wants to provide information to students about how they are progressing in their learning. Which is the best way to provide effective feedback?
Item 42	A student's performance over time indicates 100% mastery of a learning target. How should the teacher use this information when talking to the student?
Item 43	How should a teacher best make use of unit pre-assessment results?
Item 44	A teacher always marks all student errors on their work before returning it to them for review? Is this effective feedback?
	Alpha .717

The results of the pilot data analysis indicate that the instrument created to assess teacher knowledge of formative assessment has modest reliability for all three scales. Each are above .70 which is the recommended acceptable level, particularly during preliminary validation research (Nunnally & Bernstein, 1994). However, participant sample size was small for each administration. To continue validation of the instrument, a larger sample size ($n \geq 100$) is needed.

Based on the instrument pilots, another version of the instrument was created, which was used for this study. This version of the instrument includes the same 30 items that were on the fifth pilot with some modifications (see Appendix F). Modifications included adjusting distractors for items where the majority of participants selected one

particular distractor. Adjustments were intended to make the correct answer clearer or wrong answers definitively incorrect. Additionally, on questions that the majority of participants answered either correctly or incorrectly, the question or the distractors were modified as a way to add clarity and focus to the items.

Participants

This instrument was administered to 108 elementary teachers, kindergarten through fifth grade. The instrument was completed by 102 teachers. The teachers work at nine elementary schools within one school district in the Mountain West region of the United States. These teachers were participants in a research study designed to develop a professional development program to improve teachers' skills in formative assessment and mathematics instruction. The project worked within several schools. At two schools, teachers participated in formative assessment professional development. At two other schools, teachers participated in professional development in Developing Mathematical Thinking (DMT). At three schools, teachers participated in both formative assessment and DMT professional development. Two schools served as controls and did not participate in professional development.

Data Collection

Teachers completed the knowledge of formative assessment instrument using Qualtrics survey software. Questions were presented to teachers in a random order. Institutional Review Board permission to conduct the assessment was granted through the ITML project. An email with a link to the assessment and request to complete was sent to each teacher Monday December 9, 2013. As recommended by Dillman, Smyth, and

Christian (2009), I sent follow-up emails (see Appendix G for email messages). The second email was sent Monday, December 16, 2013 to serve as a reminder to those who have not yet completed the survey. At that time, a thank you email was sent to participants who completed the survey. A third email was sent on Monday, January 13, 2014 that indicated the short amount of time remaining to complete the survey and reiterated the importance of responding. A final follow-up email was sent Friday, January 17, 2014. Finally, personal emails were sent to participants who did not complete the survey after the final reminder.

Analysis

The data was analyzed through a confirmatory factor analysis (CFA) using EQS software version 5.4. This hypothesis-testing approach requires that the relationship of the variables be established a priori based on a theory of the relationship between variables and factors. This is different that an exploratory factor analysis (EFA) where a researcher sets out to explore the relationship between variables and factors. CFA is used to confirm that items hypothesized to load on a particular factor do indeed load on that factor and do not load on other factors. However, EFA may be used as a starting place prior to conducting a CFA to help establish an interpretable structure. When using CFA, an initial step is to establish the goodness-of-fit of the measurement model (Byrne, 2012). In this step, all items designed for a particular construct (factor or latent variable) are set to load freely on that factor and not allowed to load on remaining factors. That is, this analysis confirms that individual items are measuring the desired factor. Of primary interest is the strength of the relation from the factors to observed variables.

Once the measurement model has been evaluated to confirm the factors are well measured, the relation among the factors is evaluated. In a first-order CFA, there are paths between the factors, which indicates that the factors are allowed to covary (be related); see Figure 3. In a second-order CFA, there are additional paths between first-order factors and the higher order factor. In this study, the items on the assessment are the variables. First-order factors are the components of formative assessment, specifically learning targets, monitoring student learning, and feedback. The higher order factor is formative assessment. Figures 3 and 4 represent the models tested.

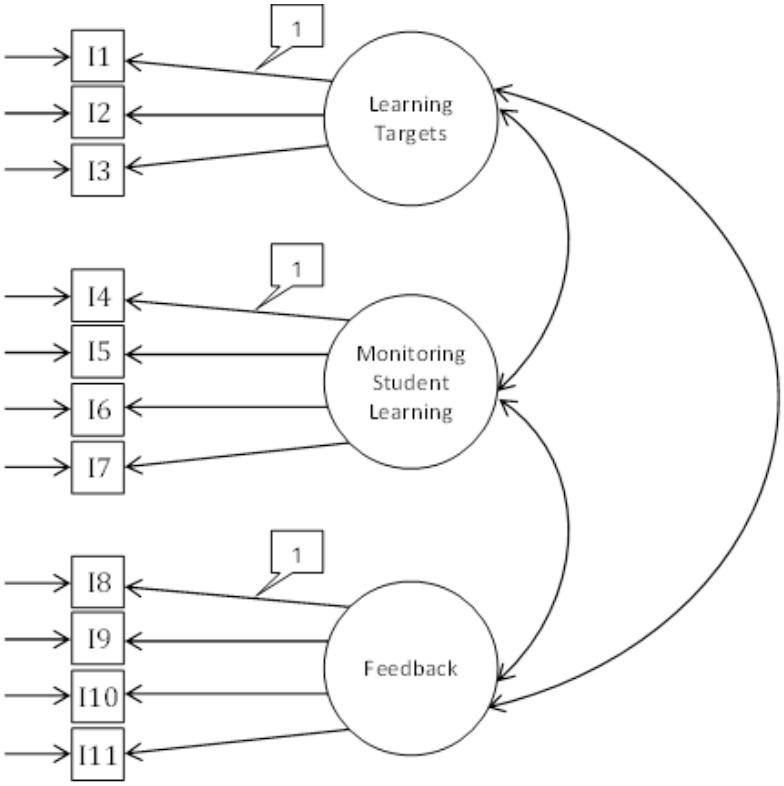

Figure 3. Hypothesized First-Order Confirmatory Factor Analysis Model

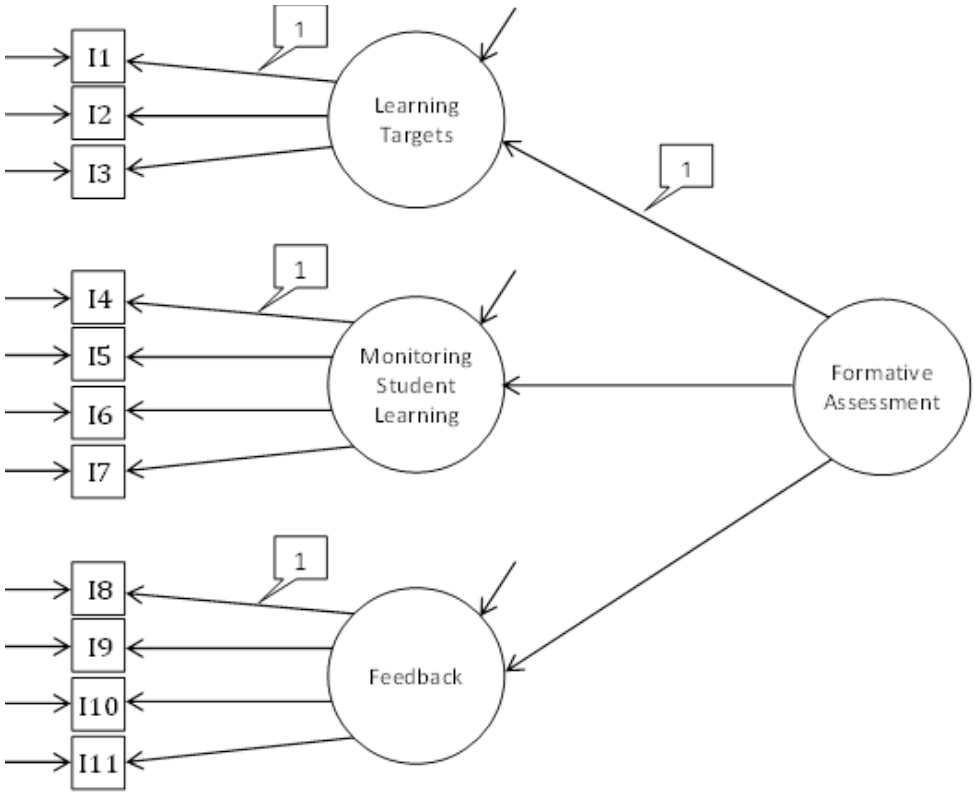

Figure 4. Hypothesized Second-Order Confirmatory Factor Analysis Model

CHAPTER FOUR: RESULTS

Preliminary Analysis

Before conducting the confirmatory factor analyses, two preliminary analyses were conducted. First, Rasch analysis was used to screen data for misfitting participants. This analysis identified six participants whose responses were inconsistent with the others in the sample. The data of these participants were dropped from subsequent analyses.

Second, exploratory factor analyses (EFA) were conducted before the confirmatory factor analysis. In particular, an EFA was conducted for each scale (i.e., learning targets, monitoring, and feedback) to identify groups of items that best measure the underlying factor of the scale. Before presenting the results for each scale, a general overview of EFA is provided.

An EFA begins by extracting principal components (factors). Principal components are extracted until all the variance among items is accounted for; thus, for a set of 10 items, there are 10 units of variance (each item contributing one unit of variance), and the EFA will continue extracting until all 10 units of variance are assigned to a component. However, not all principal components are considered important and different procedures have been devised to determine the number of important components. For instance, the Kaiser rule (Kaiser, 1960) suggests only principal components that account for more than one unit of variance be considered important. An

alternative procedure is to examine the eigenvalues (which describe the amount of variance accounted for by a principal component) and determine the point at which the eigenvalues change dramatically. Components at or above the point are considered important, whereas points below the point are not considered important (Cattell, 1966).

An EFA provides factor loadings, which describe the relation of each item to a specific factor. An item is considered to be "loading" on a factor when the loading is greater than .40. Items with only one factor loading greater than .40 are loading cleanly on a factor; whereas, items loading on more than one factor are said to be cross-loading on factors, which is problematic as items are written to measure only one factor. A varimax rotation increases the alignment of items to specific factors, which can decrease cross-loading, and make it easier to interpret the results of the EFA.

For each scale, an EFA was conducted, with a varimax rotation. Using a procedure described by Cattell (1966), each EFA showed one dominant factor. To provide a more thorough description of how the items held together, all the factors with an eigenvalue greater than 1 are presented (as suggested by Kaiser, 1960).

For learning targets, four components were extracted that accounted for more than one unit of variance. The first component had an Eigenvalue of 2.599, meaning that component accounts for 25.99% of the variance among the learning target questions. The remaining three components had eigenvalues of 1.470, 1.296, and 1.024; thus, the eigenvalues changed dramatically after the first component — suggesting only one important component. The factor loadings for each item are presented in Table 6. As seen in Table 6, four items had factor loadings above .40 on component one, and are shown in bold. Item 7 had a factor loading above .40 on the first component; however,

this item is cross-loading on two factors, therefore it was dropped from the analysis. The remaining three questions were identified as the items that make up the construct of learning targets and were used in the CFA. The final set of questions is shown in Table 7.

Table 6 Learning Targets Rotated Component Matrix

	Component			
	1	2	3	4
Q1	.004	.078	-.019	.945
Q2	.032	-.238	.780	.069
Q3	**.790**	.246	-.168	-.101
Q4	.125	.752	-.008	-.133
Q5	**.798**	-.083	.032	.117
Q6	**.853**	.070	-.129	-.053
Q7	**.515**	**.522**	.272	.120
Q8	.364	-.359	.278	.030
Q9	.012	.633	-.054	.257
Q10	.233	-.286	-.706	.132

Table 7 Learning Target Questions Extracted from EFA

Learning Target Questions	
Q3	Two fourth grade teachers want their students to know the learning objectives for the lesson. One writes the objectives on the board and begins teaching. The other doesn't write the objectives but spends 5 minutes discussing the objectives with the class. Which is a better approach and why?
Q5	A teacher does not like writing learning objectives on the board. Instead, she begins each lesson by telling students what they are going to be learning and shows them examples of high and low quality work related to the objectives. Is this an effective way to share learning targets with students? Why?
Q6	A teacher wants her students to know the learning objectives for a lesson. She doesn't write the objectives on the board, instead she spends 5 minutes discussing the objectives with the class. Is this effective teaching?

For monitoring student learning, four components were extracted that accounted for more than one unit of variance. The first component has an Eigenvalue of 2.606,

meaning that component accounts for 26.03% of the variance among the monitoring student learning questions. The remaining three components had eigenvalues of 1.377, 1.246, and 1.129; thus, the eigenvalues change dramatically after the first component — suggesting only one important component. The factor loadings for each question are presented in Table 8. Four questions have loading factors above .40 on component one and are shown in bold on Table 8. The four questions were identified as the items that make up the construct of monitoring student learning and were used in the CFA. The questions are show in Table 9.

Table 8 Monitoring Student Learning Rotated Component Matrix

	Component			
	1	2	3	4
Q11	.293	.053	-.171	-.682
Q12	**.750**	-.144	-.020	.131
Q13	.106	.115	.744	.057
Q14	.212	-.775	-.223	-.001
Q15	**.722**	-.150	.196	.090
Q16	.211	.768	-.236	-.026
Q17	.234	.028	-.143	.788
Q18	**.768**	.104	.062	-.232
Q19	.065	-.113	.726	-.047
Q20	**.813**	.215	.027	-.060

Table 9 Monitoring Student Learning Questions Extracted from EFA

Monitoring Student Learning Questions	
Q12	Which of the following instructional techniques assists a teacher in quickly assessing what individual students know?
Q15	How would you formatively assess students' **understanding** of the causes of the American Civil War?
Q18	What would best help a teacher find out if students know the four basic needs of living things?
Q20	Which of the following would best help a teacher formatively assess students' ability to **explain** why communities have laws?

For feedback, PCA extracted three components that accounted for more than one unit of variance. The first component has an Eigenvalue of 3.246, meaning that component accounts for 32.46% of the variance among feedback questions. The remaining two components had eigenvalues of 1.267 and 1.229; thus, the eigenvalues change dramatically after the first component — suggesting only one important component. The factor loadings for each question are presented in Table 10. Six questions have loading factors above .40 on component one, and are shown in bold on Table 10. To keep the number of items for each construct roughly equivalent, two of the items were eliminated. Question 21 was eliminated due to having the lowest correlation. Question 27 was eliminated because of cross-loading on feedback component 3. The four remaining questions were identified as the items that make up the construct of feedback and were used in the CFA. The questions are show in Table 11.

Table 10 Feedback Rotated Component Matrix

	Component		
	1	2	3
Q21	**.490**	-.125	-.058
Q22	**.780**	.024	.029
Q23	**.643**	.184	.242
Q24	.048	.084	.921
Q25	.422	.610	-.379
Q26	.053	.815	.225
Q27	**.713**	.032	**.373**
Q28	**.688**	.254	-.169
Q29	.390	-.410	.008
Q30	**.750**	.003	-.054

Table 11 Feedback Questions Extracted from EFA

Feedback Questions	
Q22	A teacher puts a letter or numeric grade on every assignment to provide feedback to students about how well they understand what they are learning and let them know where there is room for improvement. Is this effective feedback?
Q23	A student turns in a paper and the teacher notices two words are spelled incorrectly. What teacher response would most help the student progress in learning to review and edit his own writing?
Q28	A student's performance over time indicates 100% mastery of a learning target. How should the teacher use this information when talking to the student?
Q30	A teacher always marks all student errors on their work before returning it to them for review? Is this effective feedback?

As a result of the EFA, eleven items (shown in Tables 7, 9, and 11) were identified to be used in the CFA.

Descriptive Statistics

Descriptive results are presented in Table 12. Note the 1.000 numbers along the diagonal indicate that each item correlates perfectly with itself. The correlations for the three separate constructs — learning targets, monitoring student learning, and feedback — are boxed together on Table 12. The items within each construct are significantly correlated to one another.

Table 12 Descriptive Statistics and Bivariate Correlations

Item	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11
I1 Learning Target Question 3	1.000										
I2 Learning Target Question 5	.478*	1.000									
I3 Learning Target Question 6	.626*	.634*	1.000								
I4 Monitoring Student Learning Question 12	.065	.051	.156	1.000							
I5 Monitoring Student Learning Question 15	-.006	-.021	.09	.447*	1.000						
I6 Monitoring Student Learning Question 18	-.112	-.147	-.07	.378*	.384*	1.000					
I7 Monitoring Student Learning Question 20	.076	-.135	.02	.461*	.487*	.669*	1.000				
I8 Feedback Question 22	.175	.069	.175	.130	.120	-.006	.083	1.000			
I9 Feedback Question 23	.160	.063	.212*	.052	.132	.124	.189	.341*	1.000		
I10 Feedback Question 28	.098	.099	.117	.140	.231*	.250*	.168	.520*	.442*	1.000	
I11 Feedback Question 30	.117	.031	.091	.066	.170	-.074	.022	.492*	.466*	.376*	1.000
M	.550	.600	.610	.670	.470	.350	.380	.680	.470	.600	.610
SD	.500	.493	.491	.473	.502	.480	.488	.469	.502	.493	.491

Note. * Indicates correlations are significant at the .05 level.

Confirmatory Factor Analysis

Model One First-Order Confirmatory Factor Analysis

Figure 5 represents the hypothesized model that was tested. Note that learning targets has three indicator variables (i.e., the three items identified in the EFA). Likewise, monitoring student learning and feedback each have four indicator variables. A key feature to the first-order model is that the three factors are allowed to covary. That is, if the factors are related to one another, those relationships will be captured in the model.

