The Elementary Math Learning Stations Day:
A Performance Assessment for Elementary Teacher Education Students

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Introduction

The performance assessment given to teacher education students in an elementary mathematics methods class at Millikin University in Decatur, Illinois was to create a mathematics learning station for ethnically diverse, urban children in grades 3-4-5 that would demonstrate the interrelations of mathematics at different grade level bands. As Richard Stiggins explains in his book Student-Involved Classroom Assessment, “With performance assessments, we observe students while they are performing or we examine the products they create and evaluate the level of proficiency demonstrated.” (Stiggins, 1997, p. 184) In NCTM’s publication, Making Change in Mathematics Education, they make a viable case for performance assessment: “Proponents of reformed assessment use qualitative as well as quantitative data, and they focus more on describing student progress then on categorizing individuals or predicting future success. Thus there is a move away from a reliance on multiple-choice tests and toward an increased use of performance assessments, open-ended questions, group projects, portfolios, journal writing, oral reports, and observations.” (NCTM, 1998, p. 99)

Furthermore, new certification policies written by state legislatures mandate that teacher education institutions preparing individuals for a license to teach, develop programs where candidates demonstrate competency in professional teaching standards. In order for a candidate to be recommended for a probationary teaching license, the candidate must show a proficient level of competency in all of the professional teaching standards. There are many ways that students can show competency and one way is to participate in a performance assessment within a teacher education course. “Performance assessments involve students in activities that require them to demonstrate mastery of certain performance skills or their ability to create products that meet certain standards of quality.” (Stiggins, p. 184) A performance assessment is a very effective way to evaluate a student’s content knowledge at the end of a teacher education course because it requires the student to synthesize their knowledge in an integrated style. Performance assessments are an integral part of a pre-service teacher’s growth and understanding.

This article will explain how one performance assessment was used in an elementary mathematics methods course at Millikin University in Decatur, Illinois as a means of demonstrating competency in some of the course objectives.

How the Performance Assessment Works

“Prospective teachers must be taught in a manner similar to how they are to teach-by exploring, conjecturing, communicating, and reasoning.” (NCTM, 1989, p. 253) A performance assessment that is given at the
end of a course gives a student an opportunity to demonstrate their knowledge of course content through application of that knowledge in a real teaching situation. “NCTM’s Assessment Standards for School Mathematics” takes a more inclusive view, identifying “evaluating students’ achievement” as just one of four purposes of assessment (NCTM, 1995). Other purposes are monitoring students’ progress, making instructional decisions, and evaluating programs.” (NCTM, 1995, p.25) The purpose of the performance assessment was to demonstrate competency in the following course objectives taken from the elementary mathematics methods course:

1. Recognize how and demonstrate understanding about the ways in which learners’ cultural background, life and learning histories, developmental needs, learning disabilities, learning styles, cognitive approaches, attitudes about mathematics, and ideas about math concepts and beliefs can influence learning.

2. Employ a wide range of techniques to teach and assess mathematics for learners having diverse needs and behavioral issues, diverse backgrounds, multi-ages, developmental levels, language literacy and skills.

3. Teach and assess mathematical topics such as number systems and number sequences, geometry, measurement, statistics and probability, functions and use of variables.

All course objectives for the elementary mathematics methods course are aligned with NCTM Professional Standards for Teaching Mathematics (NCTM, 1992) as well as the NCTM Curriculum and Evaluation Standards for School Mathematics grades K-4 (NCTM, 1989). The course objectives are also aligned with the Illinois Professional Teaching Standards. (see Appendix A). Students were required to use all of these sets of standards when they constructed learning stations, which would become their performance assessment.

The Math Learning Stations Day would occur over a two day period for 90 minutes each day. The two 90 minute sessions would provide the teacher education students the opportunity to demonstrate teacher education competencies by facilitating their Math Learning Station for children. Before the Math Learning Stations Day, the professor collaborated with the elementary teachers whose children would be attending. The teachers told the professor what concepts and skills their children were working on. In planning and designing learning stations, the students understood the premise that, “Children need to understand that mathematics is an integral part of real-world situations and activities in other curricular areas.” (NCTM, 1989, p. 18) Therefore, each station had to include activities that integrated other areas of curriculum with the chosen mathematical concept.

Besides alignment with NCTM curriculum standards, other parameters of the assignment included the following:

1. The mini lesson conducted at the learning station should employ teaching methods and student tasks that align with the specified mathematics curriculum of the elementary school visited.

2. The mini lesson activities should be cognitively and developmentally
3. The facilitator designs activities that consider a child’s varying learning styles.

4. The learning station is conceptual in its learning approach and offers different contexts, procedures, formats, and situations.

5. The learning station activities allow students to experience mathematical concepts at different cognitive levels.

6. The learning station activities integrate other areas of the curriculum with the mathematical concept.

7. The learning station accommodates a small group of children comfortably and is attractive, organized, and managed efficiently by the facilitator.

