

RAPPORTEUR'S REPORT

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The agenda for the Statewide Conference places a number of important challenges for Virginia's colleges and universities on the table. The new licensure requirements in the areas of mathematics and science for prospective K-8 teachers represent a major, and very much needed, change in current practice. It will be extremely difficult for those of us in the science, mathematics, and education departments to make the necessary changes to respond to this challenge.

This report will attempt to measure the magnitude of the changes needed to produce the requisite numbers of adequately prepared teachers, the extent to which individual colleges and universities have begun to respond to this challenge and our collective capacity to respond to this challenge.

I have found these two days to be highly productive. I welcome the opportunity given to me to give the "Rapporteur's Report" summarizing where we are as we leave this Conference.

As reported by Patty Pitts, Associate Director of Teacher Education and Licensure of the Virginia Department of Education, the Virginia Board of Education has done a great service by clearly stating greatly enhanced science and mathematics expectations for early/primary, elementary, and middle education teacher licensure. The mathematics and science requirements for future elementary school teachers will no longer be the same as the minimum requirements for other humanities majors. Middle school teachers may no longer be certified to teach science and mathematics based upon a general middle school certificate earned by virtue of competence in language arts and social science.

TWO CHALLENGES

The new expectations from the Virginia Board of Education are clear:

1. Future elementary teachers must meet specific competencies in mathematics and science; approved programs must demonstrate that these competencies are met. (Individuals seeking licensure through the alternate route must complete 9 hours each of mathematics and science for PreK-3 endorsement and 12 hours each of mathematics and science for PreK-6 endorsement).

2. Future middle school teachers must either complete 6-12 endorsement which requires majoring in their area of endorsement or complete the middle school endorsement which requires a concentration in the areas that they will teach. *Teachers will no longer be permitted to teach mathematics or science unless they have completed an area of concentration in mathematics or science, respectively.*

The need to develop courses and programs to prepare adequate numbers of future teachers who appropriately meet these licensure requirements presents two major challenges to Virginia's colleges and universities.

It has been apparent throughout this conference that there is universal agreement that future elementary and middle school teachers must have strong academic backgrounds in the areas that they will teach. In reporting on the results of the international TIMSS study, Donna Sterling of the George Mason Graduate School of Education, provided clear evidence that the type of effective teaching that will improve the performance of American students requires that teachers have strong disciplinary background and a deep conceptual understanding of the topics they teach. This agreement provides an important foundation on which to build.

However, we have a long way to go. As Conference Director and University of Virginia Professor of Physics, Steve Thornton, stated, increased science and mathematics teaching licensure requirements are clearly necessary to prepare teachers to appropriately teach the new Virginia SOL. In addition, he stated that "most Virginia colleges and universities are not currently offering the appropriate courses, nor courses taught in the appropriate manner, to meet licensure requirements. Teaching all of the mathematics and science required within even the number of credits indicated by the alternate route guidelines will prove to be very difficult. Both interdisciplinary courses and interdisciplinary programs will be needed."

Jerry Benson, Dean of the College of Education and Psychology of James Madison University, reiterated the view that the sophistication and understanding of science and mathematics that is needed at both the elementary and middle school level is indeed substantial. He emphasized the key role of faculty from the disciplines and challenged us to "think of yourself as one of the most powerful pedagogical models for future teachers - model effective instructional strategies". He also urged those in education to reach out and

effectively involve arts and science colleagues in co-supervising of student teachers, in integrating education methods courses with content courses, and participating in other ways in the preparation of teachers. However, he also cautioned how difficult it will be for teacher preparation programs to require the number of credits in mathematics and science indicated by the guidelines, particularly in the light of all of the other needs of future teachers and the push for a reduction in credit hours for a degree.

GOOD NEWS

The good news from this conference is that many Virginia colleges and universities are responding in exciting ways to the challenge of developing and offering appropriate courses and programs that meet the spirit of the new Licensure requirements.

Programs Preparing Elementary Teachers in Mathematics and Science:

- Longwood College, through its Liberal Studies Program, requires all future elementary teachers to complete 31 credits in mathematics and science;
- Lynchburg College requires all prospective elementary teachers to complete 22 hours of mathematics and science;
- Virginia Commonwealth University requires all future elementary school teachers to complete a total of 27 hours of mathematics, science and methods courses including one interdisciplinary mathematics/science course and 6 hours of mathematics/science methods.