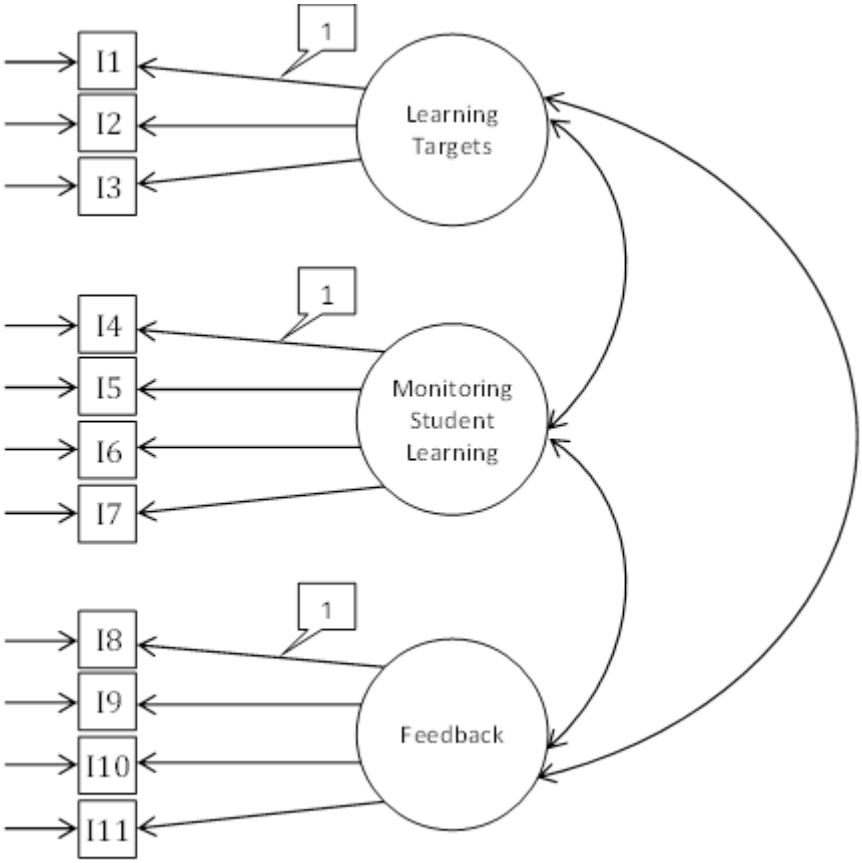

Figure 5. Hypothesized First-Order Confirmatory Factor Analysis Model

Figure 6 shows the results of the CFA, including the fit statistics for the model. The following fit indices were used to assess model fit: chi-square (χ^2), root-mean-square error of approximation (RMSEA), standardized root mean residual (SRMR), and comparative fit index (CFI; Kline, 2011). When the χ^2 statistic is not statistically significant, it can be concluded that the model was able to reproduce the observed correlations among variables. That is, the relationship among the variables produced based on the model do not differ significantly with the actual observed correlations (Kline, 2011). The χ^2 was not statistically significant for the first-order CFA model (p = .10), nonetheless additional indicators are necessary to evaluate the model fit. Commonly accepted guidelines for acceptable fit indices include: RMSEA close to .06 and below, SRMR close to .08 and below, and CFI close to .95 or greater (Hu & Bentler, 1999). SRMR can range from 0.0 to 1.0. A small SRMR indicates a good model fit, while 0.0 indicates a perfect model fit. Similarly, the closer an RMSEA value is to 0.0, the better the fit of the model. CFI values range from 0.0 to 1.0 with values greater than .95 indicating a good fit (Brown, 2006). Overall, as seen by the fit indices reported at the bottom of Figure 6, the model of the first-order CFA is a good fit for the data. It is important to note that the Lagrange multiplier indicated the model fit would be improved by allowing the error terms between Item 8 and Item 9 (i.e., E8 and E9) to covary. Allowing these error terms to covary reduced the effect of a local minimum of the function used in the structural model and helped the software converge on an appropriate solution.

There are two key findings from the CFA. First, the items are good indicators of the factors (i.e., Learning Targets, Monitoring Student Learning, and Feedback). In

particular, the standardized path coefficients, which can be interpreted like correlations, indicate the items are significantly and strongly correlated to their respective factors, all Zs > 4.94, $p < .001$. Second, the CFA shows the relation among the factors. As seen in Figure 6, only Learning Targets and Feedback were significantly correlated to one another — and this correlation is fairly weak. Learning Targets and Monitoring Student Learning, and Monitoring Student Learning and Feedback were not significantly related. These findings will be discussed further in the next chapter.

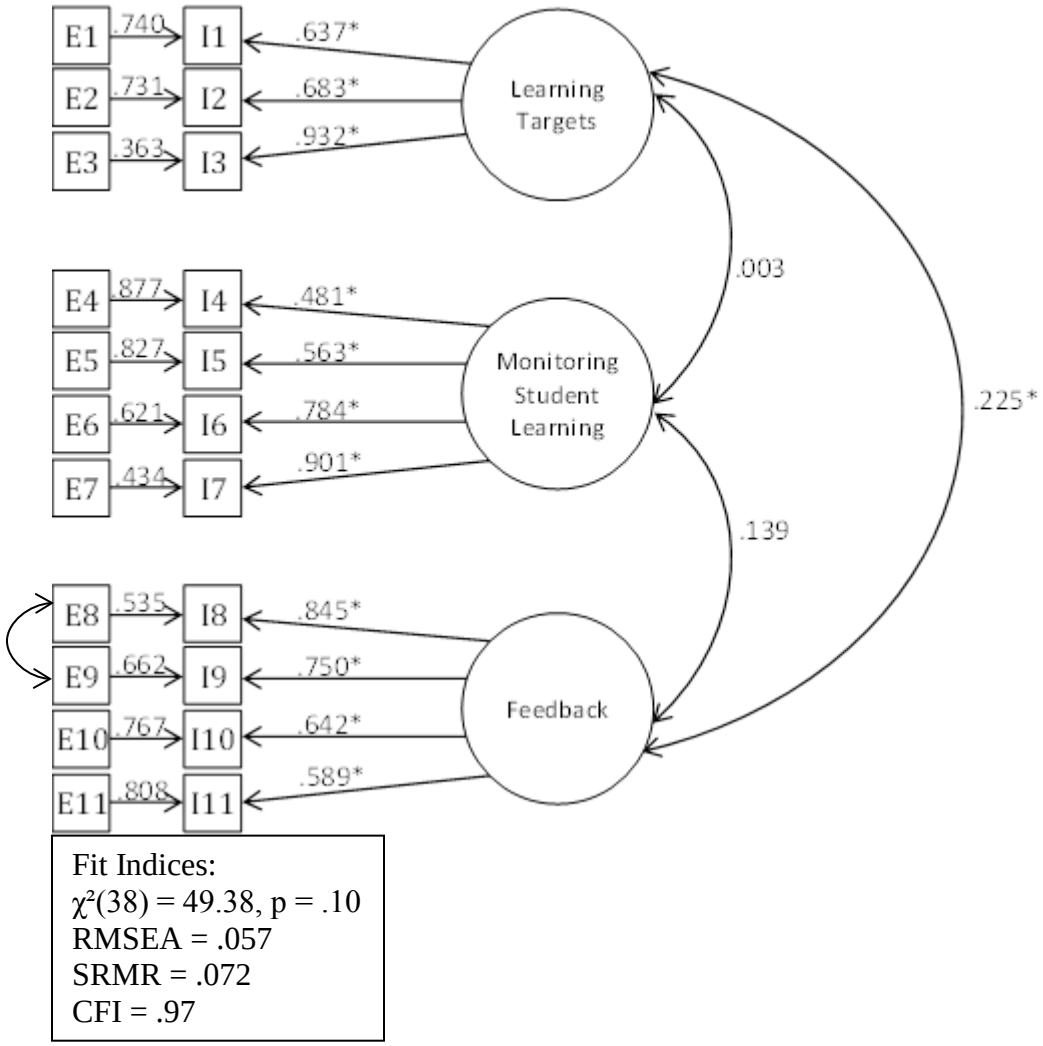

Figure 6. First-Order Confirmatory Factor Analysis Model with Results

Model Two Second-Order Confirmatory Factor Analysis

Figure 7 shows the second-order CFA model. This model hypothesizes Learning Targets, Monitoring Student Learning, and Feedback are related because they are all influenced by a higher-order factor: knowledge of Formative Assessment. The same fit indices used to evaluate the first-order CFA were used to evaluate the second-order CFA. The χ^2 was statistically significant (p = .001), indicating the model is not a good fit for the data. The RMSEA (= .146) was above the .06 level that indicates good fit, and the CFI (= .781) was below the .95 level that indicates good fit. Overall, the model of the second-order CFA is not a good fit for the data; therefore, the path coefficients will not be reported.

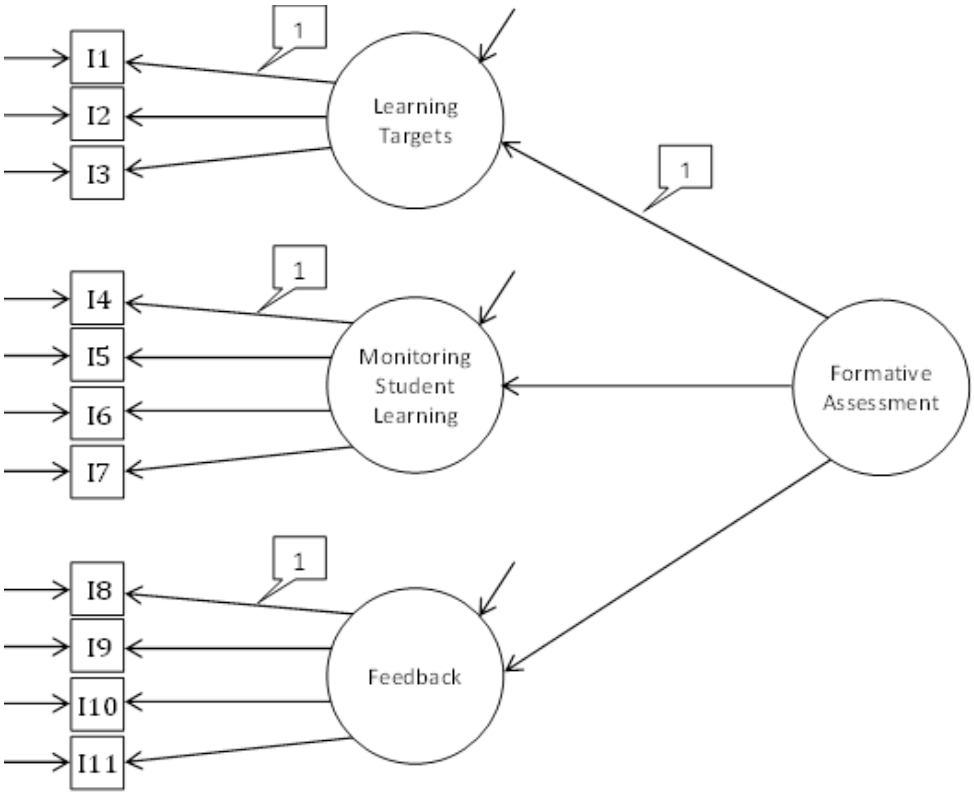

Figure 7. Hypothesized Second-Order Confirmatory Factor Analysis Model

In summary, the learning targets, monitoring student learning, and feedback factors were all well measured. The items were highly correlated to their hypothesized factor. The three factors were not highly correlated to one another, and do not appear related to a higher order factor: knowledge of formative assessment.

CHAPTER FIVE: DISCUSSION AND CONCLUSIONS

Discussion

The discussion will consist of six parts: (1) a review of the results, (2) a closer look at the aspects of each construct that was measured, (3) an examination of the relationship among the three constructs, (4) implications of the study, (5) limitations of the study, and (6) recommendations for future research.

Review of Results

The aim of this study was to establish reliability and initial validity of an instrument to measure teachers' knowledge of formative assessment. The research questions for this study were:

1. Is the Teacher Knowledge of Formative Assessment (TKFA) instrument represented by a factor model that includes the three expected factors of learning targets, monitoring, and feedback?
2. Is there a relationship between the three factors — learning targets, monitoring, and feedback — such that they load onto a larger construct of formative assessment?

The CFA findings suggest the three scales each measure a single factor and the items load strongly on the factors. Thus, the TKFA instrument is represented by a factor model that includes the three expected factors. Items 1, 2, and 3 on Table 13 measure learning targets, items 4, 5, 6, and 7 measure monitoring student learning and items 8, 9, 10, and

11 measure feedback (to see the full list of the items with answer choices see Appendix H). As noted in the introduction, there is no existing instrument to assess teachers' knowledge of formative assessment; thus, this study provides an important first step and makes a contribution to the literature.

Table 13 CFA Items

Item 1	Two fourth grade teachers want their students to know the learning objectives for the lesson. One writes the objectives on the board and begins teaching. The other doesn't write the objectives but spends 5 minutes discussing the objectives with the class. Which is a better approach and why?
Item 2	A teacher does not like writing learning objectives on the board. Instead, she begins each lesson by telling students what they are going to be learning and shows them examples of high and low quality work related to the objectives. Is this an effective way to share learning targets with students? Why?
Item 3	A teacher wants her students to know the learning objectives for a lesson. She doesn't write the objectives on the board, instead she spends 5 minutes discussing the objectives with the class. Is this effective teaching?
Item 4	Which of the following instructional techniques assists a teacher in quickly assessing what individual students know?
Item 5	How would you formatively assess students' **understanding** of the causes of the American Civil War?
Item 6	What would best help a teacher find out if students know the four basic needs of living things?
Item 7	Which of the following would best help a teacher formatively assess students' ability to **explain** why communities have laws?
Item 8	A teacher puts a letter or numeric grade on every assignment to provide feedback to students about how well they understand what they are learning and let them know where there is room for improvement. Is this effective feedback?
Item 9	A student turns in a paper and the teacher notices two words are spelled incorrectly. What teacher response would most help the student progress in learning to review and edit his own writing?
Item 10	A student's performance over time indicates 100% mastery of a learning target. How should the teacher use this information when talking to the student?
Item 11	A teacher always marks all student errors on their work before returning it to them for review? Is this effective feedback?

It is interesting to note the three scales are not strongly related to one another. This means teachers who know a lot about learning targets do not necessarily know much about monitoring student learning. Teachers who understand monitoring student learning do not seem to understand feedback. The significant positive correlation between learning targets and feedback suggest that teachers with more knowledge of learning targets also tend to have more knowledge of how best to provide students feedback. Given that these three constructs are all part of formative assessment, one might assume that a teacher knowledgeable in one or two of these areas would be knowledgeable in all of them, but that does not seem to be the case. The findings do not confirm the second research question as the second-order CFA did not adequately fit the data.

Measurement of the Constructs

The instrument used in this study had 30 total items, 10 items for each construct. The items for each construct addressed aspects of the construct represented in formative assessment literature (see Table 14). Interestingly, the items that held together on the CFA focused mainly on one aspect of each construct. For example, the four feedback items all measured the aspect of feedback "Teacher understands the type of feedback to give to move student learning forward" (see Table 14). Therefore, only part of each construct is represented in the resulting 11 item instrument. Perhaps the essential aspects of each construct are the parts that are represented, but deciding that is a judgment based on the available literature.

Table 14 Measured Aspects of Each Construct

Construct	Measured Aspect of Construct	Instrument Questions	Renumbered Items
Learning Targets *what teachers intend for students to learn*	Teacher establishes learning target for lessons and activities and shares these with students	9, 10	
	Teacher helps students know how to reach the learning target by clarifying expectations for success	2, 4, **5,** 7, 8	2
	Teacher makes efforts to ensure students understand the purpose and success criteria for lessons and activities	1, **3, 6**	1, 3
Monitoring Student Learning *gathering information about students' learning specific to the learning targets*	Teacher knows to focus on evidence that will indicate progress toward learning targets	11, 14, **15**, 16, 17, **18**, 19, **20**	5, 6, 7
	Monitoring activities vary in structure and may be quick or long in duration, formal or informal, occur through conversation, observation, or written work	**12**, 14, **15**, 16, **18**, **20**	4, 5, 6, 7
	Teacher has system for recording information learned through monitoring to use in later planning	13	
Feedback or Adjusting Instruction *providing students with information about their learning to help them adjust and adjusting instructional plans in response to monitoring of student learning toward the learning targets*	Teacher understands when to provide feedback to students (immediate vs. delayed)	21, 25, 26	
	Teacher understands the type of feedback to give to move student learning forward (specific vs. vague)	21, **22**, **23**, 27, **28**, **30**	8, 9, 10, 11
	Teacher understands feedback should be aligned to the learning targets or lesson and activities	24, **30**	11
	Teacher knows to adjust learning plans based on student responses	29	

Note. The 11 items analyzed In the CFA are show in bold. These items are shown respectively renumbered in the fourth column.

Looking more closely at the feedback items, it is clear that items 9 and 11 (see Appendix H) assess teacher understanding of the need to provide the right amount of feedback. As discussed in the literature review earlier, too much feedback can have a negative impact on students (Duijnhouwer et al., 2012). Items 8 and 10 assess teacher knowledge of the need to provide specific comments on errors and suggestions for improvement (see Elawar and Corno, 1985, as cited in Wiliam, 2011, p. 108). As a whole, the four feedback items examine the type of feedback a teacher provides, but they

do not address the timing of the feedback, the alignment between the feedback and learning target (with the exception of the answer for item 11), or teacher adjustment of learning plans. While the empirical evidence is strongest regarding the type of feedback teachers provide, the theoretical research places emphasis on all the named aspects of feedback. The four feedback items on the 11 item instrument, which are the result of the analysis of this study, are not measuring all the aspects of feedback described in the literature.

Taking a closer look at learning targets, items 1, 2, and 3 each focus on teacher understanding of how to share the learning target to ensure students know what the target is and have a clear understanding of the target. While the items capture the essence of what the literature explicated in regards to learning targets (Chappuis et al., 2012a; Hughes, 2010; McManus, 2008), the items are very similar and may be missing nuanced aspects of what teachers need to know about learning targets.

In relation to monitoring student learning, all four items address teacher understanding that monitoring activities vary in structure, duration, and formality. These elements are present in the theoretical literature about monitoring, but not represented in the empirical evidence. None of the four items are specific to frequent assessments, as shown to be effective in Yeh (2008), nor do they focus on the assessment conversation cycle shown to impact student achievement (Ruiz-Primo & Furtak, 2007). Moreover, items 4 and 6 are focused on the same instructional technique — use of individual student white boards, as are items 5 and 7 — use of a quick write assessment (see Appendix H). The four monitoring student learning items are not measuring all the aspects of monitoring present in the literature.

