

IMPLEMENTING STATE MATHEMATICS STANDARDS IN HAWAI'I: A PROFESSIONAL DEVELOPMENT MODEL

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INTRODUCTION

Hawai'i is in the process of implementing new K-12 State content and performance standards in ten content areas including mathematics. As part of this work, the State Department of Education (DOE) formed several committees to produce final draft versions of each set of standards. We, the authors of this article, together with the State mathematics consultant were invited to serve as members of the mathematics committee. On completion of our committee work, we were asked to participate in a project with the DOE to help teachers become familiar with the standards and to find effective ways to develop standards-based curriculum in their classrooms. A further aim was for Department staff to collect exemplars of student work. Student responses to tasks were then used to establish performance indicators in relation to established benchmarks. Finally, the project aimed to help teachers develop criteria for judging the quality of this student work.

The question of quality is an important factor in the process of developing standards-based curricula and methods of assessment. The guiding principle for the project was that the supporting evidence of quality rests in the students' work. The long-term aim is to have the DOE post samples of tasks, student work and teacher commentary on the internet as a resource for teachers.

Our interest was both complementary and supplementary to that of the DOE staff. We consider that improving teachers' knowledge of mathematics content is an important component in the difficult task of learning to make judgments about student work; without knowing mathematics content in some detail, teachers may miss important indicators in the students' work. A Title II Eisenhower teacher professional development grant funded our participation.

This report summarizes the activities of the project, the purposes of the grant and how it was implemented, together with insights into the disposition of the teachers at the beginning and the end of the project. We also provide information about the teachers' evaluations of the effectiveness of the project, describe the outcomes for the participating teachers, and include items of continuing interest for those teachers.

MATHEMATICS STANDARDS IN HAWAI'I

One principle in the development of the new standards in Hawai'i was made very clear to the writing and editing teams

and that was that these new standards were to be written for all students:

"The mathematics content standards are clear, broad statements that identify what all students should know about mathematics and be able to do using mathematics in order to make sense of the world around them, and help prepare them to use." (Hawai'i Content and Performance Standards II: Mathematics, p. 2.)

At the same time the writing and editing teams were charged with ensuring that much more attention be given to updating and expanding the mathematics content of the standards. The Introduction to the Hawai'i Content and Performance Standards II made it clear that we needed to go beyond the expectations of the previous state curriculum guide in this respect in changing expectations for teaching mathematics.

"Mathematics is seen as both a science of pattern and order and as a form of communication for describing the world. As such, instructional practices must actively involve students in exploring, conjecturing, analyzing, and applying mathematics in both real-world and mathematical contexts, and in communicating mathematical ideas. With instructional emphasis moving from just 'getting the correct answer' to justifying the solution and communicating how that solution was found, assessment of mathematical understanding using a variety of methods has become an integral part of instruction. Such assessment must link directly to the student learning standards that it seeks to measure. As part of this change, the use of mathematical tools and representation has also become necessary to help students see and understand concepts as they do math." (HCPS II: Mathematics, p 1.)

Thus, in the new standards document, which is closely aligned with NCTM (2000), the state has expressed a clear commitment to upgrading the content of the mathematics to be taught. It also influences teachers in their choices of resources and methodology for teaching mathematics. However, it is one thing to create a document expressing these wishes but quite another to expect a rapid and complete state-wide implementation within classrooms. What was needed was a professional development plan to provide long-term support to help teachers meet these new requirements.

The final form of this Eisenhower project, a beginning step in providing such support, involved a broad collaboration. The participants included State DOE mathematics personnel, members of the mathematics department at Kapiolani Community College, University of Hawai'i mathematics education faculty and mathematics faculty from the university. Our aim was to develop and test a professional development model for preparing teachers to deal with both the mathematics and the methodology changes written into the new standards.

PROJECT OUTLINE

The professional development model that was the basis for the project consisted of three elements:

- teachers would learn to judge the quality of children's work collected from their own class rooms
- teachers would learn some of the mathematics content now introduced in the new standards
- teachers would learn to write tasks to determine whether their students were meeting the new standards.