Appropriate Courses for Future Elementary and Middle School Teachers

- Norfolk State University offers future teachers an interdisciplinary mathematics and science course organized around broad themes and featuring long-term student projects;
- Virginia Tech preservice teachers are excited about their own experiences with an investigative approach to learning mathematics, and are thereby better prepared to provide their students with comparable experiences;
- Radford College is offering a new interdisciplinary physical science course that expects

students to be actively engaged in observation, data gathering, and analysis;

- Hampton University has developed a science seminar for students in their Masters in Teaching program that allows students to share their particular expertise with students from other majors;
- Mary Washington College has developed a geology sequence, taught in a non-traditional discovery oriented style, with an emphasis on collaborative learning in a variety of field settings;
- Virginia Union University faculty are emphasizing experimental design, handling data, and the scientific method for elementary school teachers who find teaching science difficult;
- Mary Baldwin College has developed "Inquiry in Mathematics" that addresses future teacher's attitudes and dispositions, and their beliefs and conceptions of mathematics itself;
- Science and mathematics methods courses are taught in consecutive hours at the College of William & Mary so that the concept of simultaneously teaching appropriately selected mathematics and science topics can be stressed;
- Faculty at the University of Virginia are exploring ways to incorporate more mathematics and science in the culminating field project/thesis experience that is required of future elementary school teachers;
- Faculty from Northern Virginia Community College have developed innovative ways for classroom to teachers to both increase their content knowledge and develop curriculum units;
- Faculty from community colleges across Virginia are accepting the responsibility that they share for the recruitment and preparation of future teachers.

Programs Preparing Future Middle School Teachers

- Virginia Commonwealth University has developed an interdisciplinary science degree that includes concentrations in both mathematics and science, providing the breadth required to teach middle school mathematics and science;
- Science and mathematics faculty at the University of Virginia are exploring the possibility of an interdisciplinary degree in mathematics and science, particularly appropriate for future middle school teachers;
- Longwood College is considering the addition of an add-on middle school endorsement that would build upon the mathematics/science required in the Liberal Studies program, and simultaneously provide students with a masters degree and an additional middle school mathematics and science endorsement.

There is indeed a lot of good news. Five years ago the programs described above that require significant mathematics and science for all future teachers did not exist, and there were very few courses of the type described. We still have a long way to go to respond to the new licensure requirements, but change and enthusiasm and many models do exist in Virginia.

WHAT'S IN THE AIR AT THE CONFERENCE?

When Steve Thornton asked me to serve as Rapporteur, he asked me to report on a sense of what "is in the air". The two themes that I heard most often were the *need for interdisciplinary courses and programs* and the *importance of collaboration between education and science/mathematics faculty*. These two themes were stressed in the plenary talks, and the course work described in the concurrent sessions also reflected these themes. In addition, Robert Watson, long time director of the Division of Undergraduate Education of the National Science Foundation, highlighted each of these themes in his presentation.

Need for Interdisciplinary Courses and Programs

There are many substantive scientific and pedagogical reasons why interdisciplinary courses and programs are important. Most of the reasons center around the fact that public policy issues do not present themselves as disciplinary situations, but rather involve quantitative reasoning and aspects of many scientific disciplines. Most topics of interest and importance to students and to members of the public involve many scientific disciplines; e. g.

the environment, space exploration, sources of energy, the human body. As Robert Watson reported, "the most important work in science is going on increasingly at and across the interfaces of the traditional disciplines." He proposed that "the preparation of all future elementary teachers contain an interdisciplinary emphasis encompassing all the sciences including mathematics and that middle and high school science and mathematics teacher's training be largely interdisciplinary in nature as well."

However, as Rapporteur, I must report that most of discussion around the need for interdisciplinary courses and programs centered around the more prosaic question of how to meet the new Licensure requirements. In particular, Longwood College's interdisciplinary major in Liberal Studies attracted great attention since it provides a way, within a four year program, to meet and exceed the number of credits now required for licensure, while also permitting future teachers to learn about human development and cognition and instructional strategies.

The interdisciplinary courses described at the Conference, including *Experiencing Science*, developed and offered through the Science Museum of Virginia, were of great interest since they seem to many to provide a way to cover all of the different science topics described in the Standards of Learning within the 12 hours of mathematics and 12 hours of science that is the guideline for the PreK - 6 license.

University of Virginia Education faculty discussed the possibility of having the Capstone Field Project/Thesis Experience required of all students be used by some students to fulfill a portion of their science requirement. The idea of having students simultaneously gain a strong understanding of science and mathematics and develop the needed content pedagogical knowledge was stressed throughout the meeting.

Importance of Collaboration Between Education and Science/Mathematics Faculty

Jerry Benson set the tone by emphasizing the need for collaboration and issuing the invitation: *Let's Dance*. Robert Watson continued the theme by noting that, at the national level, "the norm even at traditional teacher training institutions is more nearly that of armed camps and fortress mentalities, than collaboration."

