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SENIOR PROJECT

"The Standards for Teaching Mathematics"

Wendy Moon

Spring 1995

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Having read and studied the Professional Standards and Curriculum and Evaluation Standards for Teaching Mathematics compiled by the National Council of Teachers of Mathematics, I am aware of the established standards for math teachers, their students, the math curriculum, and the learning environment. In addition, I have witnessed math instructors carrying out such standards while observing at Oak Ridge High School, visiting the university seminar for women in mathematics, and reviewing the Smoky Mountain Mathematics Educators' Association newsletter. In this paper I will summarize the established standards for math teachers and make comparisons between the written text and the actual examples I observed from math instructors in action.

The set of Curriculum and Evaluation Standards for math teachers has been adopted for the following reasons: to ensure quality, to indicate goals, and to promote change (2). Because I am aware of these standards, I have a better understanding of the characteristics of quality math instruction, goals I should have for my future students, and the changes that are currently being promoted in mathematics instruction. I have chosen to elaborate on three aspects of the established standards for teaching mathematics: (1) the shift pertaining to (a) the teacher's role in instruction, and (b) the math curriculum, (2) the characteristics of effective student-teacher discourse, and (3) establishing a quality learning environment.
In order for quality math instruction to occur in the classroom, there should be a shift in the teacher's role in instruction as well as a shift in curriculum goals. Traditionally, the teacher has dominated the class lecture, and the students have been responsible for receiving the information presented to them. However, in the *Curriculum and Evaluation Standards* for grades 9-12, the established standards "require the teacher's role to shift from dispensing information to facilitating learning, from that of director to that of catalyst and coach" (128). Traditional teacher demonstrations and teacher-led discussions should be supplemented with "small-group work, individual explorations, peer instruction, and whole-class discussions in which the teacher serves as a moderator" (128). I have witnessed evidence of such a shift in the teacher's role in instruction while observing at Oak Ridge High School. There the students meet for "math lab" three times during every nine-week grading period. The students collaborate to complete the lab, which consists of calculus application problems. The teachers present, Mrs. Benita Albert and Ms. Phyllis Hillis, "coach" and monitor the students, giving assistance as needed. In addition, the text describes "a new classroom dynamic in which teachers and students become natural partners" (128). Such a partnership is modeled by Mrs. Albert by her requiring students to sign student-teacher contracts that signify their agreement on classroom policy, rather than her dictating the rules. By shifting the role of the teacher from a dictator to a facilitator in the high school classroom,
the students' curiosity for the subject of math and their independence as learners can flourish. Thus the goal of math instructors to "encourage students to become self-directed learners who routinely engage in constructing, symbolizing, applying, and generalizing mathematical ideas" can be obtained (128).

The shift in the teacher's role in math instruction should be accompanied by a shift in the features of the curriculum that are emphasized. Rather than teaching math as an isolated subject and accumulating memorized individual math skills, the curriculum should integrate math skills with other subjects and teach students to combine "a variety of mathematical methods effectively to solve nonroutine problems" (5). In the September 1994 edition of the Smoky Mountain Mathematics Educators' Association Newsletter, Leslie Howe states that "a goal of all educators" should be to "work to integrate their specialty with other disciplines." In an effort to prevent math students from having "compartmentalized minds," she argues that math teachers should "put our mathematics in its philosophical and historical context," while relating "math and science; math and music; math and art. It's good for our minds." During the seminar held at UT to honor women in mathematics, I witnessed that Dr. Lenhart chose female mathematicians to describe their work with population censuses and AIDS research to the high school students, thus integrating math with other subjects. In addition, the Curriculum and Evaluation Standards text advocates a curriculum that "emphasizes conceptual understandings, multiple
representations and connections, mathematical modeling, and mathematical problem solving" rather than stressing "memorization of isolated facts and procedures" (125). Such a shift in curriculum emphasis will create math students who are more well-rounded scholars with a better understanding of the application and importance of mathematical ability.