To more fully explore each construct, separate instruments may need to be developed, tested, and validated. For example, more items could be written designed to measure the aspects of feedback represented in the literature (see Table 1). The four feedback items used in the CFA all address the type of feedback teachers provide to students. Items that assess teachers' knowledge of the alignment of feedback to the learning target, how to adjust instruction, and when to provide feedback could be developed and added to the existing four items. Then this instrument containing only feedback items could be tested and validated. This same process could be used to validate a learning targets instrument and a monitoring student learning instrument. Then these three instruments could be combined to create a formative assessment instrument. The second-order CFA could be tested again to determine whether the constructs of learning targets, monitoring student learning, and feedback load onto the higher order construct of formative assessment.

Relation Among the Constructs

According to the literature, formative assessment is an instructional approach comprised of several integral components (learning targets, monitoring, feedback, self-assessment, and peer-assessment). Most notably, the large effect sizes Black and Wiliam (1998) reported were generated by summarizing effect sizes of studies focused on the individual components. Perhaps Bennett's (2011) contention that the collection is "too diverse to be sensibly combined" (2011, p. 11) is warranted. Despite the vast amount of theoretical literature purporting formative assessment as a compilation of several component instructional techniques, there is a dearth of empirical research examining the relation among the components. It is possible that each of the components need to be

conceptualized independently rather than as part of the process of formative assessment. However, I contend that the empirical link between the components merits further exploration.

It does not make sense to have learning targets, monitoring, and feedback stand alone. The value of learning targets is inherently instrumental. There is no point in establishing a learning target and sharing the target with students unless steps are taken to ensure students are progressing toward the learning target. This is where monitoring comes in — teachers monitor student learning in terms of their progress toward the learning target. Monitoring cannot take place unless there is a clearly defined and understood learning target. Yet without feedback, monitoring itself has no value. Monitoring is instrumental in providing information that teachers use to adjust instruction or help students individually correct misunderstandings — this is feedback. Feedback cannot stand alone either. The adjustments teachers make and the direct feedback they provide to students are all done to help students reach the learning target. The three components comprise an intricately connected process. While these components may be connected, the results of the present study suggest that teachers' knowledge of the components are not strongly associated

It may be that the lack of relationship between learning targets, monitoring, and feedback in the CFA results is indicative of poorly coordinated and aligned professional development teachers have received. Teachers' knowledge level may differ for the components based on their past professional development experience. For example, some teachers may have participated in significant professional development regarding learning targets but not have experienced professional development related to monitoring

student learning. Even though the findings of this study indicate teachers' knowledge of the components are not strongly associated, it does not indicate that the components themselves are not related. Further study of the relation between the components of formative assessment is needed.

Implications

The implications of the results relate directly to professional development. As discussed earlier, formative assessment is a process comprised of establishing learning targets and making them known to students, monitoring student learning toward the learning targets, and providing feedback that will help students achieve the intended learning targets. Teachers must understand all three of these process components in order to reap the powerful student achievement benefits associated with formative assessment. The weak relation among the three factors suggests that professional development must approach the three areas of formative assessment separately — because they are not related to one another. Yet, an impact in the classroom is unlikely to be evident until teachers have knowledge in all three components, including an understanding of the links between them.

When I have facilitated formative assessment professional development, teachers mention that they already understand and implement many of the instructional practices in their teaching. Through observations in the teachers' classrooms, I have seen evidence that confirms the teachers' comments. Some of the teachers I observed shared learning targets with students. Most teachers used questioning and all-pupil response techniques to solicit evidence of student learning. Most teachers provided some form of feedback to students. However, I rarely observed teachers making explicit connections between

learning targets, monitoring, and feedback. For example, teachers that made the learning target explicit at the beginning of a lesson did not focus student feedback on the learning target. Students' answers to questions and responses during monitoring were rarely recorded and, with rare exception, were not being used to adjust future instruction. Teachers understand and use some elements of formative assessment components in their teaching. However, teachers who understand and use only one or two of the components of formative assessment are not going to be able to effectively employ formative assessment in their classroom practice. Therefore, we must assess teachers' knowledge of each of the components of formative assessment and work to develop expertise in each area.

Using the TKFA instrument, professional developers will be able to see which components teachers' have strong knowledge in and which components they have weak knowledge in. The professional development should be designed to build on teachers strengths and help them to increase their knowledge in the components they are less knowledgeable about. Efforts should be made during the professional development to help teachers understand the relationship of the components and how the components comprise the essence of formative assessment.

Limitations

While the instrument has potential to be a powerful tool for designers of professional development, only initial validity has been established for the 11 items used in the CFA. The 11 item instrument resulting from this study needs to be used to collect more data. These data can be used to continue the validation process of the instrument to measure teacher's knowledge of formative assessment.

Other limitations include the sample size, which did not allow for cross-validating the findings with a second sample — but this is planned for a future study. Additionally, the sample was a homogenous group of teachers from one school district. Three-quarters of the teachers in the sample are receiving professional development in classroom assessment, which may have influenced the results. It will be important to assess teacher knowledge with a more diverse sample.

Recommendations for Further Research

If I were to begin this study again, I would start by developing individual measures for each of the three constructs. By creating separate measures, there can be more items assessing each construct without fatiguing participants. Factor analyses can be conducted for each of the constructs that will perhaps illuminate sub-constructs within each construct. This would aid in further understanding the nature of each particular construct. One would be able to test whether the aspects of each construct present in literature hold together and load on the construct. For example, feedback takes many forms and may be oral, written, directed to multiple students or just one, or an adjustment to instruction (Wiliam, 2011). According to the literature, the volume of feedback provided, specificity, and timing all play into the effectiveness feedback has on student achievement (Duijnhouwer et al., 2012; Eckert et al., 2006; Simmons & Cope, 1993). It would be interesting to see if items written to measure teachers' knowledge of these various aspects of formative assessment load on distinctive scales within feedback, and furthermore, if these scales all load on the larger factor of feedback. Then, if this process is done for learning targets and monitoring as well, with large loading factors for each main factor, the items that hold together from the three analyses could be compiled into

one measure to assess teachers' knowledge of formative assessment. At that juncture, the current study could be repeated.

However, all of that would be a very intensive process and may not prove worthwhile in a cost-benefit analysis. Therefore, the next reasonable step following this study is to use the 11 item instrument to collect more data and repeat the confirmatory factor analyses to continue the instrument validation process. Once the TKFA is validated, it can be used in other research. First, the instrument can be used to evaluate the effectiveness of formative assessment professional development, by using it before and after formative assessment professional development. Teacher scores can be compared to measure whether formative assessment knowledge increased as a result of the professional development. Second, the instrument can be used to see if there is a correlation between teacher formative assessment knowledge and student achievement. The relationship between teacher formative assessment knowledge and student achievement will further our understanding of the potential impact of formative assessment. If a relationship exists, then efforts to ensure teachers have an adequate knowledge base in formative assessment will be warranted. If a relationship does not exist, we may need to reconsider the amount of emphasis placed on ensuring teachers understand formative assessment.

Additionally, it would be interesting to explore the relationship between teacher knowledge of each of the components of formative assessment and student achievement. In other words, compare teacher knowledge of learning targets to student achievement, compare teacher knowledge of monitoring student learning to student achievement, and compare teacher knowledge of feedback to student achievement, separately. This

information could help address Bennett's (2011) concern about trying to summarize the impact of a variety of teaching techniques into one formative assessment effect size statistic. These relationships could be explored before teachers receive professional development and after professional development to detect whether a change in knowledge corresponds to change in student achievement. It would be interesting to see whether high knowledge in only one or two components corresponds to high student achievement or if high knowledge in all three components is essential to detect student achievement benefits.

Conclusion

Ultimately, why do we care about teachers' knowledge of formative assessment? Could we not instead teach teachers techniques, such as posting learning objectives, and assume successful outcomes? No. Training teachers in techniques will never result in teachers who are able to do the work of developing students into thinkers. Shulman stated, "Reinforcement and conditioning guarantee behavior, and training produces predictable outcomes; knowledge guarantees only freedom, only the flexibility to judge, to weigh alternatives, to reason about both ends and means, and then to act while reflecting upon one's actions. Knowledge guarantees only grounded unpredictability, the exercise of reasoned judgment rather than the display of correct behavior" (Shulman, 1986, p. 13). Teachers gain knowledge to make reasoned judgment in a variety of ways and one crucially important way is through professional development. Beginning professional development after determining teachers' starting knowledge level will provide for more tailored and specific professional development. For this reason, I developed an instrument that will provide professional developers with information about

teachers' knowledge of formative assessment to use when planning for and executing professional development in formative assessment.

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APPENDIX A

Pilot Instrument 1

Thank you for taking the time to complete this inventory. Type your responses in the box below each question. Please answer each question the best that you can. A few sentences should suffice to answer most questions.

If you have feedback on the items, please include that below your response; mark with an asterisk* to indicate. Or email amandabremner@u.boisestate.edu. Thank you!!!

How many years have you taught?
Please round up to the nearest whole number of years.

What grade level(s) have you taught?

- o K
- o 1st
- o 2nd
- o 3rd
- o 4th
- o 5th
- o 6th
- o 7th
- o 8th
- o 9th
- o 10th
- o 11th
- o 12th
- o College
- o Other:

1. A teacher wants her students know the learning objective for the lesson. She writes the objective for the lesson on the board. She hands students a bell ringer activity, collects their papers after five minutes and begins the lesson. Do you think the students know the learning objective for the lesson? Explain how you know.

2. A second grade class is working on using capitalization and punctuation in their writing. Before turning in their writing, the teachers ask the students to circle in green every time they began a sentence with a capital letter and circle in red every

time they ended a sentence with punctuation. The teacher collects and reads student writing. The teacher marks on the paper the number of times the student should have used beginning capitalization and ending punctuation. The teacher has the students go back through their papers to identify these additional instances. Explain how this teacher is or is not providing effective feedback to students.

3. A teacher is very excited about using an electronic all pupil response system. She shows a multiple choice question on the screen, students select their answer and the program instantly graphs student responses. Another teacher thinks the system is a waste of money. Questions are limited to selected responses only. She wants to be able to probe her students with open ended questions and provide them with plenty of time to think and respond. Which teacher's method is best for gathering information about student learning? Explain.

4. A teacher wants students to understand what they can do next to continue learning after they take a mid-unit assessment. How can she share their test results in a way that will achieve this purpose?

5. After teaching part of a unit on the life-cycle of animals, a teacher gives the students a ten-item quiz. Before turning in the quiz, she asks the students to look through each item carefully and predict how well they think they did by starring items they are sure they got correct, checking items they think they got correct and writing a question mark by items they were unsure they answered correctly. She collects the quizzes and scores them. Why do you think the teacher asked students to predict their own performance on the quiz?

6. A teacher has students peer edit as part of the writing process in his classroom. When students review each other's work they must make two comments about things they thought were good in the writing and one suggestion for improvement. When reviewing students' comments, she finds that many student comments are very superficial such as, "You have pretty handwriting," or "I wish your story was funny." What can the teacher do to help students learn to make comments that will lead to improvement?

7. During a unit, a teacher has students turn in exit cards at the end of each lesson. These cards provide students the opportunity to demonstrate their learning from the lesson. The teacher uses the cards to determine where the students are in their learning and helps her plan where to go next with the lessons. She also assigns students one point for correct exit cards and zero points for incorrect. She sums these points at the end of the unit and enters them as a quiz score in the students'

grades. What formative assessment strengths is this teacher demonstrating? What, if anything, should she change?

8. A teacher recently began teaching students about measures of central tendency used to summarize data. He is aware of several misconceptions students typically have about the concept "median." Before students begin working independently, he displays a problem completed by a student with a common error. The class examines the work together. He asks them to identify what the student did well and where, if anything, the student could improve in completing the task. What do you think the teacher's purpose is for examining student work with the class?

9. Students submit their rough draft essays to the teacher. She puts checks by three places where they did something well. She puts minuses by three places where they need improvement. The teacher does not point out every spelling, grammar or editing error the students make. Can the students improve when the teacher does not point out all of the places in their writing that need to be corrected? Explain.

10. At the beginning of the trimester, students do a writing activity. At the end of the trimester, they do the same writing activity again. They are given both writing pieces and a form that says, "I used to….but now I…." The teacher instructs the students to write about ways that their writing has improved. How can this activity help move student learning forward?

11. A first grade student sees the word 'was' and reads 'saw' aloud. The teachers tell her, "That word is 'was,' but don't worry lots of people make that mistake. Those words have the same letters." Explain what the teacher did well working with this student and what she could have added or done differently to help move the student's learning forward.

12. What is the purpose of formative assessment?

13. During a lesson on the basic components of our solar system, the teacher describes asteroids, comets, and meteors. She pauses to ask the class if they understand the difference between the three. The teacher asks the student to put their thumbs up if they understand and thumbs down if they do not. All but two students have their thumbs up, so the teacher moves on in the lesson mentally noting to later talk to the two students who had their thumbs down. What did the teacher find out about her students learning using the thumbs up/down technique?

14. A teacher does lots of checking in with her students during her lesson. She asks them to show thumbs up or down to indicate if they do or do not understand something, she has them show her answers on their individual white boards, and she uses popsicle sticks with students names to ensure every student the opportunity to be called on and answer probing questions. The teacher makes mental note of the students responses to each of the things that she does. The next day she continues on with the next lesson she previously planned. What is this teacher doing well related to formative assessment? What, if anything, could she change?

15. At the end of a lesson on multi-digit multiplication, a teacher asks students to review the learning goal they wrote in their notebooks at the start of the lesson. Then she tells them to write in their own words what they learned during the lesson and prove it. The students solve a multi-digit multiplication problem in their notebooks and then mark the effort they put into the lesson using a one to four scale. The students also put a red, yellow, or green dot on their paper to indicate how well they feel they understood the lesson. Explain whether or not this is an effective way to help students take ownership of their own learning.

16. Before beginning a unit on clouds, a teacher wants to pre-assess his students to find out what they already know about the topic. He uses a KWL chart and determines that the students know many of the concepts he planned to teach them. What should the teacher do now to prepare to teach the cloud unit?

17. In collaboration time teachers are discussing formative assessment. One teacher says that for formative assessment she has the students signal with a thumbs up or thumbs down to indicate if they understand what she just taught. She moves on if most of the thumbs are up and repeats the last part of the lesson if most thumbs are down. Do you agree with this teacher that this is formative assessment? Explain why or why not.

18. A teacher begins class with a multiple choice question on the board. Students hold up a letter card (A,B, C, or D) indicating the answer they believe is correct. The teacher asks the students to justify their choice. As they respond she asks questions such as, “How do you know that?” “What evidence to you have to support your answer?” and “Why is answer C better than B(or A or D)?” The discussion continues for ten minutes. What did the teacher find out about her students by having them discuss their answer?

19. A teacher wants her students to be independent learners during small group reading, but knows that sometimes they will need assistance to successfully

complete their work. She decides to implement a rule where students must ask three classmates for help before they can ask her. The teacher thinks this will help her students act as instructional peers for each other and thereby help them all work toward their learning goals. Do you agree with this teacher's rationale? Explain.

20. How frequently should formative assessment be used in the classroom?

21. When talking to a teacher in the hall, she remarks that she does not like formative assessment. "It is just more tests to give students and they are over tested already," she says. What does this teacher appear to understand about formative assessment? What more might she need to learn?

22. A teacher wants to show examples of student work before having her students write an essay. She only has time to show two examples. She is trying to decide whether to show two really good examples or one really good example or one low quality example. What would you recommend she do and why?

23. A teacher puts a grade on every assignment students turn in, even if that grade does not go in the gradebook. She believes students will not be motivated to do their best work if they do not receive a grade. She also believes that grades provide valuable feedback to students about how well they understand what they are learning. Do you agree with her reasons for providing grades on all papers? Explain.

24. A teacher wants his students to take more ownership of their own learning. After giving a unit test, he projects the answers on the overhead screen and tells students to correct their own test. He asks them to write the number they got wrong at the top and turn the test in. Explain whether or not this is an effective way to help students take ownership of their own learning.

25. Midway through teaching a unit, a teacher has the students complete a performance assessment. Some of it covers material she has taught them, some of it covers upcoming material. Many of the students score around 50%, others score lower, a few score as high as 70%. Should she share the results with the students or just use that information herself? Explain.

26. A teacher chooses a social studies objective from the standards to teach her students. She wants to find out what her students already know so she prepares a

pre-assessment for them to take. How will the pre-assessment prepare to teach the objective?

27. A fourth grade teacher wants students to identify the differences between vertebrate and invertebrate animals. She teaches a lesson about the differences in the animals and then explains to students the objective. She then assigns them to cut out pictures of animals from magazines she has provided and sort them into vertebrates and invertebrates. She asks the students to tell a partner why they are doing this activity. Then she asks someone to share with the class what they are learning from the activity. Why do you think the teacher is having the students talk about why they are doing the activity?

28. A teacher administers a weekly quiz that covers the topics taught between quizzes. To provide the students with feedback on their understanding, she scores the quizzes with the number correct, indicates wrong answers with a check and writes in the correct answer. The quizzes are returned to the students and the teacher tells them to use the quizzes to help them study for the unit test. Explain how this teacher is or is not providing effective feedback to students.

29. After completing an assignment, a teacher tells students to find a partner and discuss their work. If they disagree about something, they must discuss it and come to a common answer before turning in their assignment. Do you think this will help students move forward in their learning? Explain.

30. A new teacher does not understand what to do with the information she learns from formative assessment. What can you tell her to help her?

APPENDIX B

Pilot Instrument 2

How many years have you taught? (Please round to the nearest whole year.)

What grade levels have you taught? (Please mark all that apply.)

- ❑ Prekindergarten
- ❑ Kindergarten
- ❑ First Grade
- ❑ Second Grade
- ❑ Third Grade
- ❑ Fourth Grade
- ❑ Fifth Grade
- ❑ Sixth Grade
- ❑ Seventh Grade
- ❑ Eighth Grade
- ❑ Ninth Grade
- ❑ High School
- ❑ Other (please specify) _____

Please respond to the following questions. Please answer all the questions on each page before going to the next page. You cannot go back to previous pages.

