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Learning to Assess Student Understanding through Formative and Summative Assessment

Sheryl McGlamery
University of Nebraska at Omaha, smcglamery@unomaha.edu

Saundra Shillingstad
University of Nebraska at Omaha, sshillingstad@unomaha.edu

LEARNING TO ASSESS STUDENT UNDERSTANDING THROUGH FORMATIVE ASSESSMENT MEASURES

Sheryl L. McGlamery

Saundra L. Shillingstad

University of Nebraska at Omaha

Abstract: *Following extensive discourse and observation (2015-2016) of pre-service teacher candidates' engagement in academic practicum experiences in math, science, and social studies methods courses, two undergraduate methods professors noted that many of the teacher candidates struggled in the area of assessing student learning in K-6 practicum experiences. We noted that pre-service teacher candidates struggled to differentiate between formative and summative assessment practices, struggled with knowing when and how to assess students during instruction, and lastly how to identify if student learning had occurred. This action research study reports the impact that modeling, teaching experience, and demonstrations of assessment measures had on pre-service teacher candidates' understanding of formatively and summatively assessing student learning.*

This article will address two College of Education professors' experiences and interactions with preservice teacher candidates enrolled in elementary math, science, and social studies methods courses. A predominant focus of the article will be on an action research project where formative assessment practices were first modeled and demonstrated by the professors in the higher education classroom, and then integrated into the lesson plans the preservice teacher candidates taught in their practicum experiences. Both professors strive to provide teaching and learning experiences built upon differentiated instruction and assessment practices. Over the past two years (2015-2016), both professors have strongly integrated and collected data on pre-service teacher candidate's ability to access K-6 student learning through formative assessment measures. Preservice teacher candidates are required to write lesson plans that include performance objectives that include assessment measures throughout the lesson, are required to teach the lesson, then complete a reflective journal prompts discussing the outcome of student learning.

Darling-Hammond & Bransford (2007) noted that the field experience should actively engage students in forming their own pedagogical schemata through experiential learning in course-relevant context. As pedagogy, field-based learning is education grounded in experiential learning and includes structured time for students to reflect on the experience.

How do we define assessment for our pre-service teacher candidates engaged in practicum experiences with K-6 students? We emphasize that assessment is a part of the process of teaching and learning and needs to be built into the planning of teaching. Assessment involves making informed judgments about student's achievements and progress and can take place on an occasion when students express themselves, intentionally or otherwise, in relation to a learning objective.

Understanding and Implementing Assessment Measures in K-6 Classrooms

Assessment of student learning is challenging for all educators. How are we preparing pre-service teacher candidates to assess student learning? As professors preparing future teachers we strongly communicate to our pre-service teacher candidates that assessment of student learning is in a continuous cycle of change. Wiggins (1998) noted, "The aim of [formative] assessment is primarily to educate and improve student performance, not merely to audit it" (p. 7). Dixson & Worrell (2016) noted that the purpose of integrating formative assessments into lessons

serves many purposes: (1) to improve teaching and learning, (2) to diagnose student difficulties, (3) to determine what is working, and (4) to determine what needs to be improved.

Through observation and engagement in the field practicums with our pre-service teacher candidates, we readily recognized that the teacher candidates lacked a conceptual understanding of when and how to assess student learning in K-6 classrooms. We determined that we needed to model for our pre-service teacher candidates how to move K-6 students beyond basic understandings and move to challenge students to think critically and analytically through formative assessment measures (e.g. observations, review of seatwork and homework, question and answer sessions, self-evaluations, reflections). Our goal was to develop pre-service teacher candidates who become active participants in the learning process. Therefore, we identified the need to change how we modeled assessment in the higher education classroom.

Through continuous modeling we noted that assessment is based on evidence of what students know, understand, and can do as a result of the teaching and learning process. For each lesson that pre-service teacher candidates created, a focus was placed on monitoring continuity and progression of student's learning. As professors modeling formative assessments, our goal was to articulate to the pre-service teacher candidates that assessment is a subtle art, not an exact science.

