

COLLABORATIVE EFFORTS TO ENHANCE AND STRENGTHEN TEACHER TRAINING IN MATHEMATICS AND SCIENCE

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J. Sargeant Reynolds Community College (Reynolds) has a rich history sponsoring and being involved in a variety of activities focusing on the preparation of K-12 teachers. Described in this article are the different collaborations that Reynolds faculty initiated or in which they participated. Mathematics and science course content was first highlighted through collaboration with discipline faculty at nearby Virginia Commonwealth University (VCU). More recently there was intense participation with several other two-year and four-year colleges in a National Science Foundation (NSF) funded urban collaborative grant, extending for five years. This collaborative will soon begin the third year of its enterprises. In addition, Reynolds faculty received funding and provided several highly successful Eisenhower professional development activities for in-service teachers. The authors are faculty members at J. Sargeant Reynolds Community College and are writing on behalf of the collective efforts of about 15 faculty members from that institution. Both Ms. Jovanovich and Ms. Turbeville have been actively involved in many of the efforts described below, helping Reynolds become the most active community college in Virginia's collaboratives for teacher preparation.

Through these courses and collaborative efforts, Reynolds hopes to enrich the training of in-service and pre-service teachers and to broaden teachers' bases of knowledge in these disciplines. Reynolds faculty recognizes that many in-service teachers are insecure in their understanding of and ability to convey knowledge of mathematics and science. This training will provide future students with more enthusiastic teachers and hence better training for the students in math and the sciences. Furthermore, these more enthusiastic role models may help recruit future teachers.

Liberal Arts Mathematics Course

On its three campuses, Reynolds serves a diverse student body of more than 15,000 students annually from nearby urban, suburban, and rural areas. More than 30% of

Reynolds' student body is composed of minorities who are traditionally underrepresented in mathematics and science. More than 75% of the college transfer students enrolled at Reynolds plan to transfer to VCU, which is within three miles of Reynolds. In a collaboration which began about six years ago, Ms. Turbeville together with a VCU professor developed and piloted a new contemporary mathematics course for liberal arts students, many of whom are prospective elementary school teachers. Topics covered in the course include polling methods, networks, fair division, voting, and population growth.

The two instructors used team teaching to develop and present the innovative course, which included writing assignments and group project components and alternative assessment techniques. Because both instructors were concerned that any negative attitudes about mathematics of future teachers might be transferred to their future classrooms, developing an improved attitude toward mathematics was a key emphasis for the course.

VCU currently offers this course to all liberal arts majors, including elementary education and non-mathematics and non-science secondary education majors. The course is in place at Reynolds and students completing the course may successfully transfer the credits to VCU.

Virginia Collaborative for Excellence in the Preparation of Teachers (VCEPT) Participation

As a direct result of the successful collaboration for the contemporary mathematics course described above, Reynolds and VCU joined with five other two- and four-year institutions in a large-scale effort to improve the mathematics and science backgrounds of K-8 school teachers. National Science Foundation (NSF) funding of an urban collaborative grant is providing an opportunity for students, public school teachers, and college faculty to meet and discuss the development needs of the K-8 classroom teacher. As a result of this communication, college instructors can best design courses to equip future teachers in the teaching skills they need, to enhance future teachers' confidence in tackling the mathematics and science content of the K-8 curriculum, and to provide a solid foundation in their own content knowledge.

Ms. Turbeville serves as a member of the VCEPT Steering Committee and as chair of the mathematics course development team. Through this collaborative, mathematics and science

content courses and methods courses are being designed and field-tested to model best practices in teaching. The Reynolds mathematics and science faculty have been active members of many of the grant's course development teams, helping with the design of course activities. These "model" courses are showcased and taught during a Summer Institute. During 1997, three Reynolds faculty members were part of the teaching teams of the Summer Institute. It is hoped that these general education courses, which are taken by students with majors other than education, will also serve as a recruiting tool for more K-8 teachers.

During the spring semester of 1998, Reynolds initiated plans for a "teaching apprentices" program where prospective teachers are paired with a senior faculty member in a mentoring relationship. The teaching apprentice "adopts" a course, observes classes for modeling of best practices, "shadows" the instructor to learn about lesson preparation and design, and learns about one-on-one teaching by offering a weekly problem session for the class. The teaching apprentices are also invited to attend campus professional development activities, such as graphics calculator workshops.