Our aims at the first meeting was to introduce teachers to the elements of the model, impart information about the new state standards and show how best practice can be incorporated into the teaching of mathematics. The first session introduced participating teachers to activities designed to refresh their knowledge of the mathematics now required in the new standards. If they were unfamiliar with the content the activities would provide a springboard to learn it. At subsequent meetings teachers engaged in a cycle that began with reflection on student work, proceeded to the development of new tasks based on that reflection and ended with increased knowledge of content and standards. Each meeting engaged the teachers in more mathematics activities to extend or refresh their mathematics knowledge in topics such as statistics and probability, geometry and measurement, and patterns and algebraic thinking.

Collaborative learning was the underlying theme for all three elements. Teachers worked in all of three group formations: school level groups, cross-school grade level groups and cross-school/cross grade-level groups. The following is a sample task that teachers worked on in their groups and adapted for use in their classrooms:

"DO NOT LOOK IN THE BAG. Working in pairs you are to determine the colors of the cubes in the bag without looking. Each bag contains eight cubes. Some cubes may be the same color and some may be different. You may take one cube out at a time, record its color, replace it, and shake the bag. (This is called sampling.)

You may repeat this as many times as you feel is necessary until you are fairly sure you know what is in the bag. Still DO NOT LOOK IN THE BAG. Several pairs will be called upon to explain their predictions to others."

Another example shows a task designed to challenge teachers' own mathematical thinking:

"Take the cone, pyramid, cylinder, and cube. Compare the base and height of each. Estimate: How many pyramids will it take to fill the cube? Use beans to check your estimates. Estimate: How many cones will it take to fill the cylinder? Use beans to check your estimates. What can you generalize from this? Estimate which holds more, the cone or the pyramid. On what is your estimate based? Use the beans to check your estimates. Estimate, then calculate how many cubic cm fit the cube. Fill one plastic cube with water. Estimate the mass, then weigh to determine it. What weight of water will fill the cone and the pyramid? Approximate each and justify your approximations."

These tasks and similar problems served more than one purpose. Teachers wrestled with mathematics ideas that developed their own content knowledge. They dealt with tasks that were also suitable to use with their students. And when used in classrooms, such tasks often presented teachers with a wide variety of student responses, thus furthering the development of their skills in judging the quality of children's work.

Group work promoted teacher discussions about how to use these and similar tasks in the classroom and engaged them in debate about how to implement teaching strategies compatible with the new math standards.

IMPLEMENTING THE PROJECT

The project was implemented through a series of full-day workshops, six for each participant. In order to produce maximum effectiveness at the school level, participation was invited from schools that could guarantee that a majority of their faculty would attend.

From a pool of over 300 applicants, 172 teachers were chosen from 7 schools and organized into four sites based on geographical location. (See Table 1.) As part of a cost-sharing commitment the DOE provided funds to pay for substitute teachers for all participants for each of the six days at all four sites.

At all the sessions, teachers worked in grade level teams for the first two hours on assessing and judging the quality of the student work that they brought from their classrooms.

DOE staff took the lead in each of these beginning sessions,



"How many people fill a meter cube?" asks Neil Pateman.

as the teachers worked together to evaluate the quality of student work. At the same time, they learned how to develop standards-based tasks and adapt them to their own needs.

During the next two to three hours, teachers worked in cross-school, cross-grade-level groups, under the guidance of university mathematics and education faculty, on tasks designed to extend the teachers' own knowledge of mathematics. Finally, they were grouped for the remaining two hours according to their school and grade level. Their task was to design new activities based on the state standards and aimed at developing skill in teacher assessment of student's mathematical knowledge. Thus, during each session (except the sixth) teachers were able to produce a set of standards-based tasks to use with their students. Student work in response to these tasks was then collected by teachers and used to provide the material for the first, two-hour group work of the following session.

The project concluded with a final meeting in which all the teachers presented their findings and shared their future plans for adapting their curriculum, teaching and assessment strategies to meet the standards.

