A MODEL FOR FACULTY COLLABORATION IN PREPARING VIRGINIA'S K-8 TEACHERS

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The overall goals of the Virginia Standards of Learning (SOL) [1] are for students to become good problem solvers and communicators about mathematics, to reason logically and to make connections within mathematics and to other disciplines such as in solving science problems. Unfortunately, the beliefs about teaching of many preservice teachers are not consistent with the these goals. Furthermore, the college mathematics courses experienced by preservice teachers are generally in contrast to these goals. This study outlines a collaborative effort of three colleges to encourage faculty to adopt a more student-investigative style of instruction. A planning team offered a semester of workshops in which professors experienced student investigations, critiqued them, and were encouraged to try them in their classes. The data gathered from this study suggest there was success toward changing the beliefs and instructional practices of the professors to be more consistent with the stated Virginia overall goals for students.

The Virginia Mathematics Standards of Learning (SOL) outline specific goals for students at all grade levels as follows: (1) to be creative problem solvers, (2) to be good communicators about mathematics, (3) to reason logically, both inductively and deductively, and (4) to make connections among ideas within mathematics and to other disciplines, i.e., in solving science problems. These are the same goals of the *Curriculum and Evaluation Standards for School Mathematics* [2] and are representative of the current reform movement in mathematics education. Unfortunately, the beliefs of students preparing to be mathematics teachers are frequently in sharp contrast to the reform goals [3]. It has been widely reported that teachers tend to teach as they were taught. It would seem that the traditional instructional models prospective teachers have experienced as students have quite naturally influenced their beliefs about the nature of mathematics and the role of the teacher. A challenge for the reform movement has been how to break this cycle of sameness in mathematics teaching.

Most of the reform efforts have been directed toward K-12 teachers by means of summer institutes, workshops, conferences, etc. However, the most recent teaching the prospective teacher has experienced is at the college level. It is proposed that mathematics teaching at the college level is a vital and timely opportunity to influence prospective teachers' beliefs and

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goals for teaching mathematics. However, changing college and university teaching proves to be a challenging situation. Many professors have had little or no training in theories of teaching and learning and have scant familiarity with the goals of the mathematics reform movement.

The concern is how to impact a change in mathematics teaching and learning along the lines of the reform goals at the university and college level. There have been some summer workshops for college and university teachers such as Project Prompt at Humbolt State University, California. Another avenue for reform has been the adoption of reform-style texts and curriculum materials such as the "lean and lively" Harvard Calculus. While these efforts are experiencing some success, they are affecting only a small percentage of college mathematics instruction. Professors frequently simply decline to attend reform workshops or to use reform texts and materials. It appears that the source of the problem is due to the lack of many professors' belief in the reform goals and consequently their continued use of traditional pedagogical methods (Larry Sowder, personal correspondence 1997). In contrast to the K-12 teacher who is generally more influenced by school district or school board decisions concerning teaching goals and curriculum materials, university teachers generally have a great deal of autonomy concerning their teaching style and choice of texts and materials and can effectively avoid involvement or influence of the reform movement.

Methodology

To investigate how beliefs of university mathematics instructors might be changed to posit more value to the goals of the reform movement, a collaborative of three local universities/colleges in a large metropolitan area was established. With the support of the National Science Foundation, a planning team of four persons from the three institutions met for a year to discuss pertinent literature, establish common goals, and make a specific plan for engaging colleagues at the three schools. The team decided to use a model similar to that espoused by Carne Barnett [4] calling for frequent discussions among mathematics teachers.

The planning team wrote and tested sixteen student investigations which used cooperative learning groups and emphasized active student involvement and development of major concepts. They also included student communication through reflections and discussions. The mathematics professors at the three institutions who taught preservice K-8 teachers were

invited to attend the workshops of interest to them. The intent was to have the professors experience each activity somewhat "as a student" and then to discuss and critique the effectiveness of the activity and suggest how it might be altered for a particular course or improved. The professors were encouraged to use the activities in their current courses and give further feed-back to the group. The participants were given a token stipend for their efforts. A series of seventeen workshops were held during Spring '97 with about fifteen participants and the four planners.

Baseline data from an "Instructional Practices Scale" consisting of 21 items was collected from seven participants at the beginning of the series and from twelve participants at the end of the work-shop series, as several participants did not fill out the initial form. Means of the available data for each question was generated on the pre and post survey. In addition, a short open response follow-up survey (six questions) was sent out after the workshop series. There were eleven surveys sent with nine replies.