1. What is the purpose of formative assessment?

2. How frequently should formative assessment be used in the classroom?

Consider the following scenarios and respond to the questions that follow. Assume only the information given. A few sentences should suffice to answer each question.

3. A teacher does lots of checking in with her students during her lesson. She asks them to show thumbs up or down to indicate if they do or do not understand something. She has them show her answers on their individual white boards. She uses popsicle sticks with students names to ensure every student the opportunity to be called on and answer probing questions. The teacher makes mental notes of the students' responses to each of the things that she does. The next day she continues on with the next lesson she previously planned. What is this teacher doing well related to formative assessment? What, if anything, could she change?

4. A teacher wants to show examples of student work before having her students write an essay. She only has time to show two examples. She is trying to decide whether to show two really good examples or one really good example and one low quality example. What would you recommend she do and why?

5. Students submit their rough draft essays to the teacher. She puts checks by three places where they did something well, she puts minuses by three places where they need improvement, and writes one or two specific comments. The teacher does not point out every spelling, grammar or editing error the students make. Can the students improve when the teacher does not point out all of the places in their writing that need to be corrected? Explain.

6. A teacher makes the statement “All squares are rectangles.” She asks them to decide if they agree or disagree with her statement by entering their responses on an electronic response system. She then tells them they must prove their opinion. They can do this by writing a paper, drawing pictures, holding a debate, using objects, or another way the students may think of. What might be the teacher’s purpose in eliciting responses in the various ways for this one task?

7. A teacher administers a weekly quiz that covers the topics taught between quizzes. To provide the students with feedback on their understanding, she scores the quizzes with the number correct, indicates wrong answers with a check and writes in the correct answer. The quizzes are returned to the students and the teacher tells them to use the quizzes to help them study for the unit test. Explain how this teacher is or is not providing effective feedback to students.

8. A teacher wants her students to know the learning objective for the lesson. She writes the objective for the lesson on the board. She hands students a bell ringer activity, collects their papers after five minutes and begins the lesson. Do you think the students know the learning objective for the lesson? Explain how you know.

9. A teacher begins class with a multiple choice question on the board. Students hold up a letter card (A, B, C, or D) indicating the answer they believe is correct. The teacher asks the students to justify their choice. As they respond she asks questions such as, "How do you know that?" "What evidence do you have to support your answer?" and "Why is answer C better than B(or A or D)?" The discussion continues for ten minutes. What did the teacher find out about her students by having them discuss their answers?

10. A teacher puts a grade on every assignment students turn in, even if that grade does not go in the gradebook. She believes students will not be motivated to do their best work if they do not receive a grade. She also believes that grades provide valuable feedback to students about how well they understand what they are learning. Do you agree with her reasons for providing grades on all papers? Explain

11. During a lesson on the basic components of our solar system, the teacher describes asteroids, comets, and meteors. She pauses to ask the class if they understand the difference between the three. The teacher asks the student to put their thumbs up if they understand and thumbs down if they do not. All but two students have their thumbs up, so the teacher moves on in the lesson mentally noting to later talk to the two students who had their thumbs down. What did the teacher find out about her students learning using the thumbs up/down technique?

12. A teacher shares the learning objective of a lesson before beginning instruction. After teaching a lesson she explains an activity the students will work on related to the objective. She asks the students to tell a partner why they are doing this activity. Then she asks someone to share with the class what they are learning from the activity. Why do you think the teacher is having the students talk about why they are doing the activity?

APPENDIX C

Pilot Instrument 3

Please indicate the grade or subject area you currently teach: _____

Instructions: Please choose the best answer.

1. Which of the following best describes the purpose of formative assessment?
   A. To get an immediate read of an individual student's understanding of a skill or concept currently being taught.
   B. To quickly gather information regarding the class's understanding of key concepts being taught.
   C. To identify where students are at in relation to a learning target and allow teachers and students to make adjustments needed to continue to move the learning forward.
   D. To determine the depth of knowledge being taught in a lesson.
   E. To gather informal data to support the decisions made using summative assessment.

2. How frequently should formative assessment be used in the classroom?
   A. daily, multiple times per day, in every lesson
   B. daily in math, twice per week in other subject areas
   C. at the beginning and end of each unit and skill set taught
   D. several times a week

3. A teacher remarks that she does not like formative assessment, "It is just more tests to give students and they are over tested already." What does this teacher need to understand about formative assessment?
   A. Formative assessment is not stressful or time consuming for students. It helps students learn by challenging them and not leaving students confused or bored.
   B. Formative assessment does not have to be a test. It is a process used to gather information about student learning in order to adjust instruction.
   C. Formative assessment should be done in a variety of ways, like making a game or a writing assignment.
   D. Summative assessment is a test. Formative assessment should be disquised as part of a lesson and provide information to the teacher about student learning.

4. When should a teacher share learning targets with students?
   A. Learning targets should be posted on the board so that students can see them anytime.
   B. At the beginning of each lesson and again at the end for review of what was learned.
   C. At the start of lessons and activities so that students know what they are responsible for achieving.
   D. It is not necessary for students to know the learning targets, so long as the teacher knows.

5. A teacher wants her students to know the learning objectives for a lesson. She doesn't write the objectives on the board, instead she spends 5 minutes discussing the objectives with the class. Is this effective teaching?
   A. No. The objectives must be written on the board to make learning visible.
   B. No. Without the objectives on the board the students will not have a reminder of the objectives.
   C. No. Spending 5 minutes discussing objectives is a waste of valuable instructional time.
   D. Yes. The discussion increases the likelihood that students understand the objectives.

6. A teacher wants to show examples of student work before having her students write an essay, but only has time to show two examples. What would you recommend she do and why?
   A. Show one high quality and one low quality example. Comparing examples helps to clarify the learning target and assist students in recognizing how to achieve it.
   B. Show two high quality examples. This will let students know what the learning target is, and set high expectations for students.
   C. Show two high quality examples. She shouldn't show her students the wrong way to do something.
   D. Show two low quality examples. This will clarify the kind of work students should avoid producing.

7. A teacher shares the learning objective of a lesson before beginning instruction. After teaching a lesson she explains an activity the students will work on related to the objective. She asks the students to tell a partner why they are doing this activity. Then she asks someone to share with the class what they are learning from the activity. Why do you think the teacher is having the students talk about why they are doing the activity?
   A. The teacher is ensuring that students understand the learning objective.
   B. She is teaching metacognition. The students are thinking about their thinking. They are explaining the purpose for the activity which provides relevance for the learner.
   C. It validates their learning and that what they are doing is important.
   D. When students share orally, they retain information better. Hearing the objective and then restating it, is a great way to remember.

8. At the beginning of a lesson the teacher states, "Today you will be able to go from a mixed number to an improper fraction." This objective is also written on the board. Has the teacher provided the students with a vision of what they are responsible for learning in that lesson?
   A. No. Stating and writing an objective is not enough for students to understand what they should be learning.
   B. No. The teacher should clarify the meaning of terms in the objective and explain to students how they will know when they achieve the objective.
   C. Yes. Posting and stating the objective of the lesson provides students with two opportunities to know the objective they are responsible for learning.
   D. Yes. The teacher made clear that students will be going through a process starting with mixed numbers and changing them into improper fractions.

9. A teacher wants her students to learn the structure of an argumentative essay. She teaches a lesson on the structure of an argument. On students' drafts she writes specific comments related to argumentative structure, but does not point out every spelling or grammar error. Is this effective feedback, why or why not?
   A. No, because spelling and grammar are important components of effective communication.
   B. No, because overlooking spelling and grammar errors sends the message that these are not important.
   C. No, it is important to align feedback with the overall learning target.
   D. Yes, the feedback is well aligned to the lesson's learning target.

10. Which is the most effective way to make use of the results of a free-response formative assessment?
    A. Assign a grade
    B. Show to parents to explain student progress
    C. Provide instructional feedback to students
    D. Motivate students by praising creative responses

11. A teacher shows her class how to measure angles using a protractor. During student work time the teacher watches one student struggling in her attempts to measure angles. Which of the following is the best next step for the teacher?
    A. Ask the student to demonstrate using the protractor. Guide the student by asking corrective questions and modeling small steps as needed.
    B. Show the student the process to measure an angle again. While demonstrating, stop periodically to ask the student if she understands.
    C. Stop the class and explain that there appears to be confusion on how to use a protractor. Ask for a volunteer to go to the front of the room to demonstrate how to measure an angle using a protractor.
    D. Tell the student she is measuring the angles incorrectly so that she does not continue to practice the wrong way. Measure several of the angles on the student's paper until she indicates she understands.

12. A third-grade teacher wants to provide students with timely feedback, so she scores a test while the students are at recess. She writes the number correct at the top, puts a check by wrong answers and writes in the correct answers. Is this effective feedback?
    A. No, immediately showing students their results is helpful, but she needs go over the test with the class and do a mini lesson to cover areas missed.
    B. No, she does not provide information about how they can move their learning forward, she only tells them if they are right or wrong.
    C. Yes, by providing students with the correct answer she is helping them learn about the concept or the misunderstanding of what was taught.
    D. Yes, she is allowing students to learn from their mistakes. Looking at what they did wrong and figuring out how they can correct their own thinking is excellent. It involves critical thinking and evaluation.

13. A common mistake in two-digit addition (e.g., 68 + 24) is to forget to carry one ten when the ones sum to ten or more. A teacher wants her student to avoid this mistake, so she focuses a lesson on it. She has students solve a problem and discusses only those where the student forgot to carry a ten. Is this effective feedback, why or why not?
    A. No, she should comment on all errors because accuracy is important.
    B. No, she should comment on only correct responses to avoid reinforcing students' misconceptions.
    C. No, she should comment on all the students' work to avoid singling out students.
    D. Yes, the feedback is well aligned to the lesson's learning target.

14. A new teacher does not understand what to do with the information she learns from formative assessment. What can you say to help her?
    A. Formative assessment is the way that you continually gauge your students progress and concept understanding. The results should inform how and what you teach next.
    B. Formative assessment shows the students strengths and weaknesses as a whole and individually.
    C. Formative assessment shows how many students are making progress toward standards and goals.
    D. Formative assessment is used to help determine grades and talk to parents about their children's progress.

15. A teacher begins class with a multiple -choice question on the board. Students must justify their choice. As they respond the teacher asks questions such as, "How do you know that?" "What evidence do you have to support your answer?" and "Why is answer C better than B (or A or D)?" The discussion continues for ten minutes. What did the teacher find out about her students by having them discuss their answer?
    A. The teacher learned the depth of understanding students have when they attempted to explain and compare their reasoning.
    B. She found out which students were randomly guessing, and which students had reasons for their choice.
    C. The teacher found out that there are many ways her students figured out the answer.
    D. She learned about their thought processes, how different students think, and revealed preconceived ideas the students have about a topic.

16. Which of the following instructional techniques assist a teacher in quickly assessing what their students know?
    A. Teacher explains a concept and asks students to put their thumb up if they understand or thumb down if they do not understand or have a question.
    B. Students solve a problem on an individual white board and hold it up for the teacher to see.
    C. Teacher makes a statement. Students stand if they think the statement is true and stay seated if they think the statement is false.
    D. Students put a green, yellow or red dot on the top of a paper before turning it in indicating if they feel confident in their understanding, still have some confusion or questions, or do not understand.

17. How can a teacher best keep track of student data learned through formative assessment?
    A. By grading assessments and recording scores in a grade book.
    B. Since it is a process of informally gathering information, a teacher should keep track of this information mentally throughout lessons and activities.
    C. Using checklists and notes organized in a way that a teacher can review when planning instruction and responding to students.
    D. Through collecting evidence pieces and keeping them in a file for each student.

18. A teacher wants to determine students' progress toward being able to discuss the causes of the American Revolution. Which activity would help her do that best?
    A. The teacher asks students to write on a notecard two events that led to the American Revolution. The students hand in the card before going to lunch.
    B. The students read a short text about the American Revolution. Then teacher gives the students a cause and effect chart and asks them to fill the chart in based on the reading.
    C. The teacher makes several statements about the American Revolution. After each statement, students raise their hand if the statement is about a cause of the American Revolution.
    D. Students identify an event that led to the American Revolution and talk with a partner about why it led to the American Revolution. The teacher listens to students' discussions.

19. A teacher wants to find out if her students can identify the difference between renewable and nonrenewable resources. Which of the following should the teacher have students do on an exit slip?
    A. List and label three renewable and three nonrenewable resources.
    B. Explain why wind is considered a renewable resource.
    C. Identify if wind is a renewable or nonrenewable resource and explain.
    D. Explain the importance of renewable and nonrenewable resources.

20. How would you formatively assess students' understanding of the causes of the American Civil War?
    A. Use of a checklist while students debate the causes of the Civil War.
    B. Have students do a 5-minute quick write about the causes of the Civil War.
    C. With an exit ticket on which students rate their understanding of the causes of the Civil War using a scale of 1 to 5.
    D. A quiz that has students answer true/false statements about the causes of the Civil War.

Thank you!

APPENDIX D

Pilot Instrument 4

Please list your current or most recent teaching assignment (grade and/or subject):

How many years have you taught?
- ❍ Less than 1 year
- ❍ 1-3 years
- ❍ 4-10 years
- ❍ 11-25 years
- ❍ 26 or more years

Instructions: Please select the BEST answer for each item.

Which of the following best describes the purpose of formative assessment?
- ❍ To get an immediate read of an individual student's understanding of a skill or concept currently being taught.
- ❍ To quickly gather information regarding the class's understanding of key concepts being taught.
- ❍ To identify where students are at in relation to a learning target and allow teachers and students to make adjustments needed to continue to move the learning forward.
- ❍ To determine the depth of knowledge being taught in a lesson.
- ❍ To gather informal data to support the decisions made using summative assessment.

A teacher wants students to know what they are responsible for learning during a lesson and so she posts the learning objective on the board. Is this an effective way to share learning targets with students?
- ❍ No. A teacher must read the objective with the students.
- ❍ No. A teacher must explain the learning objective to students and refer to it throughout the lesson.
- ❍ No. A teacher must refer to the objective at the beginning of a lesson and return to it at the end of the lesson.
- ❍ Yes. Having targets written on the board allows students refer to the learning target throughout the lesson.

A teacher does not like writing learning objectives on the board. Instead, she begins each lesson by telling students what they are going to be learning and shows them examples of high and low quality work related to the objectives. Is this an effective way to share learning targets with students?
- ❍ No. The learning objectives are not visible to students and they will no remember by the end of the lesson what it is they were supposed to be learning.
- ❍ No. Learning objectives should be posted for students to see and then shared with students at the beginning of the lesson.
- ❍ No. Students will focus on details of the work they are shown and not remember what it is they are supposed to be learning.
- ❍ Yes. The students hear the learning objectives and see examples that will help clarify to students the criteria for success in meeting the learning objectives.

Two fourth grade teachers want their students to know the learning objectives for the lesson. One writes the objectives on the board and begins teaching. The other doesn't write the objectives but spends 5 minutes discussing the objectives with the class. Which is a better approach?
- ❍ Writing the objectives on the board because this clearly defines the objectives for students.
- ❍ Writing the objectives on the board because this clearly defines the objectives for students and reminds students of the objectives throughout the lesson.
- ❍ Writing the objectives on the board because fourth graders are better with written instructions than verbal instructions.
- ❍ Discussing the objectives because this allows the teacher to check for understanding and clarify the objectives if necessary.

When should a teacher share learning targets with students?

- Learning targets should be posted on the board so that students can see them anytime.
- At the beginning of each lesson and again at the end for review of what was learned.
- At the start of lessons and activities so that students know what they are responsible for achieving.
- It is not necessary for students to know the learning targets, so long as the teacher knows.

A teacher wants her students to know the learning objectives for a lesson. She doesn't write the objectives on the board, instead she spends 5 minutes discussing the objectives with the class. Is this effective teaching?

- No. The objectives must be written on the board to make learning visible.
- No. Without the objectives on the board the students will not have a reminder of the objectives.
- No. Spending 5 minutes discussing objectives is a waste of valuable instructional time.
- Yes. The discussion increases the likelihood that students understand the objectives.

A teacher wants to show examples of student work before having her students write an essay, but only has time to show two examples. What would you recommend she do and why?

- Show one high quality and one low quality example. Comparing examples helps to clarify the learning target and assist students in recognizing how to achieve it.
- Show two high quality examples. This will let students know what the learning target is, and set high expectations for students.
- Show two high quality examples. Students need to see what they are aiming for, not the wrong way to do something.
- Show two low quality examples. This will clarify the kind of work students should avoid producing.

A teacher shares the learning objective of a lesson before beginning instruction. After teaching a lesson she explains an activity the students will work on related to the objective. She asks the students to tell a partner why they are doing this activity. Then she asks someone to share with the class what they are learning from the activity. Why do you think the teacher is having the students talk about why they are doing the activity?

- The teacher is ensuring that students understand the learning objective.
- She is teaching metacognition. The students are thinking about their thinking. They are explaining the purpose for the activity which provides relevance for the learner.
- It validates their learning and that what they are doing is important.
- When students share orally, they retain information better. Hearing the objective and then restating it, is a great way to remember.

At the beginning of a lesson the teacher states, "Today you will be able to go from a mixed number to an improper fraction." This objective is also written on the board. Has the teacher provided the students with a vision of what they are responsible for learning in that lesson?

- No. Stating and writing an objective is not enough for students to understand what they should be learning.
- No. The teacher should clarify the meaning of terms in the objective and explain to students how they will know when they achieve the objective.
- Yes. Posting and stating the objective of the lesson provides students with two opportunities to know the objective they are responsible for learning.
- Yes. The teacher made clear that students will be going through a process starting with mixed numbers and changing them into improper fractions.

A teacher begins class with a multiple-choice question on the board. Students must justify their choice. As they respond the teacher asks questions to promote discussion such as, "How do you know that?" "What evidence do you have to support your answer?" and "Why is answer C better than B (or A or D)?" What might the teacher have been trying to find out through the discussion?

- The teacher wanted to learn the students' depth of understanding as they attempted to explain and compare their reasoning.
- The teacher wanted to find out which students were randomly guessing, and which students had reasons for their choice.
- The teacher wanted to know which students actually knew the correct answer and how they knew.
- The teacher wanted to discover her students' thought processes, how different students think, and reveal preconceived ideas the students had about the topic.