Participants in the project were able to earn university credit and/or professional development credits provided by the DOE. Each teacher was assessed on two sets of documents. The first was a DOE assessment that measured implementation efforts and the development of benchmarks to be used to judge the quality of student work. The second was designed to meet university requirements and focused on what the teachers had learned, including reflections on the participants' own learning processes.

| Site | School | Number of Participants |
|--------------|-------------------------|------------------------|
| Leeward I | Kaimiloa Elementary | 30 |
| | Waikale Elementary | 29 |
| Leeward II | Kapolei Elementary | 25 |
| | Kapolei Middle | 9 |
| Windward | Kailua Elementary | 28 |
| | Pu'ohale Elementary | 19 |
| Pearl Harbor | Pearl Harbor Elementary | 26 |

Table 1: Participation by Site and School

DATA SOURCES

Data were collected from four distinct sources:

1. Grade level focus groups were formed from the teachers at each of the four sites. Each focus group was interviewed twice, once during the second meeting of the project and once during the sixth meeting. The interviewer transcribed the responses during each interview, wrote summaries of the transcripts, and also wrote notes of his impressions of each interview.
2. Portfolios were collected from each teacher who participated. These portfolios included:
 - Written responses to questions relating to learning of mathematics
 - Written responses to questions asking about knowledge of the new state standards
 - Samples of problem solving in mathematics
 - Samples of student work from the classroom.
3. Extensive surveys were completed during the final day of the project and future action plans were collected from each school group.
4. Observations and anecdotes collected and made by the university and DOE facilitators during workshop sessions.

ANALYSIS OF FOCUS GROUP INTERVIEWS

Emerging categories of teacher concerns from the first set of interviews were remarkably similar across all sites. Typically, concerns centered on the importance of standards in general. Teachers worried that they were not yet sufficiently familiar with the standards. They voiced concern that many other teachers would not be able to participate. Overwhelmingly, they felt that the state would need to do much more to assist teachers to meet the standards rather than simply focusing on

sanctions for those who failed. Teachers' comments also indicated that the possibility of sanctions for the faculty in those schools whose students fail to meet standards is a major concern.

Because the university faculty and the DOE staff were each focusing on different concerns with each offering separate credits, the introductory session left teachers with the perception that university faculty and the DOE staff had very different expectations for the resulting teacher outcomes. Teachers were troubled by these apparently inconsistent demands. During the initial interview following the first session these comments were heard from teachers at four different schools:

Different messages are being transmitted—one from the DOE and another from the university.
There is confusion about what needs to be turned in, both to UH & DOE.
There are different ideas coming from UH/DOE.
There seem to be different messages from UH/DOE.

This perception was acknowledged during the third set of meetings with the very different roles and hence expectations of DOE staff and UH faculty clarified.

At the same time that the Department was establishing standards for all students, schools were also being required to make unique provisions and expectations for special education students through IEP requirements another item of concern for participating teachers.

Teachers also made enthusiastic comments about their participation in the project. Feedback from all the participating sites indicated that teachers appreciated the opportunity to be involved, to learn about standards and to discuss mathematics teaching. At two of the sites, teachers expressed concern that their colleagues in other schools were not able to take advantage of the same opportunity.

Similar concerns re-emerged during the second interview. However teachers now felt much more knowledgeable about the standards, although they were still very concerned that the state had a large task ahead to work with all teachers, not only in mathematics but also in all other curriculum areas.

Nevertheless, teachers felt that the workshops they appreciated learning about the roles of manipulatives and the value of mathematical inquiry in teaching mathematics.

SURVEY RESULTS

Table 2 presents the results of a survey given as an evaluation instrument at the completion of all grant activities. The respondents were those project participants who were working for college credit at the master's level. Nineteen questions were developed to assess the impact of the project on the participating teachers and solicited their opinions

| Item | SA (%) | A (%) | N (%) | D (%) | SD (%) |
|---|--------|-------|-------|-------|--------|
| 1 I learned a good deal of factual material in this course | 44 | 50 | 5 | 1 | 0 |
| 2 I learned to recognize quality work in mathematics | 34 | 60 | 6 | 0 | 0 |
| 3 I developed enthusiasm about the course content | 27 | 60 | 12 | 1 | 0 |
| 4 I participated actively in small group sessions | 56 | 42 | 2 | 0 | 0 |
| 5 I generally understood the material presented in this course | 32 | 61 | 6 | 1 | 0 |
| 6 The instructors were enthusiastic about the course material | 74 | 23 | 3 | 0 | 0 |
| 7 The course instructors appeared to have a thorough knowledge of the subject | 85 | 12 | 3 | 0 | 0 |
| 8 The instructors stimulated me to think about the subject matter | 61 | 35 | 4 | 0 | 0 |
| 9 The instructors maintained an atmosphere of good feeling in the class | 60 | 32 | 4 | 1 | 0 |
| 10 The instructors gave individual attention to students in the class | 57 | 39 | 4 | 0 | 0 |
| 11 The instructors were well organized and prepared for each session | 36 | 37 | 20 | 6 | 1 |
| 12 The amount of work required was appropriate for the credit received | 33 | 47 | 15 | 5 | 0 |
| 13 The amount of work outside class was appropriate | 27 | 50 | 16 | 7 | 0 |
| 14 Course material was effectively presented with the team teaching approach | 47 | 43 | 7 | 3 | 0 |
| 15 Instruction was well-coordinated among the team members | 38 | 42 | 15 | 3 | 2 |

