USING TECHNOLOGY WITHIN THE TEACHER PREPARATION PROGRAM AS A MODEL FOR EFFECTIVE INSTRUCTION

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Abstract

This article describes a methods course for teachers of elementary science and how it was enhanced to increase students' abilities and attitudes toward using technology as a tool in teaching science. The course was enhanced as a result of the Virginia Collaborative for Excellence in the Preparation of Teachers (VCEPT) project. Prior to this project, the course was known for its constructivist approach, cooperative group activities, and experiential base that allowed students to actually do and teach elementary science. As a result of VCEPT, the class now also features an elaborate technology component. Technology of many types are regularly modeled in the methods classroom. Students are exposed to and have hands-on experiences with selected technologies and are asked to use technology in order to complete a variety of different projects.

Introduction

TEDU 517: Methods of Elementary Science, is a three-credit, one-semester course required of all elementary education majors at Virginia Commonwealth University (VCU). The course is designed to present best practices for effective teaching of science. Though not designed to be a content course, much of the content needed by elementary education majors is reviewed through the types of activities presented by its instructors.

The course is designed to be an effective model of a constructivist classroom, one in which students construct or reconstruct their own meaning for concepts through guided inquiry. Therefore, students complete many hands-on activities while working in cooperative groups. These activities require students to utilize basic process skills, such as making observations and measurements, as well as to use scientific reasoning to answer questions through making hypotheses, testing, and formulating inferences and conclusions from the results. While actually using the processes of scientific investigation, pre-service teachers learn how to effectively teach these skills to elementary students.

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Because of the fact that VCU is located within an urban environment, an emphasis is placed on incorporating strategies to help students adjust to the variety of situations and needs of the students they will encounter. For example, one of the classes deals with working in cooperative groups and typical problems encountered by teachers in an urban classroom.

Rationale for a Strong Technology Component

Today's students are growing up in a world where television is used to stay abreast of current events, discover faraway lands, entertain, and sometimes baby-sit. Many students have home computers or have used computers by the time they have reached school age. Within public schools, computers, televisions, overhead projectors, and laser disk players are but a few examples of equipment that has become standard issue. Computers and related technologies are an integral part of the world today. To fail to integrate technology into the curriculum would be a failure to include a rapidly increasing tool in today's society.

The use of technology within the science course grew out of this observation, as well as from Virginia state requirements that require teachers to have mastered specific technology skills. Students at VCU prove their technological proficiency by taking a competency exam and by completing the teacher prep program that integrates many of the state standards through required projects within the courses.

The teacher preparation program at VCU views technology as doing more than simply meeting state requirements. In monthly School of Education meetings and often in division meetings, there is a regular feature in which a member of the faculty shares with colleagues a way in which technology is being incorporated into his or her class and students' responses to this technology. Faculty here have become excited about students' positive reactions. The positive effects of using technology are borne out in research as well. The Office of Educational Research and Improvement within the U.S. Department of Education conducted a study entitled, *Technology and Education Reform* in which they found the following positive effects of the use of technology [1].

Students tended to play a more active role in their own learning — Traditionally, teachers have had a direct role in dispensing information to students whose role it was to receive it and process it. When students use technology, "The student is actively making choices about how to generate, obtain, manipulate, or display information. Technology use allows many more students

to be actively thinking about information, making choices, and executing skills than is typical in teacher-led lessons. Moreover, when technology is used as a tool to support students in performing authentic tasks, the students are in the position of defining their goals, making design decisions, and evaluating their progress."

Teachers reported an increase in student confidence — Almost all teachers within the study reported an increase in students' self-esteem and motivation. Even within the authors' own experiences, stories can be recounted of students who had difficulty in writing and presenting information in traditional manners, but who would shine when asked to present information using technology. Students also see the relevance of learning to use technology since our society places such value on its use, and examples of its use by adults are readily available.

Students became more adept at tackling difficult assignments — "Teachers for the observed classes and activities at the case study sites were nearly unanimous also in reporting that students were able to handle more complex assignments and do more with higher-order skills because of the supports and capabilities provided by technology."