Scriven (1991) was the first researcher to note the distinction between the basic principles related to formative and summative assessment. There have been developments theoretically in the area of assessment since Scriven (1991). Sadler (1998) referred to formative assessment as assessment that is specifically intended to generate feedback on performance in order to improve and accelerate learning. One need only type the term 'assessment' or 'evaluation' into a search engine to find thousands of references. During our research we noted that there is no one unifying definition of 'assessment' or 'evaluation.' Across our review we also noted that many times the terms were used interchangeably. In the urban school districts where we send our pre-service teacher candidates, a strong distinction is not made between formative and summative assessment. In our observations of urban teachers, student teachers, and pre-service teacher candidates we noted that assessment of student learning was often a single process, with no formative assessment in the teaching and learning process.

McTighe & O'Connor (2005) have noted in their research that classroom assessments fall into three categories: (1) summative assessments (summarize learning at the conclusion of the instructional segment, (2) diagnostic assessments (precede instruction), and (3) formative assessment (occur concurrently with instruction). In an effort to reinforce that assessment occurs continuously throughout the learning process, we have focused our efforts on assessment for learning or formative assessment. We both support that assessment should be imbedded in the learning process, as suggested by Stiggins & Dufour (2009). We model and reinforce the principles of formative assessment to provide our pre-service teachers with specific feedback to assist them in guiding their teaching to improve student learning. In 2015 all professors in the Advanced Methods Block, who teach the college's elementary methods teaching courses, adopted a lesson plan template to guide pre-service teacher candidates in the lesson planning process. The gradual release lesson plan template includes the following sections with multiple opportunities to formative assessment student learning:

Table 1: Lesson Plan Template

Lesson Plan Format

Content Area: **Grade Level:** **Nebraska State Standards Addressed:** **Rationale (Why is this important?):** **Materials List:**
Objectives(s) *(What will your students be able to do before, during and at the end of the lesson?)* *Objective(s): May include both (formative and summative assessment measures)*

Vocabulary / Concepts to be taught *(What terms need to be introduced to help the students develop understanding of the topic discussed?)* *Formative assessment*
Anticipatory Set *(How will you focus students' attention on the material?)* *Formative assessment*
Beginning of Lesson: I Do/We Do *(How will you introduce and model the content? How will you check for understanding prior to guided practice?)* *Formative assessment*
Middle of Lesson: You Do It Together *(How will students apply the new skill/strategy in small groups or in a partner setting while receiving immediate feedback?*) *Formative assessment*
End of the Lesson: You Do It Alone *(How will the students apply new skill/strategy independently?)* *Summative assessment*
Assessment Statement: *(How will you know that your students have met the learning objective?)*
Closure: *(How will you end this lesson and prepare students for the next lesson?)* **Sources: (List all books, curriculum guides and on-line resources used to plan the lesson. List all sources APA style.)**

In math, science, and social studies methods, we strongly articulated that formative assessment measures include both formal and informal methods (i.e., multi-level oral questioning, teacher observations, ungraded logs and quizzes, 'think alouds', portfolio reviews, graphic organizers, etc.). Pre-service teacher candidates enrolled in our methods courses are provided with the gradual release lesson plan template to guide them through the lesson planning process. As our focus was on developing lesson plans that were differentiated, standards-based, and assessment driven, we spent a considerable amount of class time modeling and writing performance objectives. We found that if pre-service teacher candidates could write detailed performance objectives that included a criterion measure, the criterion measure assisted them in knowing when and how to assess student learning. As noted in the lesson plan template, each lesson that a preservice teacher candidate developed needed to include three-part performance objective(s). Prior to the requirement of the three-part performance objectives, pre-service teacher candidates focused predominantly on summative assessment (summarizing student learning at the conclusion of the lesson).