The second aspect of Professional Standards for Teaching Mathematics which I saw effectively modeled at Oak Ridge High School involves the use of student-teacher discourse. It is interesting as well as beneficial for me as a future teacher to observe the different styles of classroom discourse. Experience and intuition have helped me to imagine how to effectively relate to students; however, reading the Standards text has confirmed why I trust such approaches. I noticed how Mrs. Albert made an attempt to include every student in class discourse, monitored her pace in order to alleviate the puzzled expressions on a few students' faces, and used her knowledge of each student's interests to present the material in a manner that each student could relate to. The Standards text explicitly states that "the teacher's role is to initiate and orchestrate this kind of discourse and to use it skillfully to foster student learning" (34). The text describes another feature that I observed Mrs. Albert using effectively: "Instead of doing virtually all the talking, modeling, and explaining themselves, teachers must encourage and expect students to do so. Teachers must do more listening, students more reasoning" (36). By encouraging student participation, relating to the students'
individual interests, monitoring their responses, and serving as an active listener, the math teacher can use discourse to "draw the students in" and engage them in worthwhile mathematical activity.

Finally, I will elaborate on establishing a quality learning environment as proposed in the Professional Standards for Teaching Mathematics. Although each teacher creates a unique learning environment in his or her classroom, the text points out that every teacher should inhabit a learning environment that "fosters the development of each student's mathematical power" (57) and personal self-confidence. The first step that a teacher can take to establish such a learning environment is to "set high, but reasonable, expectations for all students" (Curriculum and Instruction Standards 124). High expectations encourage students and allow the teacher to portray confidence in the ability and potential of each student.

In addition, the Professional Standards text outlines characteristics of an effective learning environment on page 57. The importance of an encouraging learning environment is stated. I detected the attitude Mrs. Albert portrays to her students which implies, "You can do it, it's not that hard." She demonstrated that she has high expectations for her calculus students while explaining a particular problem: "This question is often missed on AP tests, and I don't know why." Thus she encouraged her students to believe that they were competent and would not be tricked by questions that would stump other students. Likewise, Mrs. Albert encouraged them by complimenting
individual students at appropriate times. She acted pleased when a student responded correctly and encouraged the student by allowing her the opportunity to display her competency to the class: "Back up, Amanda, and tell the class where you got that in your head!" Also, the text proposes that the teacher should foster an effective learning environment by "respecting and valuing students' ideas, ways of thinking, and mathematical dispostions" (57). Mrs. Albert displayed respect and high expectations for her students' mathematical pursuits. In one instance, she gave them a new math formula on the board without first deriving it, and she commented, "I just handed it to you; that should be most unsatisfactory!" She proceeded to derive the proof and thus satisfy her students' math curiosity.

In addition to the verbal encouragement and respect shown to the students, I also witnessed how Mrs. Albert arranged and decorated her classroom to provide a cooperative and supportive learning environment. She arranged the seats in a way that allowed the students to look at each other as well as at the board, thus accommodating for more interaction and collaboration. Furthermore, I noticed that past students had created banners to commemorate their winning the state math contest. Thus Mrs. Albert effectively used her learning environment to be supportive, cooperative, respectful, and encouraging. Such an environment is crucial in spurring students to take intellectual risks. The goal of a math teachers should be to foster
an environment that encourages students to explore, formulate and test conjectures, prove generalization, and discuss and apply the results of their investigations. Such an instructional setting enables students to approach the learning of mathematics both creatively and independently and thereby strengthen their confidence and skill in doing mathematics (Curriculum and Evaluation Standards 128).

In summary, I would like to emphasize that reading the standards proposed by the National Council of Teachers of Mathematics and observing the teachers at Oak Ridge High School has been worthwhile and beneficial to me as a future math teacher. The text and the example of the teachers have confirmed ideas that I had about effective teaching, as well as spurred me to consider how the role of the teacher and the presentation of the math curriculum is being reformed. By analyzing in depth the shifts in the teacher's role and the curriculum emphasis, the use of effective student-teacher discourse, and the mechanics of establishing a quality learning environment, I have obtained a better understanding of the standards that I should set for myself in how I operate as a teacher and present mathematics to my future students.