

USING TECHNOLOGY TO ENHANCE PRE-SERVICE TEACHER PREPARATION

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Use of the internet to deliver a portion of the content in an introductory science, education, and technology methods course for pre-service teachers provides an opportunity for a much needed introduction to basic computer literacy. A web page was developed for use in conjunction with the math, science, and technology educational methods courses at Brooklyn College. Students are introduced to this page as a group in the computer lab, and work in small groups with more experienced students serving as mentors to other students.

The Brooklyn College Science Education Webpage is designed as a simple jump page with links to various resources for science education. It serves as a starting point to expose pre-service teachers to a wide range of resources available to them on the world wide web and in the real world. Students use their internet research skills in open-ended assignments throughout the semester. The web page continues to serve as a resource for students in the next courses in the math and science education sequence. The Brooklyn College Science Education Webpage helps education graduates to begin their teaching better prepared to use technology in the classroom.

Preparing pre-service teachers to teach to the new *National Science Education Standards* [1] and the New York State *Mathematics, Science, and Technology Standards* [2] presents a challenge in science education methods classes. There is so much to cover given the scope of the elementary mathematics, science, and technology curriculum [3]. Pre-service teachers need to become competent in the breadth of science content and become familiar with pedagogical methods. Adults, like children, learn best when given the opportunity to construct their knowledge from their own experience [4]. *Science for All Americans* [5] asserts that it is just as important to consider how subjects are taught as what subjects are taught. According to Goroff, when preparing teachers, how we teach is what we teach [6]. Teacher educators must provide opportunities for pre-service teachers to do science and to use technology; not merely, provide lectures and readings about what

constitutes best practice in elementary science teaching methods. Pre-service teachers need to become informed about the standards in a standards-based learning environment.

One approach to providing an active learning experience in math, science, and technology is to introduce students to relevant teacher resources, including the state and national standards, via the internet. In this way, basic computer literacy skills are developed at the same time that science content knowledge and pedagogical issues are explored. According to the National Science Teachers' Association, "Computers have become an essential classroom tool for the acquisition, analysis, presentation, and communication of data in ways which allow students to become more active participants in research and learning." [7] A recent initiative by former New York City Schools' Chancellor Rudy Crew will place a computer in every New York City public school classroom. Instilling computer literacy that is relevant to the professional practice of teaching is essential to prepare teachers who will consider computer use to be integral to their teaching.

Introduction to the use of computers in a classroom setting is especially important for the student body at Brooklyn College. The City University of New York, of which Brooklyn College is part, has been committed to providing access to higher education for students previously underrepresented in post-secondary institutions [8]. Students in our pre-service teacher education program reflect the racially, ethnically, and socio-economically diverse urban population of Brooklyn, New York [9]. Many of our students were born outside of the United States and may be the first in their families to attend college. Most attended public schools. Kozol describes the dismal conditions often found in New York City public schools in poorer districts [10]. A high proportion report that they have not had access to up-to-date computers in high school and that they do not currently have access to computers at home. So although most pre-service education students had limited access to computers as elementary and secondary students, they are likely, as beginning teachers, to enter a classroom that has at least one networked computer. A survey of New York City teachers has found that more than half report being either poorly or not at all prepared to use technology to increase student interest or support research (i.e. access the internet) [11]. Use of the internet to deliver a portion of the content in an introductory science, education, and technology methods course for pre-service teachers provides an opportunity for a much-needed introduction to basic computer literacy.

An additional benefit of using the internet to access resources is that valuable resources can be made available to students at no cost. This is especially important for urban students who often face considerable financial hardship while attending college, and for urban teachers who will receive lower salaries and fewer resources to support their classrooms than their suburban counterparts [10].

A web page was developed specifically for use in conjunction with the math, science, and technology educational methods courses at Brooklyn College [12]. Students are introduced to this page as a group in the computer lab. Although each student has their own computer to work on, students work clustered in small groups with more experienced students serving as mentors to students unfamiliar with the internet. After a quick introduction to internet navigation basics, students surf the internet on their own starting from the Brooklyn College Science Education Webpage. The initial assignment is open-ended: to follow links to state and national math, science, and technology teaching standards; find a math, science, or technology lesson plan; and, explore two field trip sites. This collegial work on the computer builds community in the classroom [13]. The instructor is not the center of learning. The professor is present to answer questions and provide assistance. Informal exchanges between students occur throughout the session. Experienced and inexperienced students progress at their own pace. Each student comes away with increased computer literacy and an introduction to teacher resources for science education on the internet.