Planning for Learning and Assessment

In mathematics and science the pre-service teacher candidates are required to write four lesson plans and complete four journal sets responding to questions about the learning of the elementary students they are teaching. The social studies pre-service teacher candidates are required to write four lesson plans and complete four journal sets. In the lesson plans, the pre-service teacher candidates described the formative and/or summative assessments they integrated into the lesson plan. The journal questions were scripted and provided by the methods course instructors to every pre-service teacher candidate.

The pre-service teacher candidates were challenged to evaluate student learning in a continuous cycle of four steps: Planning→Implementation →Reflection on the lesson and the outcome of learning (assessment) →Revision of the lesson based on the assessment results→Second implementation (cycle repeats for science and math).

Method

Participants and Setting

The action research project was conducted in four urban schools. The first two cooperating school sites (we will call them Westend and Eastend Elementary) serve urban populations of children from lower middle class to working class families. The schools receive aid from Title I and Chapter I funds and more than 85% of the school's population receives free or reduced lunch. The current needs of the school revolve around science and mathematics learning, so they were enthusiastic to have 25 plus pre-service teachers in the school for six weeks to provide additional instruction in science and mathematics.

The pre-service teacher candidates who taught at Westend and Eastend were given instructions for designing math and science lessons focused on the needs and directions of their cooperating teachers. The pre-service teacher candidates then designed and planned four science or math lessons to be taught in the elementary practicum setting. The total number of lessons required during the six week field was twelve, including reading, math, science and language arts.

The second group of cooperating school sites (we will call them Northend and Southend Elementary) serves an urban population of children from middle to working class families. One of the school's target goals for their elementary students is to increase students' knowledge base in the area of language arts and social studies. Northend developed a partnership with our university during the fall of 2014. Due to lack of parental and community support, the curriculum coordinator at Northend contacted the language arts methods professor at University of Nebraska at Omaha (UNO) requesting assistance in presenting and teaching their language arts and social studies curriculum. UNO readily agreed to provide assistance to the students at Northend and Southend Elementary. The field based teaching practicum for all our methods sections is six weeks in duration, four days a week and three hours each day.

Table 2: Number of Participants Engaged in the Field Practicums for the Science, Math and Social Studies Sections

Year Spring-–Fall Totals	Science /Math Methods Enrollment	Social Studies Methods Enrollment
2015 Spring	23	36
2015 Fall	31	47
2016 Spring	43	--

Action Research and Service-Learning

This action research project had as its underlying goal: to improve teaching, learning, and understanding of assessment measures in math, science, and social studies methods courses. We followed basic steps outlined by Sagor (2000) to conduct our research. We identified the problem: Pre-service teachers lacked understanding of how and when to assess student learning in K-6 classrooms. Following two years of sending our pre-service teacher candidates into field practicums we readily identified the following questions with an assessment focus noted in Table 3.

Table 3: Research Questions

Questions	Desired End Result	Method for Achieving the Desired End Results	Student Population	How the question could be answered:
1. Will K-6 pre-service teacher candidates' understanding of formative and summative assessment measures utilized in K-6 classroom improve following direct modeling and demonstration in the higher education classroom?	Improve pre-service teacher candidates' understanding of assessment	Lecture Modeling Demonstration Practice Review Revision	K-6 Pre-service teacher candidates in math, science, social studies methods courses	Lecture, modeling, and demonstration with pre-service teacher candidates in differentiating between formative and summative assessment measures. Pre-service teacher candidates' practice of writing, reviewing, and revising performance objectives that included formative and summative assessment measures
2. Will implementing performance objectives into daily lesson plans that include formative and summative assessment measures increase K-6 pre-service	Improve pre-service teacher candidates' ability to write performance objectives that include formative and summative assessment measures that will assist in	Writing performance objectives that include: (a) action statement, (b) condition statement, and (c) criterion statement.	K-6 Pre-service teacher candidates in math, science, social studies methods courses	Work with pre-service teacher candidates in writing performance objectives

teacher candidates' ability to document if K-8 student learning has occurred?	documenting whether K-6 student learning has occurred			
3. Will the integration of formative and summative assessment measures into K-6 science, math, and social studies lesson plans improve the pre-service teacher candidates' ability to recognize and document student learning?	Identification of K-6 student learning	Micro-teaching lessons to K-6 students that include performance objectives that include formative and summative assessment measures as part of the criterion statement	K-6 students	Review of per-service teacher candidates journals following the micro-teaching of each lesson in the field/practicum placement

