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Implementing Alternative Assessment Techniques in Teacher Education

by

Thomasenia Lott Adams

One of the roles of a mathematics teacher educator is to present to preservice elementary teachers a variety of teaching methods for assisting young children to develop understanding of mathematical concepts and skills. These teaching methods not only relate to the elementary mathematics curriculum, instructional methodology, and learning theory, but also to techniques of assessing students' learning. In my presentation of assessment techniques, I emphasize the relationship of classroom assessment to curriculum and instruction and the role of assessment in improving teaching and learning. Moreover, the assessment techniques that I present to the preservice teachers are characterized as alternative assessment techniques. They are alternatives to traditional techniques of assessment such as paper-and-pencil tests, which in many cases may not provide accurate and in-depth information about students' learning. Traditional paper-and-pencil tests often relate more to the percentage of correctly completed "problems" or "exercises" than to (a) students' understanding of concepts and their applications in real-life settings, (b) students' disposition and attitudes toward mathematics, (c) students' abilities to understand and develop mathematical relationships, (d) students' abilities to communicate mathematically, and (e) students' specific mathematical strengths and weaknesses. Alternative techniques of assessment are more useful for collecting information which reflects the whole learner and which can be used to obtain broad and authentic information about learners and the changes needed in curriculum and instruction to improve teaching and learning. I encourage the preservice teachers not to think of assessment as separate from curriculum and instruction, but to treat assessment as a necessary part of curriculum and instruction with the goals of improving their teaching and students' learning.

The Dilemma

I was committed to describing and promoting these alternative assessment techniques to the preservice teachers, but I did not commit myself to implementing and modeling these techniques in my own teaching. I presented alternative assessment techniques to the preservice teachers with the hope that they would implement the techniques in their school placements and in their future classrooms. Eighty percent of all of the preservice teachers enrolled over the three-semester period of this self-study were participating in school placements at local elementary schools, and each student in a placement was encouraged to teach one or more mathematics lessons during the placement experience.

My own assessment practices were very different from the techniques which I presented as part of the curriculum for the course. I consistently used paper-and-pencil tests, composed mainly of traditional short answer items, essay questions, multiple choice items, and true-false items, to assess the preservice teachers. I obtained scores by which I could provide a grade for the students, but I was not truly aware of what and how they were learning. I believed that the alternative techniques that I presented and discussed in class with the preservice teachers were valid and valuable, yet I did not use these techniques myself to assess the preservice teachers in a more comprehensive way. This dilemma led to the self-study which I report in this article. Since the situation was indeed contrary to the teaching philosophy I espoused, I decided to begin implementation of alternative assessment techniques in my own classroom. In this self-study of

my assessment practices in several course sections of mathematics education methods, I address the following question: How would implementing alternative assessment techniques impact teaching and learning in this course?

Background

Assessment is the process of determining what students do or do not know or what students have or have not learned. Among the many roles of assessment in the classroom, several roles which are most common are to improve teaching and learning (Sammons, Kobett, Heiss, & Fennell, 1992) and to inform learners and other stakeholders of learners' academic development (Clarke, Clarke, & Lovitt, 1990). The knowledge a learner has or has not acquired is too often inaccurately denoted by a numerical score attained by the learner's completion of a traditional paper-and-pencil test which is graded and assigned a score. However, learners' abilities, potential achievement, and understanding cannot be accurately indicated and characterized by a simple numerical score (National Council of Teachers of Mathematics [NCTM], 1995). Thus assessment techniques which (a) are alternatives to traditional techniques of assessment, (b) yield authentic information about learners, and (c) are presented in ways more closely connected to curriculum and instruction are the desired techniques of classroom assessment of teaching and learning. These techniques include the following:

1. classroom observation,
2. oral questioning,
3. presentations,
4. problem solving investigations and explorations,
5. journal writing,
6. student interviews,
7. at-home projects,
8. performance-based tasks and tests,
9. classroom discourse,
10. exhibitions and demonstrations,
11. experiments,
12. portfolios of students' work,
13. student-constructed tests or test items,
14. students' self-assessment,
15. essay writing,
16. open-ended questions, and
17. projects (Bagley & Gallenberger, 1992; Baxter, 1992; Clarke, 1992; Csonger, 1992; Feuer & Fulton, 1992; NCTM, 1989, 1995; Sammons, Kobett, Heiss, & Fennell, 1992).