Which of the following instructional techniques assist a teacher in quickly assessing what their students know?

- Students solve a problem on an individual white board and hold it up for the teacher to see.
- Teacher explains a concept and asks students to put their thumb up if they understand or thumb down if they do not understand or have a question.
- Teacher makes a statement. Students stand if they think the statement is true and stay seated if they think the statement is false.
- Students put a green, yellow or red dot on the top of a paper before turning it in indicating if they feel confident in their understanding, still have some confusion or questions, or do not understand.

How can a teacher best keep track of student data learned through formative assessment?

- By grading assessments and recording scores in a grade book.
- Since it is a process of informally gathering information, a teacher should keep track of this information mentally throughout lessons and activities.
- Using checklists and notes organized in a way that a teacher can review when planning instruction and responding to students.
- Through collecting evidence pieces and keeping them in a file for each student.

A teacher wants to determine students' progress toward being able to discuss the causes of the American Revolution. Which activity would help her do that best?

- The teacher asks students to write on a notecard two events that led to the American Revolution. The students hand in the card before going to lunch.
- The students read a short text about the American Revolution. The students identify causes of the American Revolution from the text and write them on a notecard to hand in before going to lunch.
- The teacher makes several statements about the American Revolution. After each statement, students move to one side of the room if they think the statement is about a cause of the American Revolution and the other side of the room if it is not.
- Students identify an event that led to the American Revolution and talk with a partner about why it led to the American Revolution. The teacher listens to students' discussions.

A teacher wants to find out if her students can identify the difference between renewable and nonrenewable resources. Which of the following should the teacher have students do?

- List three renewable and three nonrenewable resources.
- Explain why wind is considered a renewable resource.
- Identify if wind is a renewable or nonrenewable resource and explain.
- Sort resource cards into piles based on whether the resource is renewable or nonrenewable.

How would you formatively assess students' understanding of the causes of the American Civil War?

- Use of a checklist while students debate the causes of the Civil War.
- Have students do a 5-minute quick write about the causes of the Civil War.
- With an exit ticket on which students rate their understanding of the causes of the Civil War using a scale of 1 to 5.
- A quiz that has students answer true/false statements about the causes of the Civil War.

A teacher wants to elicit student discussion that will help her monitor their understanding of the characteristics of a square. Which of the following will best help her do this?

- Ask, "Is a square a rectangle?" and elicit student responses.
- Say, "All squares are rectangles." and asks students to talk about if the statement is true or not.
- Have students to turn to a partner and discuss the characteristics that make a square a square.
- Ask, "What are the characteristics of a square?" to prompt student responses.

A teacher wants to produce evidence on students' progress toward a learning goal? What method can best help her collect this evidence?

- Collecting student work samples and keeping them in a file for each student.
- By giving short practice assessment sheets and recording scores.
- Through observation of students as they work and discuss, mentally noting student progress as she observes.
- Using checklists and anecdotal notes collected on a regular basis.

Which of the following would best help a teacher formatively assess students' ability to explain the significance of the state symbols?

- Using a true/false activity in which students identify if a statement about the significance of a state symbol is true or false.
- On an exit ticket students list the state symbols and write about one that is most important to them.
- Individually ask students to orally tell about the significance of a particular state symbol.
- Students do a quick write about how the state symbols were selected.

Which is the most effective way to make use of the results of a free-response formative assessment?

- Assign a grade for students to compare to previous and future grades
- Show to parents to explain student progress
- Provide instructional feedback to students
- Motivate students by praising their progress toward the learning goal

A teacher shows her class how to measure angles using a protractor. During student work time the teacher watches one student struggling in her attempts to measure angles. Which of the following is the best next step for the teacher?

- Ask the student to demonstrate using the protractor. Guide the student by asking corrective questions and modeling small steps as needed.
- Show the student the process to measure an angle again. While demonstrating, stop at each step to ask the student if she understands that step.
- Go back to the front of the room and explain to the class that there appears to be confusion on how to use a protractor. Ask for a volunteer to go to the front of the room to demonstrate how to measure an angle using a protractor.
- Let the student know she is measuring the angles incorrectly so that she does not continue to practice the wrong way. At her desk, show her how to correctly use a protractor to measure an angle.

A third-grade teacher wants to provide students with timely feedback, so she scores a test while the students are at recess. She writes the number correct at the top, puts a check by wrong answers and writes in the correct answers. Is this effective feedback?

- No, immediately showing students their results is helpful, but she needs go over the test with the class and do a mini lesson to cover areas missed.
- No, she does not provide information about how they can move their learning forward, she only tells them if they are right or wrong.
- Yes, by providing students with the correct answer she is helping them learn about the concept or the misunderstanding of what was taught.
- Yes, she is allowing students to learn from their mistakes. Looking at what they did wrong and figuring out how they can correct their own thinking is excellent. It involves critical thinking and evaluation.

A common mistake in two-digit addition (e.g., 68 + 24) is to forget to carry one ten when the ones sum to ten or more. A teacher wants her student to avoid this mistake, so she focuses a lesson on it. She has students solve a problem and discusses only those where the student forgot to carry a ten. Is this effective feedback, why or why not?

- No, she should comment on all errors because accuracy is important.
- No, she should comment on only correct responses to avoid reinforcing students' misconceptions.
- No, she should comment on all the students' work to avoid singling out students.
- Yes, the feedback is well aligned to the lesson's learning target.

A teacher puts a grade on every assignment to provide feedback to students about how well they understand what they are learning and let them know where there is room for improvement. Is this effective feedback?

- No, grades alone do not provide feedback that helps students understand what they are doing well and where they can improve.
- No, students need to have room to make errors. Students may become discouraged or even overconfident if graded on everything they do.
- No, she should not put a grade on a paper unless it is done correctly. Students should go back to find and correct their own errors.
- Yes, students like to know how they did on an assignment. A grade helps them know if they understood the content or not.

A first grade student saw the word 'was' and read 'saw' aloud. The teachers tell her, "That word is 'was,' but don't worry lots of people make that mistake. Those words have the same letters." Is this effective feedback?

- No, she didn't give the child activities to help practice correcting the error.
- No, the teacher provided too much information which did not allow the student to make use of the feedback.
- No, she should have mentally made note of the error and then read the sentence back to the student using the correct word.
- Yes, she corrected the mistake kindly and helped the student continue moving on.

A student turns in a paper and the teacher notices two words are spelled incorrectly. What teacher response would provide the most helpful feedback for the student?

- Accept the paper and circle the spelling errors when correcting it. When the paper is returned to the student, he must correct the spelling error and then resubmit the paper.
- Point out to the student that there are two spelling errors. Have the student relook at the paper and correct the errors.
- Ask the student if he checked his work. If he says yes, tell him he needs to check again because there are spelling errors he needs to fix before turning the paper in.
- Show the student to the two words that are spelled incorrectly and help him figure out to correct way to spell the words and then have him make the corrections.

A teacher wants her students to learn the structure of an argumentative essay. She teaches a lesson on the structure of an argument. On students' drafts she writes specific comments related to argumentative structure, but does not point out every spelling or grammar error. Is this effective feedback, why or why not?

- No, because spelling and grammar are important components of effective communication.
- No, because overlooking spelling and grammar errors sends the message that these are not important.
- No, it is important to align feedback with the overall learning target.
- Yes, the feedback is well aligned to the lesson's learning target.

APPENDIX E

Pilot Instrument 5

What grade do you currently teach?

How many years have you taught?

Instructions: Please select the BEST answer for each item.

A teacher shares the learning objective of a lesson before beginning instruction. After teaching a lesson she explains an activity the students will work on related to the objective. She asks the students to tell a partner why they are doing this activity. Then she asks someone to share with the class what they are learning from the activity. What is the best reason for having students talk about why they are doing the activity?

- The teacher is ensuring that students understand the learning objective.
- She is teaching metacognition. The students are thinking about their thinking. They are explaining the purpose for the activity which provides relevance for the learner.
- It validates their learning and that what they are doing is important.
- When students share orally, they retain information better. Hearing the objective and then restating it, is a great way to remember.

A teacher wants to show examples of student work before having her students write an essay, but only has time to show two examples. What would you recommend she do and why?

- Show one high quality and one low quality example. Comparing examples helps to clarify the learning target and assist students in recognizing how to achieve it.
- Show two high quality examples. This will let students know what the learning target is, and set high expectations for students.
- Show two high quality examples. Students need to see what they are aiming for, not the wrong way to do something.
- Show two low quality examples. This will clarify the kind of work students should avoid producing.

Two fourth grade teachers want their students to know the learning objectives for the lesson. One writes the objectives on the board and begins teaching. The other doesn't write the objectives but spends 5 minutes discussing the objectives with the class. Which is a better approach and why?

- Writing the objectives on the board because this clearly defines the objectives for students.
- Writing the objectives on the board because this clearly defines the objectives for students and reminds students of the objectives throughout the lesson.
- Writing the objectives on the board because fourth graders are better with written instructions than verbal instructions.
- Discussing the objectives because this allows the teacher to check for understanding and clarify the objectives if necessary.

A teacher wants students to know what they are responsible for learning during a lesson and so she writes the learning objective on the board. Is this an effective way to share learning targets with students? Why?

- No. A teacher must read the objective with the students.
- No. A teacher must explain the learning objective to students and refer to it throughout the lesson.
- No. A teacher must refer to the objective at the beginning of a lesson and return to it at the end of the lesson.
- Yes. Having targets written on the board allows students refer to the learning target throughout the lesson.

A teacher does not like writing learning objectives on the board. Instead, she begins each lesson by telling students what they are going to be learning and shows them examples of high and low quality work related to the objectives. Is this an effective way to share learning targets with students? Why?

- No. The learning objectives are not visible to students and they will no remember by the end of the lesson what it is they were supposed to be learning.
- No. Learning objectives should be posted for students to see and then shared with students at the beginning of the lesson.
- No. Students will focus on details of the work they are shown and not remember what it is they are supposed to be learning.
- Yes. The students hear the learning objectives and see examples that will help clarify to students the criteria for success in meeting the learning objectives.

A teacher wants her students to know the learning objectives for a lesson. She doesn't write the objectives on the board, instead she spends 5 minutes discussing the objectives with the class. Is this effective teaching?

- No. The objectives must be written on the board to make learning visible.
- No. Without the objectives on the board the students will not have a reminder of the objectives.
- No. Spending 5 minutes discussing objectives is a waste of valuable instructional time.
- Yes. The discussion increases the likelihood that students understand the objectives.

A teacher wants students to know what they are responsible for learning during a lesson and so she posts the learning objective and students write the objective in their notebooks. Is this an effective way to share learning targets with students? Why?

- No. A teacher must refer to the objective at the beginning of a lesson and return to it at the end of the lesson as well.
- No. A teacher must read the objective with the students in addition to posting and having them write it in their notebooks.
- No. A teacher must clarify the meaning of the objective and help students understand the criteria for success.
- Yes. Having the objective posted and having students write it, allows them to remember what they are supposed to be learning throughout the lesson.

At the beginning of a lesson, a teacher explains the learning objective. Before each activity the teacher explains how the activity relates to the learning objective. At the end of the lesson, the teacher reviews the learning objective with the class. Is this an effective way to share learning targets with students? Why?

- No. The teacher should post the objective so that students can refer to it throughout the lesson
- No. The teacher is being redundant and students will tune out what the teacher says since it is repetitive.
- No. The teacher needs to understand how the activities relate to the learning objective, but the students do not.
- Yes. The teacher is helping ensure the students know what they are responsible for learning and how they are going to get there.

The objective for a lesson is, "Students will be able to create a model of a habitat that incorporates the four basic needs of an animal." Is this a useful learning objective?

- No. The objective should specify the four basic needs.
- No. The objective is an activity not a learning objective.
- No. The objective should be written in student friendly language.
- Yes. The objective makes clear to students what they are responsible for learning.

The objective for a lesson is, "When provided with a word problem, I can use models (pictures, arrays, number lines, numerals) to accurately multiply." Is this a useful learning objective?

- No. The objective is not clear about use of pictures, arrays, number line and numerals.
- No. The objective specified activities, not a learning objective.
- No. The objective should be written in student friendly language.
- Yes. The objective clarifies the context and method for what students are responsible for learning.

A teacher begins class with a multiple-choice question on the board. Students must justify their choice. As they respond the teacher asks questions to promote discussion such as, "How do you know that?" "What evidence do you have to support your answer?" and "Why is answer C better than B (or A or D)?" What might the teacher have been trying to find out through the discussion?

- The teacher wanted to learn the students' depth of understanding as they attempted to explain and compare their reasoning.
- The teacher wanted to find out which students were randomly guessing, and which students had reasons for their choice.
- The teacher wanted to identify which students actually knew the correct answer and how they knew.
- The teacher wanted to discover her students' thought processes to reveal preconceived ideas the students had about the topic.

Which of the following instructional techniques assists a teacher in quickly assessing what individual students know?

- Students solve a problem on an individual white board and hold it up for the teacher to see.
- Teacher explains a concept and asks students to put their thumb up if they understand or thumb down if they do not understand or have a question.
- Teacher makes a statement. Students stand if they think the statement is true and stay seated if they think the statement is false.
- Students put a green, yellow or red dot on the top of a paper before turning it in indicating if they feel confident in their understanding, still have some confusion or questions, or do not understand.

How can a teacher best keep track of student data learned through formative assessment?

- By grading assessments and recording scores in a grade book.
- Since it is a process of informally gathering information, a teacher should keep track of this information mentally throughout lessons and activities.
- Using checklists and notes organized in a way that a teacher can review when planning instruction and responding to students.
- Through collecting evidence pieces and keeping them in a file for each student to review with students and parents at conferences.

A teacher wants to determine students' progress toward being able to **discuss** the causes of the American Revolution. Which activity would help her do that best?

- The teacher asks students to write on a notecard two events that led to the American Revolution. The students hand in the card before going to lunch.
- The students read a short text about the American Revolution. The students identify causes of the American Revolution from the text and write them on a notecard to hand in before going to lunch.
- The teacher makes several statements about the American Revolution. After each statement, students move to one side of the room if they think the statement is about a cause of the American Revolution and the other side of the room if it is not.
- Students identify an event that led to the American Revolution and talk with a partner about why it led to the American Revolution. The teacher listens to students' discussions.

How would you formatively assess students' **understanding** of the causes of the American Civil War?

- Use of a checklist while students debate the causes of the Civil War.
- Have students do a 5-minute quick write about the causes of the Civil War.
- With an exit ticket on which students rate their understanding of the causes of the Civil War using a scale from 1 to 5.
- A quiz that has students answer true/false statements about the causes of the Civil War.

Which of the following would best help a teacher formatively assess students' ability to explain the significance of the state symbols?

- Using a true/false activity in which students identify if a statement about the significance of a state symbol is true or false.
- On an exit ticket students list the state symbols and write about one that is most important to them.
- Individually ask students to orally tell about the significance of a particular state symbol.
- Students do a quick write about how the state symbols were selected.

A teacher states, "Spiders are insects." She asks students to put their thumbs up if they agree and thumbs down if they disagree. How should a teacher best make use of the information she learns from the thumbs display?

- The display indicates class-wide understanding and so the teacher should use the info to determine if she should move on with planned lessons or reteach.
- The teacher should ask follow-up questions to have students explain their reasoning to learn more about individual student understanding.
- The display should be used to identify students who do not understand and need more instruction or activities to correct misunderstandings.
- The teacher should note in writing students who incorrectly answered so that she can remember who has not yet met the learning objective.

What would best help a teacher find out if students know the four basic needs of living things?

- Students pick an animal or plant and write the four basic needs of that plant or animal on an exit ticket.
- Teacher names something and students put thumbs up if it is a basic need of living things and thumbs down if it is not.
- Students write the four basic needs of all living things on individual white boards.
- Students turn to a partner and talk about the four basic needs of all living things and then share with the class.

How can a teacher best make use of a skills worksheet?

- To allow students to practice a new or reviewed skill.
- To gain information about students mastery level of the skill.
- To show parents student mastery level of the skill.
- To assess students' skills and assign a grade.

Which of the following would best help a teacher formatively assess students' ability to **explain** why communities have laws?

- Students create two laws for a fictitious community and explain the reason for those laws.
- Students identify three laws in their community that they think are most important and write them on an entrance ticket.
- Students do a quick write about the reasons for laws in the community they live in.
- Students write on sticky notes one reason communities have laws and one thing they do not understand about community laws.

A teacher shows her class how to measure angles using a protractor. During student work time the teacher watches one student struggling in her attempts to measure angles. Which of the following is the best next step for the teacher?

- Ask the student to demonstrate using the protractor. Guide the student by asking corrective questions and modeling small steps as needed.
- Show the student the process to measure an angle again. While demonstrating, stop at each step to ask the student if she understands that step.
- Go back to the front of the room and explain to the class that there appears to be confusion on how to use a protractor. Ask for a volunteer to go to the front of the room to demonstrate how to measure an angle using a protractor.
- Let the student know she is measuring the angles incorrectly so that she does not continue to practice the wrong way. At her desk, show her how to correctly use a protractor to measure an angle.

A teacher puts a letter or numeric grade on every assignment to provide feedback to students about how well they understand what they are learning and let them know where there is room for improvement. Is this effective feedback?

- No, letter and numeric grades alone do not provide feedback that helps students understand what they are doing well and where they can improve.
- No, students need to have room to make errors. Students may become discouraged or even overconfident if graded on everything they do.
- No, she should not put a grade on a paper unless it is done correctly. Students should go back to find and correct their own errors.
- Yes, students like to know how they did on an assignment. A grade helps them know if they understood the content or not.

A student turns in a paper and the teacher notices two words are spelled incorrectly. What teacher response would provide the most helpful feedback for the student?

- Accept the paper and circle the spelling errors when correcting it. When the paper is returned to the student, he must correct the spelling error and then resubmit the paper.
- Point out to the student that there are two spelling errors. Have the student re-look at the paper and correct the errors.
- Ask the student if he checked his work. If he says yes, tell him he needs to check again because there are spelling errors he needs to fix before turning the paper in.
- Show the student to the two words that are spelled incorrectly and help him figure out to correct way to spell the words and then have him make the corrections.