Increased interactions occurred — For a variety of reasons, increased group work and peer tutoring resulted from the use of technology. Technology also allowed students to interact with resources, experts, and places they could not otherwise access.

In an article entitled, "Technology in the Schools: It *Does* Make a Difference!" author Glori Chaika cited examples of districts that had used technology to get some incredible results [2]. Among her citations are the following studies:

> School officials in West Virginia selected software carefully and then integrated it into the curriculum. They provided students an adequate number of computers, and they thoroughly trained teachers in how to use the software to improve student learning. As a result, student scores on both state tests and the National Assessment of Educational Progress (NAEP) improved. *Intriguingly,* the study also found that West Virginia's program was more cost-effective than hiring more teachers or reducing class sizes!

A "Report on the Effectiveness of Technology in Education, 1990-1997," conducted by the Software Publishers Association, cites the results of a Vanderbilt University research group's study of at-risk, inner-city kindergartners. The researchers found that students studying language arts in a multimedia environment gained more auditory, language, decoding-in-context, and story-composition skills than did students in a control group who did not use computers.

An Educational Testing Service study discovered that math teachers who used computers could significantly boost fourth and eighth graders' standardized math scores, and a study of 53 elementary, middle, and high schools found that providing cutting-edge technology improves teachers' morale. That ETS study also found that students' attitudes, motivation, and behaviors improved very quickly when they used computers in school.

Changes to the Class

As a result of such research, state technology teacher competencies, an increased interest among faculty, and through funds and support made available through VCEPT, it was decided several years ago that the elementary science methods course would be improved through an emphasis on the use of technology. For these same reasons, the teacher education faculty at VCU became involved in the Virginia Educational Technology Alliance (VETA). Through VETA and VCEPT, we began to meet with other colleges and universities to share the uses of technology within our own classes.

Redesign of the actual methods of a science classroom was done to allow instructors to use technology within the classroom setting. The classroom was equipped with a ceiling-mounted video projector and audio/visual jacks into which a laptop computer and VCR may be plugged. The room was also fitted with two Internet connections.

The curriculum design of the class was altered to incorporate technology through modeling. In utilizing hands-on experiences with the various technologies in the classroom and requiring technology as a tool for student assignments, the knowledge base was effectively expanded, both in technology and in content. Instructors modeled *PowerPoint* by using it to

deliver lecture content to the class; *Excel* was used to collect and display data from class experiments; *Inspiration* software created class handouts. The use of concept mapping, a way to help students connect concepts and ideas through visual graphic organizers, was a teaching tool already in place. However, we combined it with *Inspiration* in order to broaden its benefits. This software allows students to create concept maps quickly and easily, and to convert them to outlined notes or vice versa. What especially appealed to both students and instructors about this program was its ease of use.

Interactive video and software were also explored in the class setting. The authors of this work have attended the National Teacher Training Institute which conducts teacher training in how to use video effectively. It was decided to use instructional television to show teachers how to use video interactively. Video has often been a tool that allowed teachers to present information while getting a little grading or other work done at the same time. This form of video presentation requires students and teachers to take a more active role in viewing as the teacher instructs students to watch for answers to particular questions, and stops the video at various times to discuss and test ideas within the video through hands-on activities. Through these modifications, many more styles of learning can be reached and students become much more active learners.

Students were given several projects and assignments that revolve around using technology. They were asked to review websites appropriate for classroom use. Students used the Internet to explore the use of virtual field trips, research, find lesson plans, and use interactive websites; to post notes, interact with pre-service teachers, pose questions, and post lesson plans and announcements on a class website. They were asked to preview instructional software. They used *Excel* spreadsheets during group experiments. They typed assignments using word processing software. They used Intel microscopes and experienced the advantages of a digital microscope in working with varying levels of visual abilities and motor skills. The microscopes are also compatible with presentation program software, such as *PowerPoint*. In spite of the fact that the class was taught by various instructors, these technological components evolved and remained relatively consistent. Each of these experiences and projects was selected because they represented types of technology that are readily available within local elementary classrooms and because they reflected the state teacher technology competencies.