Summer Colloquium

Reynolds assumed major planning and hosting responsibilities for the 1997 Summer Colloquium of VCEPT. As the colloquium coordinator, Ms. Turbeville lead a team of representatives from the VCEPT Collaborative, the Virginia Mathematics and Science Coalition, and the regional Mathematics and Science Center. Attended by about 125 teaching apprentices, clinical faculty, and college faculty, the three-day colloquium offered informative sessions on science, mathematics, and technology and hosted meetings of various disciplinary and interdisciplinary course development teams. The Clinical Faculty and Teaching Apprentices Standing Committees, as well as other collaborative committees, met during the Colloquium. A highlight of the colloquium was a scholarship awards ceremony held to recognize selected students, from participating VCEPT colleges, planning to enter the education profession. On a four point scale, four being the highest, the Colloquium received a mean response of 3.5 for "increased my motivation to try new teaching strategies," and a mean of 3.59 for " I will be likely to share Colloquium ideas with my colleagues during the coming year."

Experiencing Science Course

Another activity housed within the urban collaborative is the design and delivery of a three-credit interdisciplinary science course called *Experiencing Science* offered jointly by VCU and the Science Museum of Virginia to freshman liberal arts and non-science majors from both two- and four-year colleges. The course emphasizes a student-centered, investigative approach to learning science based on national science standards developed by a team of two- and four-year college professors from the disciplines of physics, chemistry, biology, mathematics, and education. Course content and assessment methodology were developed drawing upon the expertise of a team of individuals representing various disciplines and institutions including Reynolds.

This course offering is unique because it utilizes the interactive exhibit resources of the Science Museum of Virginia as its primary resource for student activities. Eight to ten primary scientific investigations carried out during class lecture time form the core of the course. Each investigation is led by a team instructor from the appropriate discipline and utilizes museum exhibits, the museum's computer facilities, and other local science resources. Student journals and research notebooks are used as an assessment tool for students and instructors. In addition to team-led investigations, the students work together to carry out an investigation of their own choosing and within the framework of the topics under study. Project results are presented in a symposium format at the end of the course.

Experiencing Science truly enables prospective teachers to experience the entire process of scientific investigation from the origin of the idea to the communication of the results to peers. Students enrolled in the course's first offering represented different area schools; the course was designed so that prospective teachers could replicate the methodology in their own future classrooms. A direct result of this collaboration, two new science courses are being offered at Reynolds. Human Heredity teaches the major principles of science, such as transfer of energy, transfer of information, and inter-relationship of systems, illustrated through genetics. The second course uses scientific inquiry to learn how physics, biology and chemistry are interrelated.

Team-taught Statistics Course

Another area of significant involvement of Reynolds in teacher education under the urban

collaborative umbrella is faculty collaboration on a statistical thinking course. The focus of the course is on understanding key ideas rather than mathematical formulation. Formulas are stated in words and students do very little calculation and table reading in this course.

Ms. Jovanovich was assistant chair of the VCEPT course development team for statistics and was one of the instructors in the team-taught course piloted during the summer of 1997. During the second summer colloquium this was one of the showcased courses, and visitors were able to see first-hand the learning activities of the course and ask questions of the each of the team instructors and the students. The innovative course was designed to produce "consumers of statistics" as opposed to "producers of statistics". Learning activities of the course included:

1. laboratory activities which reinforced ideas presented in lecture. Lab reflections reinforced the main concepts and encouraged specific applications.
2. focus exercises—homework problems that students attempted first and were then discussed in class. Students had an opportunity to revise their responses before submitting them to be graded.
3. class notes which were distributed to the students for reference during lectures. Students were then able to discuss and listen to the lecture and take a few notes as opposed to simply spending the class time taking notes.
4. an electronic statistical reference which was used to illustrate concepts and give students further practice in statistics.

The text used in this course featured thought questions at the start of each chapter that related to chapter topics. Through case studies and examples, it asked readers to think about statistical problems as they occur in the real world.

As a general education course, prospective teachers (non-mathematics/science majors) enroll in this course as part of their undergraduate program. It is hoped that this course will be adapted in the near future for offering at Reynolds and other two- and four-year colleges. Significant benefits were gained from the two-year college/university faculty interaction that focused on statistics.