Students were asked to comment anonymously on their feelings about the introductory internet class session in order to plan future sessions that would better meet student needs. Student response was uniformly positive regardless of level of computer confidence and experience. One student commented, "I thought this session was very helpful. I always wanted to know more ways to find out information for teaching on the internet, and I usually come up with nothing. Now I will have more ways to find out about lesson plans, field trips, and much more to help me in my teaching." Another student commented, "The education links we were opened up to were wonderful guides for later projects. This is the first useful computer session I have attended for a class here at Brooklyn Collège." Still another said, "Today's class was a worthwhile break from a regular lecture class. I personally spend a lot of time on the internet and I find it extremely useful. The class web page is full of information and I will visit it often!!" A less computer-literate student commented, "I thought that this exercise was a good

experience for me because I am not comfortable using computers and I saw some great ideas for field trips, and lessons.... I will further use these sites at home to get more info to bring to my classroom.” Another observed, “I had a good time today working on the computers. I enjoyed searching for field trip ideas. We got a good sense of how to search the web and explore a particular site.”

The Brooklyn College Science Education Webpage is designed as a simple jump page with links to various resources for science education, such as the Project 2061 *Benchmarks for Science Literacy*, the *National Science Education Standards* [14], and the New York State *Mathematics, Science, and Technology Standards* [15], the full texts of which can be accessed online. These are recommended texts for this class. After our first online class, one student observed, “It helped me get a better idea of what is expected in a science classroom.”

The Brooklyn College Science Education Webpage also provides links to sources for exemplary science curriculum materials, online sources for hands-on science materials, online magazines in science, nature, and science education for teachers and children, and other useful resources to enhance science learning. It has links to ongoing research projects such as Project Pigeon Watch [16] and Monarch Watch [17] that introduce pre-service teachers to standards-based science inquiry conducted by elementary school children nationwide. Links to online magazines provide access to new sources for enhancing science literacy and awareness of the changing nature of scientific understanding. The Brooklyn College Science Education Webpage serves as a starting point to expose pre-service teachers to a wide range of resources available to them on the world wide web and in the real world.

For instance, the internet can be used to explore field trip options with great efficiency. Experiences in museums help to enrich science learning by providing informal learning experiences that are unique to the museum environment [18]. Schools and museums nationwide have entered into a partnership to improve education [19], but teachers need to be aware of the value and accessibility of these resources. Despite growing up in New York City, one of the major cultural centers of the world, most Brooklyn College students are unfamiliar with the cultural resources surrounding them. A web page linked to the Science Education Webpage was created listing field trips for science education in the New York City area [20]. This page has links to the web sites of

more than twenty-five local science museums and other non-formal science resources, including the American Museum of Natural History [21], Liberty Science Center [22], the Brooklyn Children's Museum [23], and the New York Aquarium and Wildlife Conservation Society [24]. The virtual field trips made possible by the internet serve as an introduction to the vast array of informal resources available to science educators. Students clearly understood that this page was intended to provide information for planning actual field trips, not to take their place. One student commented that she was, "especially interested in the field trip link because it tells you what is entailed in planning a class trip." Another student commented, "I enjoyed going into the A-Z Field Trips site.... I found great trips to take students on."

Students are expected to use their internet research skills in open-ended assignments throughout the semester. One assignment asks for students to research minority or female scientists on the internet. During our first session, we discovered that 20 out of 23 students think of an older, white male with funny hair, a lab coat, and glasses when imagining a scientist. Almost half reported thinking of Albert Einstein. Students are asked to nominate a scientist for inclusion in a new class web page currently under development, featuring non-stereotypic scientists. Thus, students are asked to continue to use the computer skills developed in class and are given the opportunity to work independently as online researchers. Ultimately, they contribute to an online publication. After only one or two sessions in the computer lab, students are able to independently access information for this and other subsequent class assignments via the internet.

If the ideal of education encompasses lifelong learning as a goal for all, how much more so for teachers? According to Klor de Alva, "the concept of student and alumnus will merge. Today's highly partitioned system of education will blend increasingly into a seamless web, in which primary and secondary education; undergraduate, graduate, and professional education; on-the-job training and continuing education; and lifelong enrichment become a continuum." [25] The Brooklyn College Science Education Webpage continues to serve as a resource for students in subsequent courses in the math and science education sequence, in which students must begin teaching math and science in elementary school classrooms. In still later semesters, it is available for student teachers and ultimately, for in-service teachers. It is anticipated that it will serve as a familiar reference to help beginning teachers find resources online as they face their first stressful years of teaching. The Brooklyn College Science Education

Webpage helps education graduates begin their teaching career better prepared to use technology in the classroom. ■

Bio

Eleanor Miele is Assistant Professor of Science Education at Brooklyn College. Current interests focus on use of technology to enhance active inquiry in science education for teachers.

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