I now present techniques in the mathematics education methods courses in light of the standards set forth in the *Assessment Standards for School Mathematics* (NCTM, 1995). Accordingly, any classroom assessment needs to do the following:

1. represent the content which students value;
2. support students' learning;
3. meet the academic needs of each student;
4. inform students about the assessment process and the uses of assessment information;
5. indicate what students are and are not learning; and
6. reflect the purposes of assessment.

Procedure

I facilitated my self-study during three semesters of undergraduate mathematics methods courses. For each term, there were 96, 20, and 69 students enrolled, respectively. All of the students were academic juniors or seniors in an undergraduate elementary teacher education program at the university. During the terms, I recorded my reflections and experiences, made notes of my actions, and collected feedback from students.

Implementation

To prepare for the self-study, I first reviewed the alternative assessment techniques which were presented in subject-specific and general education literature and which I present to the preservice teachers as appropriate techniques of assessment. Secondly, I conversed with colleagues about the potential uses of these techniques at the post-secondary level, and I inquired about their experiences with the use of alternative assessment techniques. Lastly, I made plans to implement the techniques according to (a) my need to improve instruction and curriculum, (b) my need to attain information about students' learning, and (c) the students' need to learn from assessment results and improve learning during their matriculation in the courses.

The self-study was a challenge for me as it was difficult at first to adjust to using alternative techniques for assessing the students. The experience not only forced me to revisit my techniques of assessment but also to revisit the curriculum and instruction for the course. Some of the techniques I employed during the terms are briefly described below.

Portfolio

To provide students with an opportunity to show evidence of their professional growth and their potential as teachers of mathematics, all preservice teachers designed and completed a mathematics education portfolio. Each student submitted the following items in the portfolio:

1. cover letter,
2. résumé,
3. eight original lesson plans for teaching mathematics in the elementary school,
4. evidence of implementation (during semester placement in school) of three of the original lesson plans,
5. a problem file of 100 non-routine word problems,
6. three one-page papers to describe how the students might incorporate one standard from each of NCTM's *Standards* (1989, 1991, 1995) in the classroom, and
7. an item of choice.

I assessed the quality of the package design, the format of the presentation, and the contents of the portfolio with respect to the students' potential as teachers of mathematics in the elementary school. For grading purposes, I designed a rubric (scoring scale) for each component of the portfolio. The results of the ratings as well as my written comments were shared with the students.

Interview

The preservice teachers and I met one-on-one in my office. I returned the student's portfolio and initiated an informal discussion about the portfolio and teaching mathematics in general to begin the interview. Interview questions and comments were related to the student's understanding of teaching methodology. I asked questions related to the student's portfolio and the use of portfolios to assess the learning of elementary school children. Each interview lasted 10-20 minutes. I used the interview as an opportunity to encourage students to share additional information about the ideas they obtained by completing the assignment, to speak as future professionals in mathematics education (i.e., use appropriate mathematics education terminology), and to exercise their general speaking skills.

Writing and Oral Presentation

Each student submitted a topic-specific annotated bibliography of 20 mathematics education journal articles. I designed this assignment to encourage students to (a) become familiar with mathematics education publications, (b) learn about sources that may benefit them as teachers of mathematics, and (c) facilitate professional growth through written communication. The students chose one topic from a list of 25 (e.g., calculators, communication, decimals, problem solving) and then selected articles from a variety of journals addressing the teaching and learning of mathematics in grades K-5. Students then submitted summaries and reflections on the journal articles based on mathematics content, applicability to elementary school mathematics, and adherence to the philosophy of the National Council of Teachers of Mathematics. Additionally, each student chose two articles to present to the class by sharing their summaries and reflections.