Perhaps in some institutions, mathematics/science faculty believe that education faculty care only about education and methods courses, and do not think it is necessary for teachers to have a real understanding of the subjects that they teach. Perhaps in some colleges and universities education faculty think that mathematics/science faculty are only interested in providing lecture courses filling the notebooks of students with facts and theories of interest primarily, if not exclusively, to future science and mathematics Ph.D. students. As was clearly demonstrated at this Conference, such views are not prevalent in Virginia!

Indeed, I think that we are prepared to respond to Jerry Benson's invitation to dance, and that we have the makings of a "statewide deal":

- Education Schools will support the development of programs in which students will complete significantly more credits in science and mathematics and be well prepared to teach the topics called for in the Virginia Standards of Learning;
- The science and mathematics faculty will make a renewed commitment to model high quality instruction, including student collaboration, long-term projects and the appropriate use of technology;
- The entire university will consider flexible interdisciplinary degree programs comparable to those being currently offered by Longwood College and Virginia Commonwealth University, and courses will be collaboratively developed that simultaneously meet many needs of future teachers.

RESPONDING TO THE TWO CHALLENGES

As we leave this conference, I am optimistic about the capacity of those of us who attended this conference to respond to one challenge and pessimistic about our ability to respond to the other.

The first challenge concerns future elementary school teachers and our responsibility to appropriately prepare future elementary school teachers. I am convinced that we will do this. It will require a lot of hard work and good will. We also need the firm commitment of the

Virginia Department of Education in those cases where an institution has not made a serious commitment to addressing this new challenge. The restraints of the total number of credit hours is real, but with the introduction of interdisciplinary majors or other creative approaches, the offering of creative courses, and the willingness of all of us to work together across institutional boundaries, we can succeed.

The second challenge concerns future middle school teachers. Here, the problem centers on the provision of enough teachers to meet the demand. The results of a study by Julius Sigler (see [1]) said it all:

Number of new middle school mathematics/science teachers needed by Virginia School each year, under most optimistic assumptions	150
Annual number of graduates of all Virginia colleges and universities combined who are preparing to teach middle school mathematics/science	15

Of course, it is possible that middle school teaching positions could be filled by individuals who are preparing to teach at the high school level. Unfortunately, with the large shortage of high school science and mathematics teachers, most systems will not be able to recruit teachers from this source.

Other evidence of this situation is provided by a survey currently being conducted on behalf of the Virginia Mathematics and Science Coalition designed to determine the background of those currently teaching in Virginia. The preliminary data confirm our conjecture that most middle school mathematics and science teachers did not initially prepare to teach these disciplines as part of their undergraduate training. According to preliminary data, only 25% of the individuals currently teaching mathematics in middle schools completed the equivalent of at least a 21 hour concentration in mathematics. Even more problematic is the indication that 55% of these teachers studied 12 hours or less of mathematics as undergraduates.

I have become more and more convinced by data provided by TIMSS and other studies

and by discussions of experts across the country that the middle school years are the times when large numbers of American children begin to be unsuccessful in mathematics and science. In order to reverse this failure, we need teachers who are well prepared and committed to providing engaging and effective instruction at this level.

I am concerned about our ability to meet the challenge of preparing sufficient numbers of qualified individuals. The Schools of Education must develop and enhance programs within their institutional structure to prepare their "fair share" of future middle school mathematics and science teachers. Schools of Arts and Sciences and their mathematics and science faculty must develop attractive and appropriate courses and programs for future middle school teachers.

Further, we will need the support of the State Council of Higher Education, the Department of Education, university administrations, local school boards, and the public to provide the resources to recruit and retain these future teachers in our programs. Such support includes higher salaries for teachers, more forgivable loans for future teachers in high need areas, and a climate that encourages the type of interdisciplinary, student oriented instruction that is needed.

SUMMARY

Overall, I leave this Conference confident that we can take advantage of this great opportunity provided by the Virginia School Board. We can prepare and place individuals in elementary school classrooms with significantly stronger backgrounds in mathematics and science. Making the necessary changes will indeed take the whole university working together.

I look forward to working with all of you in the coming months and years. I can assure you that the Virginia Mathematics and Science Coalition will continue to work to assure that high standards are in place for future teachers and that support for this activity is provided statewide. I hope that many of you will be able to accept the invitation to participate in the Colloquium sponsored by the Virginia Collaborative for Excellence in the Preparation of Teachers to be held July 14-16, 1999 at Mary Washington College. I know that all of us will continue to work to assure that our classrooms provide the best environment for effective

student leaning and that our programs attract talented future teachers with an interest in children and in mathematics and science. ■

Reference

- [1] J. Sigler, "A Preliminary Analysis of the Supply and Demand for Middle School Mathematics and Science Teachers in Virginia", *The Journal of Mathematics and Science: Collaborative Explorations* 2(2) (1999) 53-64.