Disclaimer: The article below is taken from http://philseflsupport.com/why_ar.htm. I had adjusted the formatting and added the italics to emphasize the significance of the discussion.
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Guiding teachers in conducting action research

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Abstract

This paper describes how teachers in grades 3-8 analyzed their teaching by conducting action research in their mathematics classrooms. The research focused on implementing authentic assessment in which teachers followed a four-stage action research model. Teachers identified mathematics skills to assess, developed research questions, and selected assessment tasks along with a rubric. They also collected data from students' work, and reported their findings. Finally, they reflected on the value of their action research experiences in improving their teaching and student performance in problem solving.

Background

Two documents published by the National Council of Teachers of Mathematics (NCTM) were influential in setting a new course for mathematics teaching and learning based on the accumulated research on students' thinking and society's need of a skilled workforce (NCTM, 1989; 2000). The focus on problem solving posed challenges, especially in assessing higher-order skills, since problem solving required considerable thinking from the students (Szetela & Nicol, 1992). Researchers recommended that mathematics teachers explore for themselves alternative methods of assessment that require students to communicate their thinking and justify their solutions (Charles, Lester, & O'Daffer, 1987; Szetela & Nicol, 1992). These experiences should include assessing student understanding at higher levels of thinking than just knowledge and comprehension. In order to do this, teachers need formal instruction in analyzing students' thinking and in helping students to make sense of the mathematics they are learning (Buschman, 2004). In public schools the pressure is on school leaders to instigate reforms that are centered, in part, on research-based practices, including assessment in all grade levels (Cooney, Badger, & Wilson, 1993). Furthermore, school leaders are being urged to be proactive and to focus on improving learning by encouraging teachers to conduct action research at the classroom level (McTighe, Seif, & Wiggins, 2004).

The major goal of this paper is to describe those processes, events, and outcomes that guided teachers in conducting action research on the use of alternative assessments to measure problem-solving skills. Twenty-four teachers (a second cohort that was part of a larger study) took part in a 17-month needs-based professional development program. Results from the first cohort of 15 teachers were published elsewhere (Taube, Polnick, & Jasper, 2004).

Action Research

Action research has gained importance in the educational arena and, consequently, several teacher preparation institutions are offering opportunities for teachers to engage in action research for both pre-service (Price & Valli, 2005) and in-service teachers (An, 2004b). From a pedagogical standpoint, action research engages teachers in personal transformations and professional development that help them understand the nature of their work (O'Hanlon, 1997). Also known as "teacher research," action research focuses on ways to improve the quality of education and allows teachers to be involved in their own practice by engaging in self-reflective inquiry (McNiff, 2002). Action research can serve as a tens through which mathematics teachers can see connections between their beliefs and their teaching practice. Becoming aware of these connections is critical in gaining both pedagogical content knowledge and skills in inquiry and problem solving (An, 2004b).

Methodology

The methodology used in this inquiry included the collection of both qualitative and quantitative data, analyzed on two levels. The first level involved collecting and analyzing teacher data as teachers participated in coursework, monthly seminars, and classroom implementation; the second level involved teachers in collecting, analyzing and reporting their own students' data. Qualitative data on both levels included classroom observational data with anecdotal notes, teacher self-reports including reflections, student performance data on assessment tasks as analyzed and reported by the teachers, and student self-reports as they reflected on their experiences with problem solving. Quantitative data came from teacher surveys and content knowledge assessments and student performance on assessment tasks. Both types of data were used to determine the effectiveness of the professional development experiences in improving mathematics teaching. One of those experiences included action research in the mathematics classroom. In this paper we share only the data that related to the action research conducted by teachers. A modification of Kemmis' and McTaggart's (1988) model for action research was used to guide teacher inquiry into their own practice. Figure 1 outlines the four-stage model that required teachers to plan, act, observe, analyze data, and reflect.
See http://rapidintellect.com/AEQweb/fal2005.htm

Implementation of the Action Research

The teachers in our study expressed a need to not only improve students' problem-solving skills but also design effective measures of students' conceptual understanding in this area. Many were giving multiple-choice, benchmark assessments, but the teachers said these assessments did not give them enough feedback regarding needs of individual students. Teachers wanted to know how they could better assess the needs of their students in order to design instruction to help individual students improve their problem-solving skills. These concerns provided the catalyst for an action research project in which teachers collected and analyzed data gathered from the results of student performance on assessment tasks and then used their findings to improve their own teaching and student learning.

Planning Stage

In the Planning Stage of their action research, teachers accomplished four tasks. They a) discussed and collaborated on the questions to be addressed by the research, b) selected the problem solving skills to be assessed, c) designed a rubric to measure problem-solving skills and conceptual understanding, and d) selected or designed an assessment task. During the first part, questions that drove teachers' research, included: a) How do I encourage mathematics students to fully participate in all problem solving steps?, and b) How do I measure mathematics students' understanding of problem solving processes and then use that information to improve my own teaching? During the second part of the planning phase, teachers had to determine which problem-solving skills and behaviors they wanted to measure. Even though teachers had learned a variety of problem solving strategies (e.g., looking for a pattern, drawing a picture), they still needed to learn how to describe the specific behaviors they wanted to measure. The third part of the Planning Stage required teachers to develop rubrics built around what skills and behaviors they wanted to observe in their students. Again, teachers had to be taught various ways to develop rubrics. Examples of rubrics were analyzed and critiqued. Teachers then developed their own rubrics that measured at least four skills or behaviors on a four-point scale or higher. Finally, the fourth part of the Planning Stage included the selection of the assessment task. Teachers designed or modified problem-based assessment tasks aligned with NCTM Standards and demonstrated the skills they taught.