While reading the bibliographies, I prepared notes to share with the students my insights regarding the topic and to encourage them to consider different angles of approaching the same topic. For grading purposes, I used a scoring scale and considered clarity, conciseness, and the academic quality of the annotations.

Performance Task

Each preservice teacher was responsible for creating 10 or more activities that they might use in the classroom. They had the option of modeling activities that were presented during the course, but I encouraged them to develop activities unlike those they previously experienced. In addition, they completed brief, written reports describing the uses of the activities in the classroom. One of the major purposes of this assignment was to place the preservice teachers in a position to create teacher-made items for specific purposes. Therefore, their knowledge of children's learning needs would be reflected in the design and usefulness of the items. I and my assistants for the term reviewed these items and provided written feedback to the students.

Non-traditional Exams

I designed the exams for this term and subsequent terms to assess the students' knowledge related to teaching and learning mathematics. The following types of items were used on the exams:

1. true-false (with written justification of the response),
2. multiple choice (with written justification of the response),

3. short answer (writing and drawings),
4. open-ended,
5. student-constructed (chosen from items solicited from the students),
6. performance tasks (e.g., modeling of manipulatives and other learning tools), and
7. oral responses (solicited during a two-minute interview).

Self-assessment

I facilitated one self-assessment activity. The students completed a mid-exam between the two regular semester exams. It had the same characteristics of the regular exams previously described. I set up stations in the classroom where students could sit when finished with the exam and then assess their responses to exam items. I provided a rubric (scale and guidelines for assessing the responses to the items) and the students made subjective decisions about the validity of their written responses in order to use the rubric appropriately to assess the exam.

Observations

I observed the students to ascertain information about the students'

1. dispositions and attitudes towards mathematics and teaching mathematics to young children,
2. abilities to communicate mathematical ideas in a coherent and accurate manner,
3. professionalism as future classroom teachers,
4. cooperation with others during group activities and projects,
5. willingness to exercise academic judgments about children's mathematical experiences in the classroom, and
6. overall adherence to the guidelines of the course.

As I observed several students each day for specific purposes, I recorded notes from my observations on individually-named notecards. I used these notes to clarify my subjective views about the academic growth of each student and to guide my delivery of written feedback on later occasions.

Group Projects

During the three semesters, I asked the students to prepare a group project for class presentation. One project was the preparation of a teacher resource guide for the basic operations with whole numbers. The guide consisted of the following:

1. two miniature bulletin boards,
2. four lesson plans,
3. a list of 101 ways to use basic operations in real life,
4. ten non-routine word problems,
5. one activity for using a nutrition context to teach basic operations, and
6. one activity for using a science context to teach basic operations.

I included the last two components to enhance and reinforce the students' ideas about curriculum integration and connections between mathematics and other disciplines.

The second project was a statistics presentation. The students were required to model the process of statistics in ways in which elementary school children might model the process. I instructed the students to seek out situations in the campus environment which would be worthy of statistical study. The students made their own decisions about the topic of study and the responsibilities of each group member. I assessed the presentations according to the following categories:

1. method of data collection,
2. organization of data,
3. method(s) of analysis of data,
4. presentation of data,
5. originality of topic, and
6. group participation.

I intended that the students' participation in and completion of this assignment might inform me of the students' abilities to develop and implement lessons in ways in which children would experience meaningful learning.