Data Collection

The data collection techniques for the action research project included the following:

1. 2015-2016 The researchers' observations and analytic discourse of pre-service teacher candidates' teaching in practicum placements in K-6 classrooms.
2. 2015-2016 The researchers' discourse and examination of K-6 math, science and social studies lesson plans that included formative and summative assessment measures built into the performance objectives.
3. Evaluation of pre-service teacher candidates daily lesson plans (performance objectives that included formative or summative criterions)
4. Review and evaluation of pre-service teacher candidates' reflective journal responses that addressed the following statements/questions:
    - List the performance objective(s)
    - Identify the formative/summative assessment measures utilized to document student learning
    - Identify and discuss 1-2 strengths/positive factors of the lesson and provide example(s)
    - Identify and discuss 1-2 areas of the lesson which could have been improved/strengthened and provide example(s)
    - Through the assessment measures integrated into the lesson plan, how do you know that the student(s) have learned?
    - Reflection on planning: (i.e., what did you learn, what did the students learn, was your planning adequate to assess student learning, was there a need for revision, would you make any changes to your plan?)
5. Review of the pre-service elementary teachers scores on the Field Performance Rubric tied to INTASC Standards, specifically, 6.1 on Assessment.

Analysis of the Data

This action research project revealed patterns of evidence that through direct modeling, demonstration, practice, review, and implementation of formative assessment measures into daily plans, pre-service teacher candidates were able to document and determine whether student learning had occurred.

Table 4: Analysis

Question 1	Desired End Result	Method(s) for Achieving the Desired End Result	Outcome
Will K-6 pre-service teacher candidates' understanding of formative and summative assessment measures utilized in K-6 classroom improve following direct modeling and demonstration in the higher education classroom?	Improved pre-service teachers' understanding of assessment	Formative Assessment Strategies Modeled and Implemented in Math, Science, and Social Studies • T-Charts • Venn-Diagrams • 3 Way Venn Diagrams • KWL Charts • Compare/Contrast • Five W's Chart (what, who, why, when, where) • Time-Order Charts • Timelines • Cause and Effect • Flow Charts • Sequence Charts • Cluster/Word Webs • Step-by-Step Charts • Oral Questioning	Candidates demonstrated their understanding of assessment through including one to three formative assessment measures for each lesson written
Question 2	Desired End Result	Method(s) for Achieving the Desired End Result	Outcome
Will implementing performance objectives into daily lesson plans that include formative and summative assessment measures increase K-6 pre-service teacher candidates' ability to document if K-6 student learning has occurred?	Pre-service teacher candidates' ability to write performance objectives that included formative and summative assessment measures	Modeling and demonstration of writing performance objectives that included formative and summative assessment measures pre, during, and post instruction	Candidates demonstrated their understanding of writing daily plans that included objectives that assessed student learning pre, during, and post instruction
Question 3	Desired End Result	Method(s) for Achieving the Desired End Result	Outcome
Will the integration of formative and summative assessment measures into K-6 science, math, and social studies lesson plans improve the pre-service teacher candidates' ability to recognize and document student learning?	Identification of K-6 student learning	Formative and summative assessment strategies embedded into lesson to document student learning	Candidates' documentation of student learning through their journal reflections that included anecdotal discussion documenting and discussing student learning

Data Findings Summary

Assertion 1: Teacher candidates' understanding of formative and summative assessment measures improved following the direct instruction and modeling in the higher education classroom.