8. The facilitator assesses student learning using a rubric that is designed to show how the student understands the concept of the learning station.

Preparing for the Performance Assessment

The professor of the elementary mathematics methods course arranged for six different classrooms (grades 3, 4, and 5) from a local elementary school to attend the Math Learning Stations Day over a two day period for 90 minutes each day. The elementary school chosen for the Learning Stations Day was an urban elementary school located in Decatur, Illinois. The school population was of lower socioeconomic status and ethnically diverse. The students’ mathematics knowledge, based on state test scores was one to three grade levels below their chronological grade.

The teacher education students were responsible for designing the mini lesson within the learning station, acquiring materials that would be needed to accomplish the activities and designing a rubric that would assess the children’s knowledge of the mini lesson’s concept. The professor helped students acquire consumable materials for their learning stations in advance through private foundation funds.

The Math Learning Stations Day was set up in the school gymnasium. The teacher education students designed how the learning stations were built, physically arranged and set up in the gymnasium, and decided how children would be organized and grouped in order to rotate to each of the learning stations. Teacher Education students arrived at the elementary school well ahead of schedule to set up their stations that had been developed and tried out among their peers in the previous week’s class sessions. Some of the concepts chosen for the mini lessons within the learning stations were: telling time, binary number systems in other cultures, symmetrical patterns, one dimensional to three dimensional construction, graphing on an x and y axis, measuring by volume as well as linearly, heart rate ratios, musical tonality, budgeting money, scientific methodology, and fractions.

Teacher Education Students are Assessed While Children Learn Mathematical Concepts

When the children arrived at the gymnasium, they were mixed up into working groups so that they would get to know other peers from other classrooms. College students gave general guidelines for
working at the math stations as well as expectations for behavior. The professor of the course began observing the college students at this time and noted the professional standards that the students were demonstrating. According to R. Stiggins, “The great strength of this assessment methodology lies in its ability to ask students to perform in certain ways and to provide a dependable means of evaluating that performance.” (Stiggins, 1997, p. 191) This assessment was on how teacher education students can assess small groups of students in mathematical concepts. They were also assessed on how well they could diagnose a child’s mathematical understanding, and facilitate the child’s learning at an appropriate level. While the college students facilitated the learning stations, the professor observed the teaching strategies of the college students. The professor observed the college students responding to the diverse needs of the children. For example, college students used inquiry techniques to assess developmental levels, and they assessed learning styles by offering a variety of learning activities. The professor also observed the college students managing the learning environment cooperatively with their peers, effectively rotating the children through the stations after each group came to closure. The professor’s evaluation rubric reflected these methodology goals and students were rated on a scale from 1-4, one being unacceptable and 4 being exemplary.

Integration of the curriculum within the centers was strong. For example, a center focusing on the binary number system integrated the ancient Mayan culture, hieroglyphics, and the Spanish language. Another center teaching the concept of converting one-dimension into three dimensions integrated endangered wildlife information, environmental protection initiatives, and city and county planning procedures dealing with development.

Different learning styles were accommodated by having children manipulate beans, construct models using snap cubes, design and make jewelry, graph by walking on an x and y axis taped on the floor, use compasses to orient direction, use oral language skills by presenting solutions to problems and explanations for methods, reading for understanding, and writing to synthesize information.

Each center had several activities that could accommodate the different cognitive levels of various children. These activities served as diagnostic, formative and summative assessments for the teacher education students practicing their teaching methods. For example, at the learning center that taught the concept of telling time, the center’s facilitator could see the various cognitive levels of the children. The children did problems involving the hour and half hour, or getting more difficult with multi-day problems, different time zones, or adding travel distance as another variable. Through inquiry and experimentation, the children chose what level of activity they wanted to start with and then were guided further by the learning center facilitator. Each learning center provided the participant with an opportunity to produce something that they could take with them and give to their classroom teacher. As observed by G. Wiggins (1993) in his work Assessing Student Performance, “Proponents of performance assessment contend that, just as high-fidelity musical reproductions provide rich and accurate representations of the original music, so too can performance assessments provide high-resolution representations of those forms of achievement that stretch into life beyond school.” These products helped the classroom teachers see what was accomplished during the sessions and the
various levels of understanding of the mathematical concepts among their children. The classroom teachers also benefited by the Math Stations Day by being able to watch their classroom children interact with other children from other classrooms, and watch their children being taught by teacher education students. The teachers also enjoyed meeting with other professionals within their school community.

Observed Outcomes of the Performance Assessment

It is important for professors to analyze college students’ field work and determine if the work is a complete picture of what the pre-service teacher knows and is able to do in the chosen setting. For this performance assessment, the professor analyzed college students’ ability to develop and use integrated learning stations in a multi-age environment. The following observed outcomes of the performance assessment show that the Math Stations Day was a success:

1. Objectives of the course were demonstrated successfully at level 3, proficient, and level 4, exemplary by all college students in the math methods course.