On another occasion, the students were encouraged to establish working relationships in groups of four. Each group collaborated on three distinct projects: (a) two class presentations (teaching measurement and teaching statistics), (b) an integrated unit plan, and (c) a problem solving log. Among other things, I assessed the students' skills for planning and implementing instruction and their participation in a cooperative environment. For the integrated unit plan, the students had to choose a model of curriculum integration to design a mathematics teaching unit. They could choose any elementary mathematics content for the mathematics component, but were restricted to areas for the accompanying discipline (e.g., language arts, science, social studies, geography). They could choose any theme, concepts, or skills suitable for the unit. They had to provide six lesson plans, three of which were to be implemented by three individual members of the group. In addition, the students had to select ten journal articles to support their unit.

As a group, the students compiled a problem solving log of potentially useful problems for use in elementary school mathematics. The students stated and solved each problem in a group notebook. For many of the problems, different solutions and processes for obtaining the solutions existed. I intended that this experience would encourage the preservice teachers to use non-routine word problems in their own classrooms. In addition, I wanted to give the preservice teachers opportunities to develop and exercise their own problem solving skills. I used rubrics to assign grades for the presentations and projects.

Oral Discourse

At the end of each chapter of the course text were self-assessment questions which the author of the text prepared as a method of review and extension of the chapter's content. I encouraged each student to attend to the self-assessment questions as preparation for oral discourse in class. I chose some questions for individual students to use to initiate discussion during each class period. Each student had several opportunities during each term to present responses to questions. I made note of the students' responses and their abilities to synthesize the information and extend the ideas presented by the author. I used this experience to ascertain information about the students' understanding of the text, their abilities to apply the information to design

learning experiences for children, and their abilities to understand and create relationships between curriculum, instruction, and assessment.

Results and Discussion

The curriculum for the course was based on the elementary school mathematics curriculum and methods of teaching mathematics. When I made changes in the assessment techniques which I used, I also had to make changes in the curriculum, or at a minimum, to exhibit flexibility in my presentation of the curriculum. Because I now attended to broader characteristics of the students, I used some assessment techniques (e.g., oral discourse, presentations) which provided the students with opportunities to guide the curriculum. If, during a presentation, a significant discussion arose which dealt with an issue which was yet to come, on many occasions I made decisions to make changes in the agenda to accommodate the needs and interests of the students at a particular time. As another example, the students' completion of the portfolio and integrated unit plan also caused me to reconsider the curriculum. As students were completing the portfolio and integrated unit plan assignments, they posed questions and presented needs that were not readily answered and met by the curriculum as it stood. Therefore, I and the students often introduced new topics, I sometimes deleted topics secondary in importance, and I spent a great deal of time developing new approaches to topics as I foresaw the needs of the students.

By far, the curriculum was much more static when I implemented traditional techniques of assessment. When I reflect on previous teaching experiences, I do not recall keeping such a keen eye on the curriculum and being ready and willing to make changes as the needs of the students reflected the necessity to do so. I propose that, because of the use of alternative techniques of assessment, I placed the students in a much better position to communicate with me about needed changes in the curriculum. Since I was more aware of what I wanted to accomplish by using alternative techniques of assessment, I was also more equipped to make changes in the curriculum without negatively impacting the role of the course in the students' academic plans.

Some techniques required extensive planning on my part (e.g., portfolios, interviews), while others only required moderate to minimum planning (e.g., journal writing, observations). After my first experience of implementation of techniques during the first academic term, I spent considerably more time planning for the subsequent terms as I acquired information from the previous experiences that carried over into a new planning stage. For example, I learned to use time more efficiently when conducting interviews or observing students at work. I also learned how to present the new techniques as student-friendly, since most of the preservice teachers were not used to being assessed in such ways.

Since I've completed the self-study, I now have several ideas for how the curriculum might change throughout future semesters, yet I realize that I will need to be flexible as the assessment techniques I choose to implement will certainly impact the flow and content of the curriculum. Up to this point, my implementation of alternative assessment techniques has positively impacted the curriculum for this course. My implementation of alternative assessment techniques made the curriculum more relevant to the students' needs, more interesting to me and to the students, and more realistic in regard to how the elementary school mathematics curriculum might develop in the classroom.