A teacher wants her students to learn the structure of an argumentative essay. She teaches a lesson on the structure of an argument. On students' drafts she writes specific comments related to argumentative structure, but does not point out every spelling or grammar error. Does this provide effective feedback, why or why not?

- No, because spelling and grammar are important components of effective communication.
- No, because overlooking spelling and grammar errors sends the message that these are not important.
- No, it is important to align feedback with the overall learning target.
- Yes, the feedback is well aligned to the lesson's learning target.

A student is learning a relatively simple problem and makes an error. When should the teacher provide feedback?

- Wait to give feedback to the student to prevent feelings of intrusion on learning.
- Wait to give feedback to the student until you review all students' work.
- Provide immediate feedback so that the student does not learn incorrectly.
- Provide immediate feedback so the student does not become frustrated due to the error.

While a student is engaged in a task, a teacher notices the student making an error. Should the teacher interrupt the student to provide feedback?

- Yes, the student will become frustrated when the error halts her progress.
- Yes, a teacher should provide feedback to students immediately when errors are made so students do not learn incorrectly.
- No, the teacher may notice other students making the same error and should wait to help all the students together.
- No, interrupting a student immersed in a task can be disruptive and impede learning.

A teacher wants to provide information to students about how they are progressing in their learning. Which is the best way to provide effective feedback?

- The teacher should write a grade on the paper and mark problems solved incorrectly.
- The teacher should write a grade on the paper and include comments about student's strengths and information about how to improve.
- The teacher should write comments about the student's strengths and information about how to improve.
- The teacher should write comments that praise the student's success and avoid focusing on student weaknesses.

A student's performance over time indicates 100% mastery of a learning target. How should the teacher use this information when talking to the student?

- Praise the student for working hard and let him know that he has mastered the learning target.
- Share with the student his success in this area and provide him with suggestions for continued learning in the target area.
- Ask the student if he would be willing to work with his peers and provide feedback to help those still working toward the target.
- Tell the student he is doing great work and provide him with an extension project.

How should a teacher best make use of unit pre-assessment results?

- To identify students who have met the outcomes of the unit and provide them with alternative learning opportunities.
- To compare to post-assessment results and show students their learning growth during the unit.
- To adjust instructional plans for the unit based on students learning needs and strengths.
- To group students for instruction during the unit.

A teacher always marks all student errors on their work before returning it to them for review? Is this effective feedback?

- No. Not all students will get the same amount of feedback this way and that is unfair.
- No. Feedback should be focused on a few things students can do to improve in meeting the learning goal.
- No. Focusing on all the errors students make will cause them to feel like failures.
- Yes. Without noting errors, students will not know they did something incorrectly and think they have mastered something when they have not.

APPENDIX F

Teacher Knowledge of Formative Assessment Dissertation Administration Version

Grade you currently teach:

- ❑ Kindergarten
- ❑ 1st Grade
- ❑ 2nd Grade
- ❑ 3rd Grade
- ❑ 4th Grade
- ❑ 5th Grade

Number of years you have taught:

Instructions: Please select the BEST answer for each item.

Q1 A teacher shares the learning objective of a lesson before beginning instruction. After teaching a lesson she explains an activity the students will work on related to the objective. She asks the students to tell a partner why they are doing this activity. Then she asks someone to share with the class what they are learning from the activity. What is the best reason for having students talk about why they are doing the activity?

- ❍ The teacher is ensuring that students understand the learning objective.
- ❍ She is teaching metacognition. The students are thinking about their thinking.
- ❍ It validates the students learning and helps them know what they are doing is important.
- ❍ Hearing the objective and then restating it will help students remember it.

Q2 A teacher wants to show examples of student work before having her students write an essay, but only has time to show two examples. What would you recommend she do and why?

- ❍ Show one high quality and one low quality example. Comparing examples helps to clarify the learning target and assists students in recognizing how to achieve it.
- ❍ Show two high quality examples. This will let students know what the learning target is and set high expectations for students to work toward in their own essays.
- ❍ Show two high quality examples. Students need to see what they are aiming for. Showing low quality work will confuse students who may think this is acceptable work.
- ❍ Show two low quality examples. This will clarify the kind of work students should not produce and avoid having students copy the high quality models.

Q3 Two fourth grade teachers want their students to know the learning objectives for the lesson. One writes the objectives on the board and begins teaching. The other doesn't write the objectives but spends 5 minutes discussing the objectives with the class. Which is a better approach and why?

- ❍ Writing the objectives on the board because this clearly defines the objectives for students and allows others who come into the room to know the purpose of the lesson being taught.
- ❍ Writing the objectives on the board because this clearly defines the objectives for students and reminds students of the objectives throughout the lesson.
- ❍ Writing the objectives on the board because fourth graders do better with written information than verbal information.
- ❍ Discussing the objectives because this allows the teacher to check for understanding and clarify the objectives if necessary.

Q4 A teacher wants students to know what they are responsible for learning during a lesson and so she writes the learning objective on the board. Is this an effective way to share learning targets with students? Why?

- No. A teacher must direct students' attention to where the objective is written and read the objective with the students.
- No. A teacher must explain the learning objective to students and refer to it throughout the lesson.
- No. A teacher must refer to the objective at the beginning of a lesson and return to it at the end of the lesson.
- Yes. Having targets written on the board allows students refer to the learning target throughout the lesson.

Q5 A teacher does not like writing learning objectives on the board. Instead, she begins each lesson by telling students what they are going to be learning and shows them examples of high and low quality work related to the objectives. Is this an effective way to share learning targets with students? Why?

- No. The learning objectives are not visible to students and they will not remember by the end of the lesson what it is they were supposed to be learning.
- No. Learning objectives should be posted for students to see and then shared with students at the beginning of the lesson.
- No. Students will focus on details of the work they are shown and not remember what it is they are supposed to be learning.
- Yes. The students hear the learning objectives and see examples that will help clarify to students the criteria for success in meeting the learning objectives.

Q6 A teacher wants her students to know the learning objectives for a lesson. She doesn't write the objectives on the board, instead she spends 5 minutes discussing the objectives with the class. Is this effective teaching?

- No. The objectives must be written on the board to make learning visible.
- No. Without the objectives on the board the students will not have a reminder of the objectives.
- No. Spending 5 minutes discussing objectives is a waste of valuable instructional time.
- Yes. The discussion increases the likelihood that students understand the objectives.

Q7 A teacher wants students to know what they are responsible for learning during a lesson and so she posts the learning objective and students write the objective in their notebooks. Is this an effective way to share learning targets with students? Why?

- No. A teacher must talk about the objective at the beginning of a lesson and remind students of the objective at the end of the lesson, writing it is not necessary.
- No. A teacher must read the objective with the students to ensure they hear it in addition to posting it and having them write it in their notebooks.
- No. A teacher must clarify the meaning of the objective and help students understand the criteria for success.
- Yes. Having the objective posted and having students write it, allows them to remember what they are supposed to be learning throughout the lesson.

Q8 At the beginning of a lesson, a teacher explains the learning objective. Before each activity the teacher explains how the activity relates to the learning objective. At the end of the lesson, the teacher reviews the learning objective with the class. Is this an effective way to share learning targets with students? Why?

- No. The teacher should post the objective so that students can refer to it throughout the lesson to remember what they are supposed to be learning.
- No. The teacher is being repetitive and students will stop paying attention when they keep hearing the same thing repeated several times.
- No. The teacher needs to understand how the activities relate to the learning objective, but it is not necessary to explain this to students for each activity.
- Yes. The teacher is helping ensure the students know what they are responsible for learning and how they are going to get there.

Q9 The objective for a lesson is, "Students will be able to create a model of a habitat that incorporates the four basic needs of an animal." Is this a useful learning objective?

- No. The objective should specify the four basic needs.
- No. The objective is an activity not a learning objective.
- No. The objective should be written in student friendly language.
- Yes. The objective makes clear to students what they are responsible for learning.

Q10 The objective for a lesson is, "When provided with a word problem, I can use models (pictures, arrays, number lines, numerals) to accurately multiply." Is this a useful learning objective?

- No. The objective is not clear about how students will use pictures, arrays, number line and numerals.
- No. The objective specifies activities for students to do, not the learning to occur.
- No. The objective should be written in student friendly language.
- Yes. The objective clarifies the context and method for what students are responsible for learning.

Q11 A teacher begins class with a multiple-choice question on the board. Students must justify their choice. As they respond the teacher asks questions to promote discussion such as, "How do you know that?" "What evidence do you have to support your answer?" and "Why is answer C better than B (or A or D)?" What might the teacher have been trying to find out through the discussion?

- The teacher wanted to learn the students' depth of understanding as they attempted to explain and compare their reasoning.
- The teacher wanted to find out which students were randomly guessing, and which students had reasons for their choice.
- The teacher wanted to identify which students actually knew the correct answer and how they knew.
- The teacher wanted to discover her students' thought processes to reveal preconceived ideas the students had about the topic.

Q12 Which of the following instructional techniques assists a teacher in quickly assessing what individual students know?

- A student writes his solution to a problem on the class whiteboard. The teacher asks the other students to stand if they got the same answer.
- Students put a green, yellow or red dot on the top of a paper before turning it in indicating if they feel confident in their understanding, still have some confusion or questions, or do not understand.
- Students solve a problem on an individual white board and hold it up for the teacher to see.
- After a student answers a question, the other students put their thumbs up if they agree or thumbs down if they disagree.

Q13 How can a teacher best keep track of student data learned through formative assessment?

- By grading assessments and recording scores for each student.
- Formative assessment is a process of informally gathering information, so a teacher should mentally note student learning throughout lessons and activities.
- Using checklists and notes that can be reviewed when planning instruction and responding to students.
- Through collecting evidence pieces and keeping them in a file for each student to review with students and parents at conferences.

Q14 A teacher wants to determine students' progress toward being able to discuss the causes of the American Revolution. Which formative assessment activity would help her do that best?

- The teacher asks students to write on a notecard two events that led to the American Revolution. The students hand in the card before going to lunch.
- The students read a short text about the American Revolution. The students identify causes of the American Revolution from the text and write them on a notecard to hand in before going to lunch.
- The teacher makes several statements about the American Revolution. After each statement, students move to one side of the room if they think the statement is about a cause of the American Revolution and the other side of the room if it is not.
- Students identify an event that led to the American Revolution and talk with a partner about why it led to the American Revolution. The teacher listens to students' discussions.

Q15 How would you formatively assess students' understanding of the causes of the American Civil War?

- After students read about the causes of the Civil War, have them create a graphic organizer with information from the text about each of the causes.
- Have students do a 5-minute quick write about the causes of the Civil War.
- With an exit ticket on which students rate their own understanding of the causes of the Civil War using a scale from 1 to 5.
- A quiz in which students must identify if statements about the causes of the Civil War are true or false.

Q16 Which of the following would best help a teacher formatively assess students' ability to explain the significance of the state symbols?

- Using an activity in which students identify if statements about the significance of state symbols are true or false.
- On an exit ticket students list the state symbols and write about one that is most important to them.
- Individually ask students to orally tell about the significance of a particular state symbol.
- Students read about how a state symbol was selected and write a summary.

Q17 A teacher states, "Spiders are insects." She asks students to put their thumbs up if they agree and thumbs down if they disagree. How should a teacher best make use of the information she learns from the thumbs display?

- The display indicates class-wide understanding and so the teacher should use the information to determine if she should move on with planned lessons or reteach.
- The teacher should ask follow-up questions to have students explain their reasoning to learn more about individual student understanding.
- The display should be used to identify students who do not understand and need more instruction or activities to correct misunderstandings.
- The teacher should note in writing students who incorrectly answered so that she can remember who has not yet met the learning objective.

Q18 What would best help a teacher find out if students know the four basic needs of living things?

- Students pick an animal or plant and write the needs of that plant or animal on an exit ticket.
- Teacher names something and students put thumbs up if it is a basic need of living things or thumbs down if it is not.
- Students write the four basic needs of all living things on individual white boards.
- Students turn to a partner and talk about the four basic needs of all living things and then share with the class.

Q19 How can a teacher best make use of a skills worksheet?

- To allow students to practice a new or reviewed skill.
- To gain information about students' mastery level of the skill.
- To show parents student mastery level of the skill.
- To assess students' skills and assign a grade.

Q20 Which of the following would best help a teacher formatively assess students' ability to explain why communities have laws?

- Students create two laws for a fictitious community and explain the reasons for those laws.
- Students identify three laws in their community that they think are most important and write them on an entrance ticket.
- Students do a quick write about the reasons for laws in the community they live in.
- Students write on sticky notes one important community law and one thing they do not understand about community laws.

Q21 A teacher shows her class how to measure angles using a protractor. During student work time the teacher watches one student struggling in her attempts to measure angles. Which of the following is the best next step for the teacher?

- Ask the student to demonstrate using the protractor. Guide the student by asking corrective questions and modeling small steps as needed.
- Show the student the process to measure an angle again. While demonstrating, stop at each step to ask the student if she understands that step.
- Go back to the front of the room and explain to the class that there appears to be confusion on how to use a protractor. Ask for a volunteer to go to the front of the room to demonstrate how to measure an angle using a protractor.
- Let the student know she is measuring the angles incorrectly so that she does not continue to practice the wrong way. At her desk, show her how to correctly use a protractor to measure an angle.

Q22 A teacher puts a letter or numeric grade on every assignment to provide feedback to students about how well they understand what they are learning and let them know where there is room for improvement. Is this effective feedback?

- No, letter and numeric grades alone do not provide feedback that helps students understand what they are doing well and where they can improve.
- No, students need to have room to make errors. Students may become discouraged or even overconfident if graded on everything they do making the feedback ineffective.
- No, the teacher should not put a grade on a paper unless it is done correctly. Not having a grade on the paper will serve as feedback indicating to students to find and correct their errors.
- Yes, students like to know how they did on an assignment and a grade is feedback that helps them know if they understood the content or not.

Q23 A student turns in a paper and the teacher notices two words are spelled incorrectly. What teacher response would most help the student progress in learning to review and edit his own writing?

- Accept the paper and circle the spelling errors when correcting it. When the paper is returned to the student, he must correct the spelling error and then resubmit the paper.
- Point out to the student that there are two spelling errors. Have the student re-look at the paper and correct the errors.
- Ask the student if he checked his work. If he says yes, tell him he needs to check again because there are spelling errors he needs to fix before turning the paper in.
- Show the student the two words that are spelled incorrectly and help him figure out the correct way to spell the words and then have him make the corrections.

Q24 A teacher wants her students to learn the structure of an argumentative essay. She teaches a lesson on the structure of an argument. On students' drafts she writes specific comments related to argumentative structure, but does not point out every spelling or grammar error. Does this provide effective feedback, why or why not?

- No, because spelling and grammar are important components of effective communication and feedback should identify these errors for students.
- No, because overlooking spelling and grammar errors sends the message that these are not an important part of writing.
- No, to be effective it is important to align feedback with the learning target.
- Yes, the feedback is well aligned to the lesson's learning target.

Q25 A student is solving a relatively simple problem and makes an error. When should the teacher provide feedback?

- Wait to give feedback to the student to reduce intrusion on learning.
- Wait to give feedback to the student until you review all students' work and give collective feedback that will not single the student out.
- Provide immediate feedback so that the student does not learn incorrectly.
- Provide immediate feedback so the student does not become frustrated due to the error.

Q26 While a student is immersed in a task, a teacher notices the student making an error. Should the teacher interrupt the student to provide feedback?

- Yes, the student will become frustrated when the error halts her progress.
- Yes, a teacher should provide feedback to students immediately when errors are made so students do not learn incorrectly.
- No, the teacher may notice other students making the same error and should wait to help all the students together.
- No, interrupting a student immersed in a task can be disruptive and impede learning.

Q27 A teacher wants to provide information to each student about his or her individual learning progress. Which is the best way to provide effective feedback on a paper?

- The teacher should write a grade on the paper and mark problems solved incorrectly so the student knows what problems were hard for him.
- The teacher should write a grade on the paper and include comments about the student's strengths and information about how to improve.
- The teacher should write comments about the student's strengths and information about how to improve.
- The teacher should write comments that highlight the student's success and avoid focusing on the student's weaknesses.

Q28 A student's performance over time indicates 100% mastery of a learning target. How should the teacher use this information when talking to the student?

- Praise the student for working hard and let him know that he has mastered the learning target.
- Share with the student his success in this area and provide him with suggestions for continued learning in the target area.
- Ask the student if he would be willing to work with his peers and provide feedback to help those still working toward the target.
- Tell the student he is doing great work and provide him with an extension project.

Q29 How should a teacher best make use of unit pre-assessment results?

- To identify students who have met the outcomes of the unit and provide them with alternative learning opportunities.
- To compare to post-assessment results and show students their learning growth during the unit.
- To adjust instructional plans for the unit based on students' learning needs and strengths.
- To group students for instruction during the unit based on learning needs.

Q30 A teacher always marks all student errors on their work before returning it to them for review? Is this effective feedback?

- No. Not all students will get similar amounts of feedback which is unfair to students who do well and receive little or no feedback from the teacher.
- No. Feedback should be focused on a few things students can do to improve in meeting the learning goal.
- No. Marking all errors students make will cause those who did poorly to feel like failures.
- Yes. Without noting errors, students will not know they did something incorrectly and think they have mastered something when they have not.

Q31 Do you have any feedback about this assessment that you would like to share?

APPENDIX G

Email Invitation to Teachers to Complete Assessment Instrument

From: Amanda Bremner (amandabremner@u.boisestate.edu)
Sent: Monday December 9, 2013
To: ITML Teachers
Subject: Knowledge of Formative Assessment Survey

Dear ITML Grant Participant,

As has been shared with you previously, the Improving Teachers' Monitoring of Learning (ITML) is a project focused on developing teachers' understanding and ability to formatively assess students' understanding and learning. At the beginning of the school year we asked you to complete several surveys. Towards the end of the school year we will be continuing our data collection process for the ITML project. At this time, we are asking you to complete one survey which will help decrease the load in the spring.

The Knowledge of Formative Assessment Survey will take approximately 25 minutes to complete. When answering the questions, every effort should be made to answer each question honestly and to the best of your ability. We will keep the information we collect confidential, and you will not be identified in any report. Please click the link below to go to the survey.