Eisenhower-funded Geometry Project for Grades 4-8 Teachers

During the summer of 1996, a two-week summer institute entitled *"Bringing Geometry*

to *Life with Activities and Technology in the Mathematics Classroom*" was offered by Reynolds. Ms. Jovanovich together with a Reynolds' colleague served as proposal writers, project directors and institute co-instructors. Six teacher consultants from three local school districts assisted the project directors in planning the institute as a high-quality professional development activity on geometry and measurement for teachers from grades 4-8. Identified needs of local school divisions showed geometry as a strong area of need for teacher development. Content and pedagogy were based not only on NCTM *Curriculum and Evaluation Standards* [1] but also on the recently adopted *Virginia Standards of Learning (SOLs)* [2]. Instructional techniques in the institute modeled hands-on active participation, cooperative groups, and attention to real-world applications. Use of technology was emphasized through handheld interactive geometry on the TI-92, access to World Wide Web geometry resources, and geometry software packages. Each of the twenty-seven participants received a geometry manipulative kit and other resources. Teachers attended follow-up sessions and held in-service sessions for their peers. Many teachers commented on their frequent mentoring of colleagues, far beyond the requirements of grant participation. The geometry knowledge of more than 1200 Richmond area students was affected by teachers in this grant.

Response to the institute was overwhelmingly positive. Each participant and their respective principals and math specialists who responded would encourage other teachers from their schools to participate in similar institute at J. Sargeant Reynolds Community College. In follow-up surveys a year later, on a 6.0 scale the participants gave a mean rating of 5.1 for the extent to which the grant activities influenced their knowledge and skills. Math specialists gave an average rating of 5.5 for the same question, while principals gave a 4.4 rating. With regard to the influence of grant activities upon classroom instruction, participants gave a 5.0 average rating, math specialists gave a 6.0 rating, and then principals gave a 4.4 rating.

Regarding student learning, no exact measures were available, although one math specialist reported that the Literacy Passport Test (LPT) scores have risen. One participant reported close to 100% on the geometry section of LPT. Another participant reported that students on the fifth grade level scored above the 58 or 59 percentile in mathematics and that their class scored the highest. Alternative assessment forms yielded the greatest evidence of

improved comprehension and synthesis according to another participant. In another situation, two participants reported that more students passed the teacher-made test on geometry than usual. One person stated that although it was not measurable, it was gratifying to see "the enthusiasm the students (showed) as we did the geometry unit and the fact they kept returning to the geometry learning centers on their own and long after that unit was studied. They also came to recognize geometry concepts and use them in other subjects."

Eisenhower-funded Graphing Calculator Project for Grades 9-12 Teachers

Two two-week summer institutes on "*Graphing Calculators*" for secondary mathematics teachers were held at Reynolds during the summers of 1993 and 1994. With a Reynolds mathematics faculty member as proposal writer, project director, and institute co-instructor, teachers from grades 6-12 participated in courses designed to familiarize them with graphing calculator technology, technology recommendations of the NCTM Standards, and the impact of the graphing calculator on the teaching and learning of mathematics. Through intense hands-on study with follow-up sessions, participants were empowered to make a change in their instructional delivery. Thirty participants each summer from the Richmond area and from distances up to an hour away filled the courses almost immediately, with long waiting lists during both years of the project. Follow-up sessions at Reynolds and sharing sessions held by the participants for their peers served to reinforce knowledge gained and sustain the professional growth. Teachers regularly shared their resource notebook with other teachers.

Project evaluations were extremely positive. Participants were asked to evaluate the project at various times during its progress. At the end of the second two-week period, all thirty participants answered an emphatic "yes" to a question about the benefit of this course to their personal and professional growth. In follow-up sessions throughout the year, written evaluations reported that participation in this project equipped the participants very well to incorporate the graphics calculator into their teaching. To this day, school division mathematics specialists report the benefits of this Reynolds-sponsored activity.

In Summary

In addition to the above special projects, Reynolds faculty routinely participate in local, state, regional, and national conferences for teachers and prospective teachers, giving

presentations and workshops, serving as committee chairs, or holding local elected positions, such as Board member, Secretary, or President. Reynolds faculty serve on curriculum evaluation and self-study committees with area teachers and provide training of new teachers at pre-service institutes. One Reynolds mathematics faculty member, who was recently awarded the College's first faculty sabbatical leave, spent the leave period as Mathematics Educator-in-Residence at the regional Mathematics and Science Center. There she delivered mathematics through technology lessons to over 1200 students in 17 different secondary schools, thereby interacting one-on-one with more than 50 teachers. This faculty member continues to co-lead, along with Center staff, professional development activities for area teachers through daylong workshops. Informally, Reynolds faculty identifies students with an interest in teaching and encourages their participation in local conferences of teachers' professional associations. Additionally, Reynolds faculty have repeatedly served as proposal writers, project directors, and institute instructors of major grant-funded projects in teacher education. ■

References

- [1] *Curriculum and Evaluation Standards for School Mathematics*, National Council of Teachers of Mathematics, Reston, VA, 1989.
- [2] *Standards of Learning for Virginia Public Schools*, Commonwealth of Virginia Board of Education, Richmond, VA, 1995.