Action Research

In order to see whether our students were as impressed with the integration of technology as we had become, we gave students in four classes over one academic year (fall 1, fall 2; spring 1, spring 2) a survey at the beginning and end of the course (see Appendix A). We also gave a post-test to a group of VCU students who had previously taken the technology-enriched version of the course, and to a small population of previous students who were now actually in the classroom as teachers (see Appendix B).

Table 1

Question	Groups for Comparison									
	fall1 pre	fall1 post	fall2 pre	fall2 post	former stud.	first yr tchr	spr1 pre	spr1 post	spr2 pre	spr2 post
a- Elem. students should use Excel	2.64	3.30	2.64	3.09	2.83	3.00	2.35	3.06	2.23	2.77
a- Excel can be a valuable tool to teach	2.79	3.30	2.79	3.45	2.78	2.80	2.71	3.06	2.23	2.77
a- I am motivated to use technology to teach	3.14	3.80	3.14	3.82	3.67	3.40	3.59	3.67	3.46	3.69
a- I will/do encourage others to use technology	3.07	3.80	3.07	3.82	3.61	3.00	3.53	3.67	3.38	3.69
a- Inspiration can be a valuable tool	1.79	3.70	1.79	3.36	2.28	1.00	2.00	2.39	1.38	1.69
a- Intel microscope is a valuable tool	1.93	3.80	1.93	3.46	3.44	3.20	2.29	3.44	1.85	3.69
a- Internet is tool to connect with scientists	3.43	3.90	3.43	3.38	3.44	3.00	3.00	3.61	3.23	3.23
a- Internet is valuable tool for students	3.71	3.80	3.71	3.62	3.67	3.40	3.76	3.89	3.54	3.77
a- Internet is valuable tool for teachers	3.86	4.00	3.86	3.69	3.78	4.00	3.71	3.94	3.69	3.92
a- ITV is a valuable tool to teach	2.93	3.30	2.93	3.73	3.17	3.20	3.12	3.56	3.00	3.38
a- PowerPoint is valuable tool for students	3.14	3.30	3.14	3.31	3.33	3.00	2.94	3.33	3.38	3.69
a- PowerPoint is valuable tool for teachers	3.29	3.70	3.29	3.38	3.22	3.20	3.29	3.33	3.31	3.62
a- Software is valuable tool for teaching	3.21	3.80	3.21	3.73	3.28	3.20	3.06	3.56	3.08	3.23
Average	**2.99**	**3.65**	**2.99**	**3.53**	**3.27**	**3.03**	**3.03**	**3.42**	**2.91**	**3.32**
Change		**0.66**		**0.53**				**0.40**		**0.41**
d- Schools have Internet equipment	2.86	3.40	2.86	3.23	3.06	3.20	2.94	3.17	3.00	3.31
p- I am familiar with Inspiration	1.50	3.10	1.50	3.18	2.00	1.40	1.65	2.44	1.46	1.77
p- I am familiar with ITV programs	2.79	3.00	2.79	3.64	2.94	3.00	2.59	3.33	2.46	3.38
p- I am familiar with software	1.79	3.30	1.79	3.31	2.67	2.80	1.88	3.17	2.08	2.85
p- I am proficent at email	3.50	3.50	3.50	3.46	3.33	3.60	3.29	3.67	3.38	3.54
p- I am proficent with the Internet	3.21	3.60	3.21	3.31	3.22	3.40	3.24	3.61	3.15	3.38
p- I am proficient at Excel	3.00	2.70	3.00	3.36	2.50	2.40	2.76	2.78	2.38	2.77
p- I am proficient in PowerPoint	2.79	2.90	2.79	2.85	2.56	2.60	2.65	3.00	2.62	3.15
Average	**2.65**	**3.16**	**2.65**	**3.30**	**2.75**	**2.74**	**2.58**	**3.14**	**2.51**	**2.98**
Change		**0.50**		**0.65**				**0.56**		**0.47**