Survey Link: LINK

By completing this survey, you indicate that you understand the conditions of this study and voluntarily agree to participate.

If you have questions please contact Amanda Bremner (amandabremner@u.boisestate.edu).

Thank you for your help.

Sincerely,

Amanda Bremner
amandabremner@u.boisestate.edu

From: Amanda Bremner (amandabremner@u.boisestate.edu)
Sent: Monday December 16, 2013
To: ITML Teachers
Subject: Knowledge of Formative Assessment Survey

Dear ITML Grant Participant,

Recently you received an email asking you to complete a survey as part of the ITML project. We appreciate your efforts and time completing this survey.

The Knowledge of Formative Assessment Survey will take approximately 25 minutes to complete. Please click the link below to go to the survey.

Survey Link: LINK

If you have questions please contact Amanda Bremner (amandabremner@u.boisestate.edu).

Thank you for your help.

Sincerely,

Amanda Bremner
amandabremner@u.boisestate.edu

From: Amanda Bremner (amandabremner@u.boisestate.edu)
Sent: Monday January 13, 2014
To: ITML Teachers
Subject: Knowledge of Formative Assessment Survey

Dear ITML Grant Participant,

Happy New Year! We hope you had an enjoyable and restful holiday break. Before the break you received an email asking you to complete a survey as part of the ITML project. This is part of the data collection we will be conducting in the spring. Completing this survey now will reduce your load in May. Please complete this survey as soon as you are able to.

The Knowledge of Formative Assessment Survey will take approximately 25 minutes to complete. Please click the link below to go to the survey.

Survey Link: LINK

If you have questions please contact Amanda Bremner (amandabremner@u.boisestate.edu).

Thank you for your help.

Sincerely,

Amanda Bremner
amandabremner@u.boisestate.edu

From: Amanda Bremner (amandabremner@u.boisestate.edu)
Sent: Friday January 17, 2014
To: ITML Teachers
Subject: Knowledge of Formative Assessment Survey

Dear ITML Grant Participant,

This is a reminder to complete the Knowledge of Formative Assessment Survey. It will take approximately 25 minutes to complete. Please click the link below to go to the survey.

Survey Link: LINK

If you have questions please contact Amanda Bremner (amandabremner@u.boisestate.edu).

Thank you for your help.

Sincerely,

Amanda Bremner
amandabremner@u.boisestate.edu

APPENDIX H

Items Used in CFA Analyses

Item 1: Two fourth grade teachers want their students to know the learning objectives for the lesson. One writes the objectives on the board and begins teaching. The other doesn't write the objectives but spends 5 minutes discussing the objectives with the class. Which is a better approach and why?

- Writing the objectives on the board because this clearly defines the objectives for students and allows others who come into the room to know the purpose of the lesson being taught.

- Writing the objectives on the board because this clearly defines the objectives for students and reminds students of the objectives throughout the lesson.

- Writing the objectives on the board because fourth graders do better with written information than verbal information.

- Discussing the objectives because this allows the teacher to check for understanding and clarify the objectives if necessary.

Item 2
A teacher does not like writing learning objectives on the board. Instead, she begins each lesson by telling students what they are going to be learning and shows them examples of high and low quality work related to the objectives. Is this an effective way to share learning targets with students? Why?

- No. The learning objectives are not visible to students and they will no remember by the end of the lesson what it is they were supposed to be learning.

- No. Learning objectives should be posted for students to see and then shared with students at the beginning of the lesson.

- No. Students will focus on details of the work they are shown and not remember what it is they are supposed to be learning.

- Yes. The students hear the learning objectives and see examples that will help clarify to students the criteria for success in meeting the learning objectives.

Item 3: A teacher wants her students to know the learning objectives for a lesson. She doesn't write the objectives on the board, instead she spends 5 minutes discussing the objectives with the class. Is this effective teaching?

- No. The objectives must be written on the board to make learning visible.

- No. Without the objectives on the board the students will not have a reminder of the objectives.

- No. Spending 5 minutes discussing objectives is a waste of valuable instructional time.

- Yes. The discussion increases the likelihood that students understand the objectives.

Item 4: Which of the following instructional techniques assists a teacher in quickly assessing what individual students know?

- A student writes his solution to a problem on the class whiteboard. The teacher asks students stand if they got the same answer.

- Students put a green, yellow or red dot on the top of a paper before turning it in indicating if they feel confident in their understanding, still have some confusion or questions, or do not understand.

- Students solve a problem on an individual white board and hold it up for the teacher to see.

- After a student answers a question, the other students put their thumb up if they agree or thumb down if they disagree.

Item 5: How would you formatively assess students' **understanding** of the causes of the American Civil War?

- After students read about the causes of the Civil War, have them create a graphic organizer with information from the text about each of the causes.

- Have students do a 5-minute quick write about the causes of the Civil War.

- With an exit ticket on which students rate their own understanding of the causes of the Civil War using a scale from 1 to 5.

- A quiz in which students must identify if statements about the causes of the Civil War are true or false.

Item 6: What would best help a teacher find out if students know the four basic needs of living things?

- Students pick an animal or plant and write the needs of that plant or animal on an exit ticket.

- Teacher names something and students put thumbs up if it is a basic need of living things and thumbs down if it is not.

- Students write the four basic needs of all living things on individual white boards.

- Students turn to a partner and talk about the four basic needs of all living things and then share with the class.

Item 7: Which of the following would best help a teacher formatively assess students' ability to **explain** why communities have laws?

- Students create two laws for a fictitious community and explain the reason for those laws.

- Students identify three laws in their community that they think are most important and write them on an entrance ticket.

- Students do a quick write about the reasons for laws in the community they live in.

- Students write on sticky notes one important community law and one thing they do not understand about community laws.

Item 8: A teacher puts a letter or numeric grade on every assignment to provide feedback to students about how well they understand what they are learning and let them know where there is room for improvement. Is this effective feedback?

- No, letter and numeric grades alone do not provide feedback that helps students understand what they are doing well and where they can improve.

- No, students need to have room to make errors. Students may become discouraged or even overconfident if graded on everything they do making the feedback ineffective.

- No, the teacher should not put a grade on a paper unless it is done correctly. Not having a grade on the paper will serve as feedback indicating to students to find and correct their errors.

- Yes, students like to know how they did on an assignment and a grade is feedback that helps them know if they understood the content or not.

Item 9: A student turns in a paper and the teacher notices two words are spelled incorrectly. What teacher response would most help the student progress in learning to review and edit his own writing?

- Accept the paper and circle the spelling errors when correcting it. When the paper is returned to the student, he must correct the spelling error and then resubmit the paper.

- Point out to the student that there are two spelling errors. Have the student re-look at the paper and correct the errors.

- Ask the student if he checked his work. If he says yes, tell him he needs to check again because there are spelling errors he needs to fix before turning the paper in.

- Show the student to the two words that are spelled incorrectly and help him figure out to correct way to spell the words and then have him make the corrections.

Item 10: A student's performance over time indicates 100% mastery of a learning target. How should the teacher use this information when talking to the student?

- Praise the student for working hard and let him know that he has mastered the learning target.

- Share with the student his success in this area and provide him with suggestions for continued learning in the target area.

- Ask the student if he would be willing to work with his peers and provide feedback to help those still working toward the target.

- Tell the student he is doing great work and provide him with an extension project.

Item 11: A teacher always marks all student errors on their work before returning it to them for review? Is this effective feedback?

- No. Not all students will get similar amounts of feedback this way and that is unfair to students who did well and do not get any feedback from the teacher.

- No. Feedback should be focused on a few things students can do to improve in meeting the learning goal.

- No. Marking all errors students make will cause those who did poorly to feel like failures.

- Yes. Without noting errors, students will not know they did something incorrectly and think they have mastered something when they have not.

Note: Underlining indicates the correct answer choice

APPENDIX I

Teacher Knowledge of Formative Assessment Item Explanation Document

Teacher Knowledge of Formative Assessment Item Explanation Document

Note: The explanation for each question appears before the question. The assessment items are italicized. Correct answers for each item appear in **bold**.

Questions 1-10 assess teachers' understanding of leaning targets, specifically how to share and clarify the learning targets with students.

Q1: The first response is the correct answer. Teachers need to share the learning target of activities with students so that they understand the purpose of the activity, what it is the activity will help them learn. Having students talk about the purpose of the activity allows the teacher to monitor — by listening to student conversations — student understanding of the learning target. The second response is not correct because this is not a metacognitive activity. The third response is incorrect because knowing the intended learning of an activity is what establishes importance, not simply talking about it. The fourth response is incorrect because remembering the objective is not the goal. The goal is understanding the purpose of the activity related to the objective. Also, this discussion is not hearing and restating the objective. It is having students recall and explain in their own words what the objective is.

Q1 A teacher shares the learning objective of a lesson before beginning instruction. After teaching a lesson she explains an activity the students will work on related to the objective. She asks the students to tell a partner why they are doing this activity. Then she asks someone to share with the class what they are learning from the activity. What is the best reason for having students talk about why they are doing the activity?

- ***The teacher is ensuring that students understand the learning objective.***
- *She is teaching metacognition. The students are thinking about their thinking.*
- *It validates the students learning and helps them know what they are doing is important.*
- *Hearing the objective and then restating it will help students remember it.*

Q2: The first response is correct. This question is directly related to teachers' understanding of how to clarify learning targets for students. Models help students develop a vision to answer the question "Where am I going?" (Chappuis, 2009, p. 15). Using examples and models of strong and weak work is one of seven Assessment for Learning strategies taught by the Assessment Training Institute (Chappuis, 2009). Showing high and low quality examples helps to show levels of quality and helps students to recognize weaknesses in their own work. The second and third responses are not correct because students do not have the opportunity to see and discuss common mistakes and misunderstandings when they are only shown high quality models. The fourth response is incorrect for the opposite reason. If students are only shown low quality work they are not provided with a clear vision of what they are aiming for.

Q2 A teacher wants to show examples of student work before having her students write an essay, but only has time to show two examples. What would you recommend she do and why?

- ***Show one high quality and one low quality example. Comparing examples helps to clarify the learning target and assists students in recognizing how to achieve it.***
- *Show two high quality examples. This will let students know what the learning target is and set high expectations for students to work toward in their own essays.*
- *Show two high quality examples. Students need to see what they are aiming for. Showing low quality work will confuse students who may think this is acceptable work.*
- *Show two low quality examples. This will clarify the kind of work students should not produce and avoid having students copy the high quality models.*

Q3: Teachers are often prompted or required to write learning objectives on the board. While this practice is intended to assist teachers in clarifying the learning target for students, that purpose is not achieved when the teacher makes no mention of the objective. This question focuses on teacher understanding of how to

share learning targets with students. The first three responses are incorrect because writing an objective on the board with no discussion or without the teacher directing attention to it leads to unknown results. Students may or may not read it and there is no way for the teacher to know if the students understand the objective. The fourth response is correct because the teacher is sharing and clarifying the objective through discussion. The teacher is able to monitor students' understanding of the objective during the discussion and clarify as needed.

Q3 Two fourth grade teachers want their students to know the learning objectives for the lesson. One writes the objectives on the board and begins teaching. The other doesn't write the objectives but spends 5 minutes discussing the objectives with the class. Which is a better approach and why?

- *Writing the objectives on the board because this clearly defines the objectives for students and allows others who come into the room to know the purpose of the lesson being taught.*
- *Writing the objectives on the board because this clearly defines the objectives for students and reminds students of the objectives throughout the lesson.*
- *Writing the objectives on the board because fourth graders do better with written information than verbal information.*
- ***Discussing the objectives because this allows the teacher to check for understanding and clarify the objectives if necessary.***

Q4: This question assesses similar teacher understanding as question 3. The first response is incorrect because reading the objective with students is only ensuring they notice it. This does not clarify the objective for students. The third response is incorrect because referring to the objective is not enough, the teacher must explain the objective. See question three for an explanation of why the fourth response is incorrect. Only the second response includes the teacher explaining the objective. Referring to it throughout the lesson is an additional way to show students how the learning exercises and activities will help them achieve the objective.

Q4 A teacher wants students to know what they are responsible for learning during a lesson and so she writes the learning objective on the board. Is this an effective way to share learning targets with students? Why?

- *No. A teacher must direct students' attention to where the objective is written and read the objective with the students.*
- ***No. A teacher must explain the learning objective to students and refer to it throughout the lesson.***
- *No. A teacher must refer to the objective at the beginning of a lesson and return to it at the end of the lesson.*
- *Yes. Having targets written on the board allows students refer to the learning target throughout the lesson.*

Q5: See explanation for questions 2 and 3.

Q5 A teacher does not like writing learning objectives on the board. Instead, she begins each lesson by telling students what they are going to be learning and shows them examples of high and low quality work related to the objectives. Is this an effective way to share learning targets with students? Why?

- *No. The learning objectives are not visible to students and they will not remember by the end of the lesson what it is they were supposed to be learning.*
- *No. Learning objectives should be posted for students to see and then shared with students at the beginning of the lesson.*
- *No. Students will focus on details of the work they are shown and not remember what it is they are supposed to be learning.*
- ***Yes. The students hear the learning objectives and see examples that will help clarify to students the criteria for success in meeting the learning objectives.***

Q6: The fourth response is correct. See explanation for question three. Responses one and two are incorrect because there is no way for a teacher to know if students really refer to the board to remind themselves of learning targets unless this is a routine established in the classroom. Even with a routine, discussion is needed to clarify the objective. Students may not really understand the intended learning simply by reading the objective. Response three is incorrect because clarifying the objective is part of the instruction, an essential part that sets the purpose for the lesson and activities.

Q6 A teacher wants her students to know the learning objectives for a lesson. She doesn't write the objectives on the board, instead she spends 5 minutes discussing the objectives with the class. Is this effective teaching?

- *No. The objectives must be written on the board to make learning visible.*
- *No. Without the objectives on the board the students will not have a reminder of the objectives.*
- *No. Spending 5 minutes discussing objectives is a waste of valuable instructional time.*
- ***Yes. The discussion increases the likelihood that students understand the objectives.***

Q7: Similar to previous items, writing the objective does not add more clarity than having students read it from the board. Teacher explanation is required so that the teacher can help students understand what they are responsible for learning.

Q7 A teacher wants students to know what they are responsible for learning during a lesson and so she posts the learning objective and students write the objective in their notebooks. Is this an effective way to share learning targets with students? Why?

- *No. A teacher must talk about the objective at the beginning of a lesson and remind students of the objective at the end of the lesson, writing it is not necessary.*
- *No. A teacher must read the objective with the students to ensure they hear it in addition to posting it and having them write it in their notebooks.*
- ***No. A teacher must clarify the meaning of the objective and help students understand the criteria for success.***
- *Yes. Having the objective posted and having students write it, allows them to remember what they are supposed to be learning throughout the lesson.*

Q8: Response one is incorrect because, although posting the objective can be beneficial, it is not sufficient for clarifying the intended learning. Response two is unrelated to the focus of the question. Explaining relevance for each activity is not the same as repeating the objective over and over again. Response three is incorrect because students cannot take part is self or peer assessment if they do not understand the learning objectives and the relationship of the activities to the learning objective. Thus, response four is the correct answer.

Q8 At the beginning of a lesson, a teacher explains the learning objective. Before each activity the teacher explains how the activity relates to the learning objective. At the end of the lesson, the teacher reviews the learning objective with the class. Is this an effective way to share learning targets with students? Why?

- *No. The teacher should post the objective so that students can refer to it throughout the lesson to remember what they are supposed to be learning.*
- *No. The teacher is being repetitive and students will stop paying attention when they keep hearing the same thing repeated several times.*
- *No. The teacher needs to understand how the activities relate to the learning objective, but it is not necessary to explain this to students for each activity.*
- ***Yes. The teacher is helping ensure the students know what they are responsible for learning and how they are going to get there.***

Q9: This question is assessing teachers' ability to determine if an objective is clear about what students need to learn. Response two is correct because creating a model is an activity for the students to do. The learning objective that this activity is intended to help students achieve is not clear. The learning objective might be learning the four basic needs of an animal, but it could be something to do with habitats, or even students ability to create a model. Response four is incorrect because the way the objective is written tells students something they will do, not what they should learn.

Q9 The objective for a lesson is, "Students will be able to create a model of a habitat that incorporates the four basic needs of an animal." Is this a useful learning objective?

- *No. The objective should specify the four basic needs.*
- ***No. The objective is an activity not a learning objective.***
- *No. The objective should be written in student friendly language.*
- *Yes. The objective makes clear to students what they are responsible for learning.*

Q10: Like question 9, this question is assessing teachers' ability to determine if an objective is clear in terms of what students need to learn. The intended learning is clear and so response 4 is correct. Response 1 is incorrect because it is clear that the models will be used to assist in multiplying. Response 2 is not correct because the objective does not specify an activity, it tells students what they need to learn. Response 3 is incorrect because this objective is written in student friendly language.

Q10 The objective for a lesson is, "When provided with a word problem, I can use models (pictures, arrays, number lines, numerals) to accurately multiply." Is this a useful learning objective?

- *No. The objective is not clear about how students will use pictures, arrays, number line and numerals.*
- *No. The objective specifies activities for students to do, not the learning to occur.*
- *No. The objective should be written in student friendly language.*
- ***Yes. The objective clarifies the context and method for what students are responsible for learning.***

Questions 11-20 assess teachers' understanding of how to monitor student learning toward the learning target.

Q11: The activity described allows a teacher to move from simply knowing whether students know the correct answer to eliciting evidence of their understanding and seeing if they can compare and contrast various possible answers. Thus the first response is correct. The second and third responses are not formative assessment focused. Monitoring student understanding is more than determining if a student knows an answer or not. Rather it is focused on ascertaining where students are in their learning (Wiliam, 2011, p. 71). The last response is incorrect because the scenario is not focused on determining student preconceived ideas, rather it focuses on students justifying their choices through discussion.

Q11 A teacher begins class with a multiple-choice question on the board. Students must justify their choice. As they respond the teacher asks questions to promote discussion such as, "How do you know that?" "What evidence do you have to support your answer?" and "Why is answer C better than B (or A or D)?" What might the teacher have been trying to find out through the discussion?