Results and Implications

There were generally about 7-8 participants at most workshops. The sessions were consistent with the findings of Barnett in that the discussions were lively and comments centered around the mathematical ideas and how to engage students to think about them in substantive ways. The Instructional Practices Scale included eight questions pertaining to the emphases of the workshops with results as indicated in Table 1. For each area of emphasis of the workshops, the change was in the desired direction. However, this is only a rough indicator since matched pairs of data do not exist for all participants. Further statistical analysis, additional follow-up data, and possibly visits to the participants classrooms are suggested to verify if beliefs and practices were significantly changed.

The results of the open ended survey were extremely positive with almost all participants stating the workshops as "very beneficial" or "good benefit." The question "Did these meetings encourage you to continue using or to begin to use student centered activities in your teaching of mathematics?" resulted in eight replies of "yes" or "indeed yes" and one reply of "continue."

Table 1. Questions of Workshop Emphases

Scale: 1 never 2 seldom 3 sometimes 4 often 5 very frequent

How frequently do you use each practice?	pre	post	delta
Active involvement of students	3.79	4.42	+0.63
Small group cooperative learning	3.57	3.75	+0.18
Problem solving as means and goal	4.00	4.33	+0.33
Student communication, orally	3.57	3.67	+0.10
Student communication, written	3.43	3.50	+0.07
Hands-on manipulatives	2.86	3.17	+0.31
Class discussions	3.71	3.92	+0.21
Activities focus on the whys and hows	3.29	3.91	+0.62

The survey on benefits of the workshop include: new approaches to ideas, very interactive, excellent collegiality, reinforcing teaching goals, getting enthusiastic, make changes for next semesters classes, "actually having time to play with the materials, sharing techniques and materials," "discussing what doesn't work," "practicing with a group led to lots of discussion and possible solutions." The replies to "Other comments?" included: It was a great experience! Thank you so much for including me on the committee; just the time we had "chatting" was so valuable, ... inspirational. Thanks! Several of the participants used some of the student-centered activities in their courses immediately and reported the results back to the group with great enthusiasm. At least two of these persons had almost never included these types of activities in their courses in the past. Many asked it we were going to have the sessions again the following semester.

While the idea of getting college teachers together to discuss teaching ideas may sound quite simple to effect, the actual planning and work took place over several years and required a large amount of time, reasoning, and commitment by the planning team. The basic outline of the plan is as follows:

(1) Develop a cohesive and unified leadership team over a year or more.

(2) The team jointly develops and tests student investigations with reform goals for students

for college level courses.

(3) Faculty are encouraged to attend 2-4 workshops per month for a semester.

(4) Workshops have participants experience an activity and then discuss and critique it and the team later provides a revised version.

(5) A team member leads each workshop, maintaining a positive, constructive, and focused discussion with the comments of each member respected and valued.

(6) Participants are encouraged to try the activities in their classes and to share results with the group and to share their own "student centered" curriculum materials with the group.

These data suggest that this workshop process of discussing curriculum materials which illustrate student investigations, cooperative learning groups, active student involvement, and the development of major concepts was beneficial for these college professors. The workshops were led alternately by the four members of the planning team, several of whom had no prior experience leading such sessions. We suggest that the success was due to the process and not the individuals on the planning team. It is suggested that similar workshops for university and college teachers might change beliefs and teaching practices along the lines of the reform movement. The end result would hopefully provide preservice teachers with college instruction in mathematics which models reform teaching and which would encourage them to adopt the goals of the Virginia Mathematics SOLs, i.e., students become creative problem solvers, good communicators, use logical reasoning and be able to make connections within ideas of mathematics and to other disciplines. ■

References

[1] *Standards of Learning for Virginia Public Schools*, Board of Education, Commonwealth of Virginia, Richmond, VA, 1995.

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[3] B. F. Risacher, "Beliefs of Students Intending To Be Teachers: Elementary Versus Secondary," *Proceeding of the Eighteenth Annual Meeting of the Psychology of Mathematics Education, NA* 2 (1996) 383-388.

[4] C. Barnett and S. Sather, *Using Case Discussions to Promote Changes in Beliefs Among Mathematics Teachers*, Paper presented at the Annual Meeting of the American Education Research Association, San Francisco, CA, 1992.