app- I will use/do use Excel	2.79	3.30	2.79	3.27	2.67	1.80	2.59	3.00	2.15	2.69
app- I will use/do use Inspiration to teach	1.79	3.40	1.79	3.18	2.28	1.00	2.06	2.78	1.54	1.69
app- I will use/do use ITV to teach	3.00	3.30	3.00	3.82	3.17	2.20	2.88	3.50	2.92	3.38
app- I will use/do use PowerPoint to teach	2.93	3.20	2.93	3.08	2.94	1.80	2.53	3.00	2.23	3.00
app- I will use/do use software to teach	3.21	3.70	3.21	3.73	3.22	2.40	3.12	3.61	3.08	3.23
app- I will use/do use the Intel microscope to teach	1.86	3.60	1.86	3.38	3.39	1.40	2.29	3.28	1.62	3.31
app- I will use/do use the Internet to teach	3.14	3.80	3.14	3.23	3.33	2.40	3.35	3.89	2.92	3.38
AVERAGE	**2.66**	**3.13**	**2.66**	**3.17**	**2.86**	**2.33**	**2.63**	**3.05**	**2.43**	**2.81**
Change		**0.47**		**0.51**				**0.42**		**0.38**
u- I have used the Intel microscope	1.71	3.40	1.71	3.23	3.39	2.60	2.06	3.72	1.38	3.54

a= Attitude, p= Proficiency, app= Application

The survey had students rate their attitudes, perceived abilities, and their use of particular types of technology. Results indicated that all three areas showed an increase from pre- to post-course as a result of the VCEPT elementary science methods course (see Table 1). However, the attitude responses showed the greatest positive change and the application responses showed the least amount of positive change.

All groups identified the Internet as a valuable tool for educators. Pre-service teachers' attitudes, perceived abilities, and application of the Internet were consistently high. While 100% of our sample of first-year teachers saw the Internet as a valuable tool, their use of the Internet with students was much lower (only 60%—see Table 1). The value placed on using the Internet with students by all groups was lower than the value they held for their own use of the Internet to teach.

Pre-service teachers were more enthusiastic about the use of the Intel microscope as a result of taking the *TEDU 517* course. While the sample of first-year teachers was small, the data indicated that pre-service students were over twice as likely to use the Intel microscope to teach science than their first-year teacher counterparts.

It is difficult to draw conclusions about the data collected. Consistently throughout all the groups, attitudinal responses showed the most positive change. One might infer that attitudes are the easiest to change and sustain. The application responses showed the least amount of positive change. This may result because application of a particular type of technology could require more long-term and specific professional development. In the authors' views, students'

positive attitudes about the use of technology, state requirements for its use, and the potential for other positive effects warrant further study of its implementation.

The authors of this study cannot extend the results further as neither will be working in the School of Education next year. A teacher-in-residence position is temporary and dependent upon budgetary constraints. However, the methods of the elementary science course will continue to be taught the same way, and include much of the technology-related content of the past five years. It is hoped that as the VCEPT project evaluation continues, so too will this study and the tracking of VCU students as they enter the classroom. ■

Bios

Jimmy Johnson was a teacher-in-residence at Virginia Commonwealth University. He has taught fourth and fifth grades in the Hanover County Public Schools for the past twenty years. He holds a Master of Education degree in Curriculum and Instruction from Virginia Commonwealth University and a Bachelor of Arts degree in Elementary Education from Virginia Polytechnic University and State University.

Laura Wilkowski is Assistant Science Instructional Specialist for Richmond Public Schools and a former teacher-in-residence at Virginia Commonwealth University. She has been a member of the VCEPT project for five years and coordinated the Pre-Practicum Apprentice Program and the Clinical Faculty Summer Institute. She holds a post-masters certificate in Administration and Supervision from Virginia Commonwealth University, a Master of Education degree in Science Education from Clarion University of Pennsylvania, and a Bachelor of Arts degree in Elementary Education from Mercyhurst College (Erie, PA).