The science, mathematics and social studies methods courses involved the direct instruction on how to write a lesson plan and how to include the appropriate assessment statements in each lesson plan. This instruction offered teacher candidates the opportunity to practice writing lesson plans and to receive feedback from the course instructors. The plans were assessed using a rubric to score each component of the lesson plans. The teacher candidates were then given the opportunity to revise the plan to meet the learning targets set by the lesson plan grading rubric.

Teacher candidates demonstrated their understanding of assessment through including one to three formative assessment measures and at least one summative assessment for each lesson written.

Assertion 2: During the field experience, teacher candidates planned and implemented performance objectives in all the lessons they taught in the field experience. The field based lessons included formative and summative assessment measures. These measures were designed to increase K-6 pre-service teacher candidates' ability to document that K-6 student learning had occurred. The process of implementing the lessons in the field was very helpful to the teacher candidates in recognizing student learning needs and implementing their assessments to show student learning.

Teacher candidates demonstrated their understanding of writing daily plans that included objectives that assessed student learning pre, during, and post instruction in the field setting. The implementation again proved insightful for the teacher candidates.

Assertion 3: The integration of formative and summative assessment measures into K-6 science, mathematics, and social studies lesson plans improved the pre-service teacher candidates' ability to recognize and document student learning.

Teacher candidates' documentation of student learning through their journal reflections that included anecdotal discussion documenting and discussing student learning offered additional evidence of their ability to document student learning in the K-6 setting.

Reflections of Teacher Candidates

After review and analysis of pre-service teacher candidates' reflective journals, we are of the belief that our preservice teacher candidates are moving toward a firm understanding of formatively assessing student learning. The following are examples of quotes taken from the pre-service teacher candidates' reflective journals.

Mathematics: "The 5th grade students were confident with basic operations, but they had not computed the average of a set of numbers before. We were working with some word problems that required the students to compute the average. Most got stuck quickly. I learned a lot from this experience. I need to do the diagnostic assessment before each lesson so I know how to begin. This would make the teaching easier and could give me a point of reference when assessing learning at the end of the lesson." (Mathematics Methods Student #1)

"The lesson on fractions did not go like I wanted it to. The students had trouble conceptualizing "common denominator." After completing a Venn diagram with the students, I realized the students wouldn't be able to complete the lesson as planned. This was a problem at first. I changed my lesson, so I was introducing the topic with manipulatives. This helped the students quite a bit. The final assessment demonstrated growth and the formative assessment problems I collected show improvement in their understanding." (Mathematics Methods Student #2)

Science: "I think I have finally made the connection between planning, student learning and assessment. In field on Thurs. one class of students seemed to be familiar with the topic of biomes, but the second group had never experienced any of the content. I had to totally change my teaching strategy. The KWL chart we filled out together let me know where my students were and I was able to adjust quickly. The final "What we have learned" column was much improved over the beginning "What I know about biomes." (Science Methods Student #1)

"I was taken back by the lack of understanding about measurement. The 2nd graders did not have much direct experience with metric measurement or measurement in general. The students really enjoyed the opportunity to work with weights and measures and learned from the experience. I was able to document the learning with the KWL chart and the worksheet the students completed during the activity." (Science Methods Student #2)

Social Studies: "At the beginning of the term, I knew that assessment was a way to measure what was learned by the students during a lesson. I knew that assessments could be given prior to a lesson to see where students were at, during a lesson to see if they were learning what was necessary along the way, and at the end of an

entire unit to see if they met the objective of the unit. As I reflect on this semester I have determined that I prefer formative assessment over formal (summative) assessment. I don't think that all students are good test-takers and regardless of how much they learned from a lesson, they won't be able to properly convey that through a test. I also think that formative assessments are able to show the entire learning process, from where a student has started, to what they've gained and finished with. I think there are appropriate times for formal tests, but for the most part, I lean towards more authentic ways of measuring student learning." (Social Studies Methods Student #1)