- ***The teacher wanted to learn the students' depth of understanding as they attempted to explain and compare their reasoning.***
- *The teacher wanted to find out which students were randomly guessing, and which students had reasons for their choice.*
- *The teacher wanted to identify which students actually knew the correct answer and how they knew.*
- *The teacher wanted to discover her students' thought processes to reveal preconceived ideas the students had about the topic.*

Q12: This question focuses on assessing individual student knowledge. The third response includes the only technique that allows the teacher to see evidence from each student. The other techniques only inform the teacher about what students think they know and understand. While they may be helpful strategies at times, those activities do not allow the teacher to assess individual student knowledge.

Q12 Which of the following instructional techniques assists a teacher in quickly assessing what individual students know?

- *A student writes his solution to a problem on the class whiteboard. The teacher asks the other students to stand if they got the same answer.*
- *Students put a green, yellow or red dot on the top of a paper before turning it in indicating if they feel confident in their understanding, still have some confusion or questions, or do not understand.*
- ***Students solve a problem on an individual white board and hold it up for the teacher to see.***
- *After a student answers a question, the other students put their thumbs up if they agree or thumbs down if they disagree.*

Q13: The first response is a method to track summative assessment data. The second response is often how teachers
keep track of formative assessment data, however no matter how informally the data is gathered, in order to be useful it needs to be formally recorded in some manner. Thus the third response is correct. Data that is written down at the time it is collected is going to be more accurate than trying to remember and recall what occurred during a lesson or activity. The fourth response would be correct if it added using the evidence pieces to adjust instruction. Using collected information only to review with students and parents is a summative use of the data.

Q13 How can a teacher best keep track of student data learned through formative assessment?

- *By grading assessments and recording scores for each student.*
- *Formative assessment is a process of informally gathering information, so a teacher should mentally note student learning throughout lessons and activities.*
- ***Using checklists and notes that can be reviewed when planning instruction and responding to students.***
- *Through collecting evidence pieces and keeping them in a file for each student to review with students and parents at conferences.*

Q14: The key in this question is to match the formative assessment activity to the purpose. In this question the focus is on assessing students' ability to **discuss** causes of the American Revolution. The first three responses will elicit evidence about students' ability to **identify** causes of the American Revolution, but will not inform the teacher about the students' ability to discuss the causes. Only the fourth response is an activity that matches the purpose and will reveal evidence of students' ability to discuss the causes of the American Revolution.

Q14 A teacher wants to determine students' progress toward being able to discuss the causes of the American Revolution. Which formative assessment activity would help her do that best?

- *The teacher asks students to write on a notecard two events that led to the American Revolution. The students hand in the card before going to lunch.*
- *The students read a short text about the American Revolution. The students identify causes of the American Revolution from the text and write them on a notecard to hand in before going to lunch.*
- *The teacher makes several statements about the American Revolution. After each statement, students move to one side of the room if they think the statement is about a cause of the American Revolution and the other side of the room if it is not.*
- ***Students identify an event that led to the American Revolution and talk with a partner about why it led to the American Revolution. The teacher listens to students' discussions.***

Q15: Much like question 14, the important part of this item is identifying a formative assessment activity that meets the purpose identified. This question is about assessing students **understanding** of the causes of the civil war. The first response is a reading comprehension activity. The third response is a self-assessment activity, but does not provide information to the teacher about students' actual understanding. The fourth response will let the teacher know if students can identify causes, but does not assess understanding. The second response will provide the teacher with information about students' understanding based on their written responses.

Q15 How would you formatively assess students' understanding of the causes of the American Civil War?

- *After students read about the causes of the Civil War, have them create a graphic organizer with information from the text about each of the causes.*
- ***Have students do a 5-minute quick write about the causes of the Civil War.***
- *With an exit ticket on which students rate their own understanding of the causes of the Civil War using a scale from 1 to 5.*
- *A quiz in which students must identify if statements about the causes of the Civil War are true or false.*

Q16: Formative assessment can occur in many forms, the key is to gather information that indicates student progress toward the learning target. In this question the target is for students to **explain** the significance of the state symbols. In the first response, students are identifying, not explaining. In the second response they are approaching the target, but it is at a personal level and could range from related to the target to students personal preference being explained. The fourth response may relate to significance, but that is unclear. Additionally, summarizing reading is a different task than explaining significance. The third response is correct because it requires students to explain the significance of a state symbol, which is the learning target.

Q16 Which of the following would best help a teacher formatively assess students' ability to explain the significance of the state symbols?

- *Using an activity in which students identify if statements about the significance of state symbols are true or false.*
- *On an exit ticket students list the state symbols and write about one that is most important to them.*
- ***Individually ask students to orally tell about the significance of a particular state symbol.***
- *Students read about how a state symbol was selected and write a summary.*

Q17: Thumbs displays are often used in classrooms. While the display provides some information, teachers need to be cautious about how they make use of the information. The first response is incorrect because thumb signals do not provide detailed enough information for a teacher to be confident about students understanding. The first, third, and fourth response all suffer from the same problem- teachers cannot be sure students truly know what she is seeking to find out based on their thumb response. A teacher may learn what students think they know, but could also have several students who simply put their thumb up or down based on what others in the class are doing. The second response is correct because the

teacher is able to find out more about what students actually know by asking them follow-up questions. She can also find out information at the individual student level during this discussion. The thumbs activity serves as a warm-up for students and a starting place for the discussion, but it is in the follow-up questions that formative assessment actually occurs.

Q17 A teacher states, "Spiders are insects." She asks students to put their thumbs up if they agree and thumbs down if they disagree. How should a teacher best make use of the information she learns from the thumbs display?

- *The display indicates class-wide understanding and so the teacher should use the information to determine if she should move on with planned lessons or reteach.*
- ***The teacher should ask follow-up questions to have students explain their reasoning to learn more about individual student understanding.***
- *The display should be used to identify students who do not understand and need more instruction or activities to correct misunderstandings.*
- *The teacher should note in writing students who incorrectly answered so that she can remember who has not yet met the learning objective.*

Q18: The target for this activity is to find out if students **know** the four basic needs of living things. The third response will provide that information to the teacher. The first response goes beyond the target to application level. The second response suffers from the downfalls of using thumb displays (see explanation for question 17). The fourth response can provide the teacher with this information, but not at an individual level that is as clear as students individually writing on white boards.

Q18 What would best help a teacher find out if students know the four basic needs of living things?

- *Students pick an animal or plant and write the needs of that plant or animal on an exit ticket.*
- *Teacher names something and students put thumbs up if it is a basic need of living things or thumbs down if it is not.*
- ***Students write the four basic needs of all living things on individual white boards.***
- *Students turn to a partner and talk about the four basic needs of all living things and then share with the class.*

Q19: The key in this question is how a **teacher best** makes use of the worksheet. In the first response, the students are making use of the worksheet. In the third response the use is directed at parents. The fourth response is similarly for students and parents since grades serve to share information with students and parents. In the second response teachers are able to use the worksheet to help them know more about students' abilities which can help in planning for instruction.

Q19 How can a teacher best make use of a skills worksheet?

- *To allow students to practice a new or reviewed skill.*
- ***To gain information about students' mastery level of the skill.***
- *To show parents student mastery level of the skill.*
- *To assess students' skills and assign a grade.*

Q20: At first glance the first response seems correct. However it is a much more complicated task than the target requires and will not serve as the best information for the teacher. If students struggle with the first part of the activity- writing a law, they will be unable to show if they are able to do the second part- explain the reasons for the law. Thus the teacher is unable to really assess students' progress toward the target. In the second and fourth responses the focus is on the importance of the laws while the target is about the reasons for the laws. In the third response students are required to explain the reasons for the laws in their communities which directly ties to the target of explaining why communities have laws.

Q20 Which of the following would best help a teacher formatively assess students' ability to explain why communities have laws?

- *Students create two laws for a fictitious community and explain the reasons for those laws.*
- *Students identify three laws in their community that they think are most important and write them on an entrance ticket.*
- ***Students do a quick write about the reasons for laws in the community they live in.***
- *Students write on sticky notes one important community law and one thing they do not understand about community laws.*

Questions 21-30 assess teachers' understanding of how to provide meaningful feedback to students that will assist them in reaching the learning targets.

Q21: When providing feedback, a teacher must balance providing enough information to help the student move forward without providing so much assistance that the student no longer has anything to work through. The teacher must also provide information in manageable amounts. Too much information at once is overwhelming and unusable to the student (Bransford, Brown, & Cocking, 1999). Hence, responses two and four are incorrect because the teacher is providing too much information to the student. The first response is correct because the teacher is only providing as much information as the student needs and the student is the one doing the work. The third response is incorrect because the feedback is too generic. Since another student is demonstrating, the teacher is not using what she learned about the student's difficulty to guide the feedback.

Q21 A teacher shows her class how to measure angles using a protractor. During student work time the teacher watches one student struggling in her attempts to measure angles. Which of the following is the best next step for the teacher?

- ***Ask the student to demonstrate using the protractor. Guide the student by asking corrective questions and modeling small steps as needed.***
- *Show the student the process to measure an angle again. While demonstrating, stop at each step to ask the student if she understands that step.*
- *Go back to the front of the room and explain to the class that there appears to be confusion on how to use a protractor. Ask for a volunteer to go to the front of the room to demonstrate how to measure an angle using a protractor.*
- *Let the student know she is measuring the angles incorrectly so that she does not continue to practice the wrong way. At her desk, show her how to correctly use a protractor to measure an angle.*

Q22: The first response is correct. Letter and numeric grades can inhibit learning and so they should be given as infrequently as possible (Wiliam, 2011, p. 123). The purpose of feedback is to help students know where they are in relation to the learning target and know what they can do to continue moving forward in their learning. The second answer choice does not focus on the improvement aspect of feedback and so it is incorrect. The third answer is incorrect because it does not include helpful feedback for students either. Not grading everything is helpful, but comments of some manner need to be included to direct the student. The last answer is incorrect since grades have been shown to hinder learning. The purpose of feedback is to assist learning and feedback is not as effective when accompanied by a grade.

Q22 A teacher puts a letter or numeric grade on every assignment to provide feedback to students about how well they understand what they are learning and let them know where there is room for improvement. Is this effective feedback?

- ***No, letter and numeric grades alone do not provide feedback that helps students understand what they are doing well and where they can improve.***
- *No, students need to have room to make errors. Students may become discouraged or even overconfident if graded on everything they do making the feedback ineffective.*
- *No, the teacher should not put a grade on a paper unless it is done correctly. Not having a grade on the paper will serve as feedback indicating to students to find and correct their errors.*
- *Yes, students like to know how they did on an assignment and a grade is feedback that helps them know if they understood the content or not.*

Q23: As explained in question 21, a teacher needs to give enough information to help a student move forward without giving too much assistance. The first and fourth responses are incorrect because they do not provide the student with the opportunity to seek out the errors himself. The second response is correct because it focuses the student on the area to improve with specific directions (look for two misspelled words) while still allowing the student to seek out and correct the error (Wiliam, 2011, p. 131). The third response is incorrect because the feedback is too vague (Bangert-Drowns et al., 1991) and focuses on student characteristics (not good at checking work) rather than the work itself.

Q23 A student turns in a paper and the teacher notices two words are spelled incorrectly. What teacher response would most help the student progress in learning to review and edit his own writing?

- *Accept the paper and circle the spelling errors when correcting it. When the paper is returned to the student, he must correct the spelling error and then resubmit the paper.*
- ***Point out to the student that there are two spelling errors. Have the student re-look at the paper and correct the errors.***
- *Ask the student if he checked his work. If he says yes, tell him he needs to check again because there are spelling errors he needs to fix before turning the paper in.*
- *Show the student the two words that are spelled incorrectly and help him figure out the correct way to spell the words and then have him make the corrections.*

Q24: Chappuis outlines five characteristics of effective feedback, first "it directs attention to intended learning" (2009, p. 56), meaning the feedback is aligned with the learning target. For this reason the fourth response is correct. The third response is incorrect because the feedback is aligned with the learning target. The fifth characteristic of effective feedback shared by Chappuis is that only the amount of feedback a student can act on is given. The first and second answers are incorrect because they do not align with the learning target and may overwhelm the student with too much information.

Q24 A teacher wants her students to learn the structure of an argumentative essay. She teaches a lesson on the structure of an argument. On students' drafts she writes specific comments related to argumentative structure, but does not point out every spelling or grammar error. Does this provide effective feedback, why or why not?

- *No, because spelling and grammar are important components of effective communication and feedback should identify these errors for students.*
- *No, because overlooking spelling and grammar errors sends the message that these are not an important part of writing.*
- *No, to be effective it is important to align feedback with the learning target.*
- ***Yes, the feedback is well aligned to the lesson's learning target.***

Q25: The first response is correct. Error detection and self-correction skills are developed with delayed feedback (Mory, 1996). "When a student is learning a relatively simple task (again, relative to capabilities), it is better to delay feedback to prevent feelings of feedback intrusion and possibly annoyance" (Shute, 2008, p.179)*. Thus frustration occurs due to feedback occurring too quickly, not due to lack of immediate feedback as the fourth answer shows. The second response is incorrect because feedback is effective at the individual level. A student should not feel singled out when individual feedback is part of the culture in the classroom. The third response is incorrect because students need time to work through errors and learn to self-correct. When a teacher jumps in to help students immediately, the teacher is doing all the work for the student.

* "In general, there is wide support for use of immediate feedback to promote learning and performance on verbal, procedural, and even tasks requiring motor skills (Anderson et al., 2001; Azevedo & Bernard, 1995; Corbett & Anderson, 1989, 2001; Dihoff et al., 2003; Phye & Andre, 1989)" (Shute, 2008, p.179).

Q25 A student is solving a relatively simple problem and makes an error. When should the teacher provide feedback?

- ***Wait to give feedback to the student to reduce intrusion on learning.***
- *Wait to give feedback to the student until you review all students' work and give collective feedback that will not single the student out.*
- *Provide immediate feedback so that the student does not learn incorrectly.*
- *Provide immediate feedback so the student does not become frustrated due to the error.*

Q26: The key here is the engagement. The student is still trying and working. The teacher should let the student continue trying and so the last response is correct. When a student is trying to solve a problem on his or her own, interrupting is disruptive (Shute, 2008, p. 178). The first answer is incorrect because the student is immersed in the problem and thus progress has not yet halted. When the student is unable to continue on his or her own is the time to step-in with feedback. The second and third answers are incorrect, see explanation for question 25.

Q26 While a student is immersed in a task, a teacher notices the student making an error. Should the teacher interrupt the student to provide feedback?

- *Yes, the student will become frustrated when the error halts her progress.*
- *Yes, a teacher should provide feedback to students immediately when errors are made so students do not learn incorrectly.*
- *No, the teacher may notice other students making the same error and should wait to help all the students together.*
- ***No, interrupting a student immersed in a task can be disruptive and impede learning.***

Q27: Students who receive feedback that includes positive remarks, specific comments on errors and suggestions for improvement have been shown to learn twice as fast as students who receive just scores (see Elawar and Corno, 1985). The first response is incorrect because the teacher only includes a grade and wrong answers with no guidance on how to improve. The second response is incorrect because, as explained in question 22, a letter grade can inhibit learning. Furthermore, giving a letter grade with comments has been shown to produce no better learning results than a letter grade alone (see Butler, 1988). The third response is correct because the feedback includes steps to improve and positive comments. The fourth response is incorrect because the student is not given any direction about how to improve.

Q27 A teacher wants to provide information to each student about his or her individual learning progress. Which is the best way to provide effective feedback on a paper?

- *The teacher should write a grade on the paper and mark problems solved incorrectly so the student knows what problems were hard for him.*
- *The teacher should write a grade on the paper and include comments about the student's strengths and information about how to improve.*
- ***The teacher should write comments about the student's strengths and information about how to improve.***
- *The teacher should write comments that highlight the student's success and avoid focusing on the student's weaknesses.*

Q28: Even for students who master a learning target, feedback should include positive remarks and suggestions for improvement (see question 27) which indicates the second answer choice is correct. The first and fourth responses are incorrect because they focus only on praise for the student with no suggestions for improvement. The third response does not focus on the learning needs of the student. While he may serve as a peer resource, the teacher's responsibility in regards to that student is foremost to his continued learning.

Q28 A student's performance over time indicates 100% mastery of a learning target. How should the teacher use this information when talking to the student?

- *Praise the student for working hard and let him know that he has mastered the learning target.*
- ***Share with the student his success in this area and provide him with suggestions for continued learning in the target area.***
- *Ask the student if he would be willing to work with his peers and provide feedback to help those still working toward the target.*
- *Tell the student he is doing great work and provide him with an extension project.*

Q29: While all four options are ways teachers can and do make use of pre-assessments, the purpose of a pre-assessment is to assist in planning instruction. The pre-assessment results can help a teacher make initial plans for the unit, but should not be the basis for the entire unit plans. The third response is correct. A teacher must continue to elicit evidence of student learning throughout the unit and adjust instruction and grouping along the way. Response four is incorrect because it locks students into a specific learning group for the whole unit.

Q29 How should a teacher best make use of unit pre-assessment results?

- *To identify students who have met the outcomes of the unit and provide them with alternative learning opportunities.*
- *To compare to post-assessment results and show students their learning growth during the unit.*
- ***To adjust instructional plans for the unit based on students' learning needs and strengths.***
- *To group students for instruction during the unit based on learning needs.*

Q30: Students should be given enough feedback to keep them moving forward without overwhelming them (see explanation for question 24). Moreover simply marking errors is not providing effective feedback because it does not provide students with specific suggestions for improvement. Hence, the second response is correct and the fourth response incorrect. The first and third responses are focused on the student not the feedback and serve as distractors for this item.

Q30 A teacher always marks all student errors on their work before returning it to them for review? Is this effective feedback?

- *No. Not all students will get similar amounts of feedback which is unfair to students who do well and receive little or no feedback from the teacher.*
- ***No. Feedback should be focused on a few things students can do to improve in meeting the learning goal.***
- *No. Marking all errors students make will cause those who did poorly to feel like failures.*
- *Yes. Without noting errors, students will not know they did something incorrectly and think they have mastered something when they have not.*