Acting Stage

During the Acting Stage, teachers taught their lessons, reviewed the rubric with students, and administered the assessment tasks. They then scored the assessments using a rubric. When teachers taught their lessons, they incorporated problem-solving strategies and presented real-world problems. They encouraged students to use more than one problem-solving strategy. Taking time to show their thinking was challenging for most students and their teachers, since students were used to writing only the answer on paper. Sharing the rubric before hand with students was an important part of this stage. According to Parke, Lane, Silver, and Magone (2003), "sharing rubrics in the classroom helps students gain a better understanding of the elements of a good, complete response to a problem" (p. 12).

Observation and Analysis Stage

The Observation and Analysis Stage included recording results from student solutions to the problems and reactions to the experience, along with the teachers' own thoughts and reactions to the process. The data they collected and analyzed helped teachers identify areas of strength and weakness in both the lessons they taught and in their own students' understanding of problem solving. Making informed decisions about their own teaching and their students' learning was the major purpose for conducting this action research. This included asking themselves: Did students learn what they were taught'? Were students enjoying the problem-solving lessons, thus improving their attitude toward mathematics? Were there parts of the rubric that needed refinement? Were teachers' own interpretations of the students' work using the rubric consistent? What score should be given in each category?

Reflection Stage

Finally, during the Reflection Stage, conclusions were drawn and the original assessment process revised based upon the data collected. Teachers discussed what they would do differently, how they would change their teaching, and what new tasks they could investigate. Teachers reflected on how they could make more informed decisions about students' understanding of the problem-solving strategies they taught. Teachers also shared their experiences with the researchers/instructors and their peers.

Teachers' Feedback on the Action Research

In our study, teachers discovered how much better their students performed on their assessments when they took the time to discuss the rubrics with their class. Completing good assessments take time, and teachers indicated that their students were used to finishing a task quickly. Both teachers and students had to adjust to the slower pace of reflecting and communicating their ideas to others. For many teachers, displaying the class results showing how students did on the assessment task in a variety of graphic formats was a new experience, and for those who shared the charts and graphs with their students, there was the added benefit of modeling for the students how they used statistics in every day life. After the teachers shared their action research with their peers, administrators and instructors, they responded to an open-ended survey consisting of four questions. Below is the summary of the teachers' responses to each question.

Question 1. What did you discover about your own students' learning when you implemented the alternative assessment model? Teacher responses mostly centered around understanding student thinking, their strengths and weaknesses, as well as how much the students enjoyed working on the problems. Examples of teachers' responses included: "I learned more about how my students think; some see math in pictures, others in numbers or both." "Students get motivated after realizing that all facets of their work will be evaluated."

Question 2. What did you discover about your teaching when you implemented the alternative assessment model? Teachers underscored the need to express the same idea in many different ways, use authentic assessments frequently, ask more questions, and to focus on students' thought processes. Examples were: "It helped me to focus more on the students' processes rather than their answers in terms of being correct or incorrect." "The way I word or express an idea to communicate my expectations may not come across clearly with every student. I need to learn more ways to express the same math idea."

Question 3. What was the most difficult part of implementing alternative assessments in your classroom? Teachers mentioned managing time, adjusting to current grading system, and explaining rubrics to others. The pressure to score high on the state assessment limited teachers' ability to implement alternative assessments. Examples of responses included: "Time management was extremely difficult. The bell will ring in the middle of a good and exciting discovery and I have to quit and start all over next day." "My district encourages us to teach to the test, because we are under pressure to do well on our state assessments."

Question 4. What would you do differently? Teachers suggested different ways they would revise the rubrics, and when and how they would explain the rubrics to students. Examples included: "I wanted more written explanations from my students. I would change the rubric to give students more timejoumaling about math and problem solving." "I would break the project into smaller segments in order to allow my students more time to plan and implement their problem solving strategies. This will also give them time to reflect on their own learning, which was my ultimate goal for the project."

Summary and Conclusion

In this paper we shared the processes and outcomes of an action research project conducted by mathematics teachers (Gr. 3-8) who wanted to improve their own teaching of problem-solving skills. The four-step action research model used in this study helped teachers to answer specific questions about their own students' understanding of problem solving as well as ways in which they could more effectively design instruction to meet their students' needs. By systematically following this research model, teachers were better able to determine the effectiveness of using alternative assessments in their classrooms.

Teachers' reflections on their experiences and those of their students indicated that action research can be a valuable tool for teachers who want to improve the learning processes of their students. Furthermore, by collecting and analyzing data and then sharing the results with their peers and school administrators, teachers learned how to better communicate the needs of their students. In addition, teachers said they were better able to make instructional changes that specifically addressed individual needs of students, thus improving both their teaching and their students' learning of problem solving. This further supports the work of Price and Valli (2005) who found that action research could be used to help teachers make instructional changes with full awareness that change comes in multiple dimensions.

As indicated by the reflections, action research in the use of alternative assessments to improve the teaching of problem solving was an effective tool to engage teachers in reflective inquiry and help teachers improve the problem-solving skills of their students. As a result of this action research project, both the researchers and the teachers gained much from working together. As professional development instructors, we learned how to give helpful feedback and to guide teachers in designing assessments that could provide evidence about their students' thinking. We challenged the teachers to think about how this knowledge could impact their practice and what they could do differently in the classroom. They challenged us to become better researchers and mentors.

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