2. Children learned mathematical concepts in a different environment other than their regular classroom.

3. Classroom teachers could observe and assess their children’s learning by watching college students and children at the centers.

4. Children practiced their social skills as they met peers from other classrooms.

5. Teachers from one classroom met and collaborated with teachers from another classroom.

6. College students had an opportunity to teach and assess children in a self-designed learning environment.

7. Self-reflection of the teaching and learning process by the methods students demonstrated an ability to synthesize and evaluate professionally.

Teacher Education Students Self-Evaluative Reflection of the Performance Assessment

An important part of a performance assessment for professors and teacher education students is the self-reflection process that occurs after the actual performance is complete. The synthesizing that occurs during self-reflection is a higher level of critical thinking that will help teacher education students evaluate their work. Engaging in reflective practice during their teacher education coursework helps ensure that the reflection process becomes second nature when they become classroom teachers. This synthesis is required by the Illinois Professional Teaching Standards, number 10 Reflection and Professional Growth, which states: “The teacher is a reflective practitioner who continually evaluates how choices and actions affect students, parents, and other professionals in the learning community and actively seeks opportunities to grow professionally.” Effective teaching results from practitioners who are consistently reflecting about their teaching and the learning of their students. The professor and the college students engaged in this reflection phase together to mutually benefit from each other’s comments.
College students evaluated their performance during the following class session of the math methods course. Individually, they wrote how they addressed each of the assessment objectives in their experience with children at the Math Learning Stations Day. After students finished their written self-evaluations, they engaged in a general discussion. The students shared with each other how they thought they demonstrated the professional standards for teaching mathematics. They also discussed the children’s learning. The college students explained to each other how they pre-assessed the children’s abilities and learning styles and how the children reacted to the learning activities. The professor asked the students how they knew that the children learned the proposed activity objectives. The class compared the various work samples that the children produced and discussed the level of understanding that the work demonstrated. The thank-you notes that arrived a week later also gave the college students a good indication of what the children responded to most favorably and what they remembered.

Conclusion

Participating in a performance assessment to demonstrate knowledge and understanding of how to teach elementary mathematics is a very rewarding way that pre-service teachers can accomplish the objectives of a teacher education course and be more effectively evaluated. Any time that an individual can engage in an authentic experience, the outcomes are much more meaningful and relevant because they show that the student can transfer learned theory into effective practice. Working with a variety of multi-aged and multi-ethnic children whose learning styles and abilities are varied and diverse gives students the ultimate opportunity in testing their ability to diagnose and facilitate learning. The experience is also internalized for successful use later, if a synthesizing reflective process follows the teaching experience. The Elementary Math Stations Day provided a satisfying teaching experience for pre-service teachers and provided the professor of the math methods course an accurate picture of how students demonstrated national and state professional standards.

References


Making Change in Mathematics Education Learning From the Field. NCTM, Reston, Virginia, 1998.


Appendix A: Illinois Professional Teaching Standards

STANDARD 1 - Content Knowledge

The teacher understands the central concepts, methods of inquiry, and structures of the discipline(s) and creates learning experiences that make the content meaningful to all students.

STANDARD 2 - Human Development and Learning

The teacher understands how individuals grow, develop and learn and provides learning opportunities that support the intellectual, social, and personal development of all students.

STANDARD 3 – Diversity

The teacher understands how students differ in their approaches to learning and creates instructional opportunities that are adapted to diverse learners.

STANDARD 4 - Planning for Instruction

The teacher understands instructional planning and designs instruction based upon knowledge of the discipline, students, the community, and curriculum goals.

STANDARD 5 - Learning Environment

The teacher uses an understanding of individual and group motivation and behavior to create a learning environment that encourages positive social interaction, active engagement in learning, and self-motivation.
STANDARD 6 - Instructional Delivery

The teacher understands and uses a variety of instructional strategies to encourage students’ development of critical thinking, problem solving, and performance skills.

STANDARD 7 – Communication

The teacher uses knowledge of effective written, verbal, nonverbal, and visual communication techniques to foster active inquiry, collaboration, and supportive interaction in the classroom.

STANDARD 8 – Assessment

The teacher understands various formal and informal assessment strategies and uses them to support the continuous development of all students.

STANDARD 9 - Collaborative Relationships

The teacher understands the role of the community in education and develops and maintains collaborative relationships with colleagues, parents/guardians, and the community to support student learning and well-being.

STANDARD 10 - Reflection and Professional Growth

The teacher is a reflective practitioner who continually evaluates how choices and actions affect students, parents, and other professionals in the learning community and actively seeks opportunities to grow professionally.

STANDARD 11 - Professional Conduct and Leadership

The teacher understands education as a profession, maintains standards of professional conduct, and provides leadership to improve student learning and well-being.