Table 2: Post-sessions Evaluation Survey (N=136)

about the level of information they received in the project, its effectiveness on their ability to judge student work and other aspects of their involvement in the project. The survey also provided us with information about the general conduct of the workshop portions of the project.

The responses to the 15 questions were clearly very positive. Teachers acknowledged that the purposes for the program were satisfactorily met, and they were also generous in their praise for all elements of the program. In fact, the only negative responses made were in relation to the delay in finalizing the requirements set for the participants to earn college and in-service credits.

ISSUES FOR FUTURE CONSIDERATION

Preliminary analysis of the data indicates that different issues arose for each of three distinct groups involved in the project: (1) teachers who participated, (2) university and college faculty who led the mathematics activities and assisted in the other activities, and (3) DOE members who facilitated group assessments of students work and the development of tasks, and assisted in the mathematics activities.

For the university faculty the major concern that emerged in numerous conversations with different teachers was the relatively limited knowledge that they revealed of important mathematics topics like statistics and probability, which are now more strongly emphasized in elementary mathematics curricula. On the positive side, however, many teachers showed a great deal of interest in and enthusiasm for learning more about these concepts. They were very willing to take ideas into their classrooms and to try them out with their students. Teachers' comments showed that they

understood that the instructional approach taken in the workshops was appropriate for them to adopt in their own teaching. Nevertheless, university faculty were troubled that a small number of the teachers saw little point in developing their own understanding and knowledge of mathematics beyond the specific topics that they were required to teach to children.

The single greatest concern that we, the university faculty, took from the project is the need to clear up a mistaken impression we heard over and over again. It appears that many teachers and administrators are interpreting the standards as providing the curriculum, and that this curriculum is to be a standardized curriculum everywhere in the state. This is not the intention of the group responsible for developing the mathematics standards. Our intention is made explicit in the language used to articulate the standards. Each school is to use the standards as a starting point for making its curriculum choices—therefore the call is for standards-based curricula, it is NOT a call for standardization of curricula. Such a call is inappropriate in a state with such diversity of areas and diversity of needs as ours.

The major issue for the participating teachers was that this project was merely a first step in helping them to prepare for implementing standards in mathematics. They appealed for continuing professional development support that involved greater levels of participation and intensity of instruction than is currently available. They felt that teachers who were unable to participate, for whatever reason, in similar projects would be disadvantaged in their implementation attempts. Teachers also expressed concern about the issue of student management in activity-based programs and how to engage students in such programs. Another ongoing concern for the teachers was whether the standards contained realistic expectations for all students. On the other hand, teachers strongly approved of the opportunity to work together for long periods of time, and felt that similar amounts of time would continue to be needed. Another issue mentioned frequently was that this in-service experience related only to mathematics, and teachers have nine other content areas to adapt to the new standards and few planned professional development opportunities.

While the DOE staff were able to collect a very large number of exemplars of student work for which teachers wrote commentary supporting their judgments, and commenting on precision of assessment, there remains the very real challenge for teachers in learning how to judge the quality of both the task used with students as well as determining the quality of their students' responses. These are issues for which no clear resolution came from this study. It may well be that these issues will require much time and energy to be devoted in further professional development.

This project made an important beginning in providing much-needed professional development support for a

relatively small numbers of teachers in our state. It demonstrated the kind of intensity of instruction needed to bring about standards-based reforms. It also highlighted the need for a much more concerted, state-wide professional development effort to ensure that all teachers are equipped to adapt their teaching and curriculum to the new standards.

REFERENCES

- Hawaii Department of Education. (2000). *Hawaii Content and Performance Standards II—Mathematics*. Honolulu, HI: State Department of Education.
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