"The assessment form that I prefer now is formative assessment. It provides a snapshot of where a learner's abilities stand at any particular moment, as well as an opportunity for an educator to use scaffolding to transport a learner to a higher level of achievement. My competence regarding student assessment now is at a much more proficient level, as I have learned many authentic assessment measures that can be utilized as formative assessment measures, and will provide an opportunity for differentiation." (Social Studies Methods Student #2)

"My view of assessment was broad at the start of the term. I knew there were two types--formative and summative, but I knew little about what makes each what they are. Being able to actually administer assessment measures to the students helped to gain an understanding of what it means to accurately assess students learning. I prefer formative assessment because of the immediate feedback you get. This is best done when doing things like asking questions or suggesting thought provoking ideas. Another reason I like formative assessment measures is because it takes the pressure off the student to get the right answer. They are able to think freely and are more willing to take chances." (Social Studies Methods Student #3)

Discussion and Implication of Outcomes

Following two years of observations in the field with our pre-service teacher candidates, both professors have noted that the best place to assess student learning is in a field-based learning environment. Pre-service teacher candidates need to be provided with opportunities to transfer learning from the higher education classroom to the K-6 setting. We strongly believe that providing our pre-service teacher candidates with a strong conceptual understanding of assessment is where the true understanding of assessment begins. Through our observations, in and outside of the university classroom, we have noted that modeling and demonstration of formative assessment in the higher education classroom is critical to the transfer of formatively assessing student learning in K-6 classrooms. At the end of the spring 2016 term, an elementary science teacher candidate noted: "Looking back, prior to this semester I knew somewhat little regarding the assessment of student learning. I was aware of the terms formative and summative assessment and knew that it was important to include these forms of assessment into the curriculum in order to reach every student. However, I did not know enough about either assessment form that would allow me to confidently implement them into lessons. I also knew that standardized tests and traditional forms of assessment are not always the most effective tools to assess students' learning as they do not give a well-rounded example of the student's knowledge of the material. I am now more confident in my ability to include various assessment methods into my lessons in order to gain a stronger understanding of my students' knowledge."

Recommendations for Higher Education

- Provide teacher candidates with a strong knowledge base on assessment
- Provide examples of various assessment measures utilized in K-6 classrooms
- Provide teacher candidates with structured time to develop and write performance objectives that include criterion measures
- Provide a structured instrument (lesson plan template) for teacher candidates to utilize for design and implementation of lesson plans
- Assign teacher candidates with guiding questions to reflect on lesson plans taught
- Engage teacher candidates to dialogue how they know students have learned

Plan of Action

Where are we going? After observing the improvement in our pre-service teacher candidates' understanding of assessment and the learning process, we have compared the learning of pre-service teachers in the regular academic semesters (fall and spring) with pre-service teachers learning during the summer term. In the summer term there was not a field based practicum available. Subsequently, we have found a profound lack of conceptualization in pre-service teachers who complete the methods courses in the summer semester.

Pre-service teachers enrolled in the summer methods courses are only experiencing the planning phase of the planning/implementation/assessment process. We believe the lack of opportunity to carry the process into a field setting and try out the process for themselves does impair their ability to conceptualize the planning/implementation/assessment process. As a result of the findings just discussed we are eliminating all methods courses from the summer schedule. Methods courses will only be offered fall and spring terms.

Table 5: Planning Process

Planning/Implementation/Assessment Process	Field Experiences (Fall and Spring Semesters)	Service Learning (Summer)
Planning	X	X
Implementation	X	X
Reflection	X	
Revision	X	-

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Dr. Sheryl L. McGlamery (smcglamery@unomaha.edu) is a **professor of science education** and co-director of the office of STEM Education at the **University of Nebraska at Omaha**. She holds a Ph.D. in science education, with a research background in teacher development, induction programs and science learning.

Dr. Saundra L. Shillingstad (sshillingstad@unomaha.edu) is a **professor of teacher education** at the **University of Nebraska at Omaha** with a focus on social studies and educational foundations. She holds an Ed.D. in Educational Leadership from Kansas State University, with a background in teacher development, induction programs and assessment.