In regard to instruction, my implementation of alternative techniques of assessment forced changes in instruction. My instruction beforehand was very much a model of a lecture-type

college course until it was necessary for the students to engage in hands-on experiences. However, because I made decisions to assess the students with alternatives to traditional tests, I could decrease the amount of time I spent giving “lecture notes” to be studied by the students for the tests. I spent more time engaged in interactions (e.g., interview, observations, initiating oral discourse in the classroom) with the students. I spent more time assisting students with developing their own ideas about teaching mathematics and sharing and debating those ideas with others. I spent more time developing hands-on activities and assignments for the students to experience within cooperative groups in class. My instruction became more student-centered, more hands-on as I, too, participated with the students, and more relevant to the students’ needs to “see” how something should or could be taught. However, the most significant impact of implementing alternative assessment techniques on my instruction is that the assessment techniques became tools of instruction. Each time I facilitated the implementation of a technique, I did so with the intent that the students would learn something new or fully develop a familiar concept or skill. Thus, assessment was also a means for me to provide meaningful learning experiences.

Because assessment is related to curriculum and instruction, it would be difficult for assessment to affect teaching and not affect learning. In the beginning, I did not know exactly how the students’ learning would be affected by my implementation of alternative techniques of assessment. At first, I spent a great deal of time reviewing students’ grades to make sure that the students were making grades comparable to students’ grades during previous semesters of traditional assessment. While engaged in an assessment activity (interviews) on a particular day, I realized that the grades were not the most important thing for me to look at to ascertain the impact of the alternative assessment techniques on the students’ learning. I began to solicit feedback from students to questions like the following:

1. What have you learned from this experience?
2. What did you learn today that might influence you in the classroom?
3. What might you do to handle a situation like ... ?

I began to listen to the students speak through their answers to such questions, interviews, presentations, assignment productions, etc. to ascertain if the students were indeed learning appropriately. By participating in alternative assessment technique experiences, the students were more informed about what was expected and what was to be learned. The students exhibited behaviors which indicated to me that they were responding to curriculum and instruction with interest and intent to acquire knowledge about teaching mathematics in the elementary school. I wanted to gather more data on what students were learning and what their experiences were in the course, so I asked the preservice teachers to write me a letter in response to my open-ended request. The following are excerpts from three letters:

So here I am preparing to be a teacher. Now it is my turn to help kids who are having the same problems with math that I once had. Believe it or not, I am excited! The way we are learning about math puts everything in a new light. The manipulatives, the real life problems—they all make sense.

At the beginning of the semester, I didn’t know what math methods was all about. I figured we would learn how to teach children certain skills such as fractions and decimals. I was right, barely. Math methods is much more than that. Math methods is learning how to organize and assess instruction. It is also problem solving, communications, reasoning,

and connections. Now that three months have passed, I feel that I have a better understanding of what teaching mathematics is all about.

In all my years as a student, mathematics has always been my worst subject. That is why this methods class was so important to me. I never want a child to feel the way I felt when faced with mathematical concepts and procedures. This portfolio is my first attempt at making this commitment real. When I first started to put this portfolio together, I was concerned with what I considered busy work. As I got into it, however, I began to see the value of letting students choose what they think is their best work. It is more confidence building than taking a test, and it is really a way of seeing which students value their own learning.

This experience has encouraged me to continue with alternative approaches to classroom assessment. From my perspective, my teaching changed and improved as I gained more insight into the students' learning because of my implementation of alternative techniques of assessment.

At the end of my self-study, it was quite clear to me that the experience was one which would have a long-term impact on how I teach and how I assess students' learning. The change was one which focused on the relationships between curriculum, instruction, and assessment. I now have a personal and supported message to share with the preservice teachers: The implementation of alternative assessment techniques positively affected teaching and learning in my classroom.

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