References

[1] *Technology and Education Reform*, Office of Educational Research and Improvement, U.S. Department of Education, Internet: http://www.ed.gov/pubs/EdReformStudies/EdTech/welcome.shtml

[2] G. Chaika, "Technology in the Schools: It *Does* Make a Difference!" *Education World*, (1999), Internet: http://www.educationworld.com/a_admin/admin122.shtml/

Appendix A

Virginia Collaborative for Excellence in the Preparation of Teachers

Fall 2001 Post-517 Technology Survey

Action Research Project

The Virginia Collaborative for Excellence in the Preparation of Teachers (VCEPT) was a project that began in 1995 and involved collaboration between colleges and universities around the state. One of its goals was to help make teacher preparation classes more constructivist based and to help instructors utilize research to make their classes better in some way. This survey is designed to investigate the use of technology within the classroom. Please help us complete some research as to the Methods of Elementary Science Class (TEDU 517) by answering the questions below.

Semester and Year that you took TEDU 517 _____

TEDU 517 instructor _____

Biographical Information

- Academic classification at the beginning of the fall semester (please circle one)

Freshman Sophomore Junior Senior Graduate Post Graduate

- Grade Level you would like to teach (please circle one)

Kindergarten First Second Third Fourth Fifth Sixth Don't Know

Technology Survey

Please use the following scale to respond to the statements below.

A= Strongly Agree B=Agree C=Disagree D=Strongly Disagree

1.	The Internet is a valuable tool for teachers to get new information.	A B C D
2.	The Internet is a valuable tool for students to get new information.	A B C D
3.	The Internet is a valuable tool to connect with scientists.	A B C D
4.	Most schools have equipment to connect to the Internet.	A B C D
5.	I am proficient at doing research using the Internet.	A B C D
6.	I am proficient at communicating with others using the Internet.	A B C D
7.	I will use the Internet to teach elementary science.	A B C D
8.	I have used the Intel microscope.	A B C D
9.	Intel microscope is valuable tool for observation.	A B C D

10. I will use the Intel microscope to teach elementary science.	A	B	C	D
11. PowerPoint is valuable tool for teachers to use for instruction.	A	B	C	D
12. PowerPoint is valuable tool for students to use in doing presentations.	A	B	C	D
13. I am proficient in using PowerPoint.	A	B	C	D
14. I will use PowerPoint to teach elementary science.	A	B	C	D
15. I am familiar with several examples of elementary science software.	A	B	C	D
16. Science software can be a valuable tool for teaching science.	A	B	C	D
17. I will use software to teach elementary science.	A	B	C	D
18. I am familiar with several instructional television programs.	A	B	C	D
19. Instructional television is a valuable tool to teach elementary science.	A	B	C	D
20. I will use instructional television to teach in teaching elementary science.	A	B	C	D
21. I am proficient at Microsoft Excel.	A	B	C	D
22. Microsoft Excel can be a valuable tool to teach elementary science.	A	B	C	D
23. Elementary students should use Excel (or other spreadsheet software).	A	B	C	D
24. I will use Excel (or other spreadsheet software) to teach elementary science.	A	B	C	D
25. I am familiar with Inspiration software.	A	B	C	D
26. Inspiration can be a valuable tool for teaching science.	A	B	C	D
27. I will use Inspiration to teach elementary science.	A	B	C	D
28. I am motivated to use various technologies to teach within my classroom.	A	B	C	D
29. I will encourage others to use technology in their classrooms.	A	B	C	D

Please describe any especially useful or valuable methods of technology used within the 517 class.

What do you see as your challenges to using these technologies within the classroom?

How do you see yourself using these technologies within your class? Give specific examples. For example, I might use Excel when...

Appendix B
Virginia Collaborative for Excellence in the Preparation of Teachers
Fall 2001 Post-517 Technology Survey for first year teachers
Action Research Project

The Virginia Collaborative for Excellence in the Preparation of Teachers (VCEPT) was a project that began in 1995 and involved collaboration between colleges and universities around the state. One of its goals was to help make teacher preparation classes more constructivist based and to help instructors utilize research to make their classes better in some way. This survey is designed to investigate the use of technology within the classroom. Please help us complete some research as to the Methods of Elementary Science Class (TEDU 517) by answering the questions below.

Semester and Year that you took TEDU 517 _____
TEDU 517 instructor _____

Biographical Information

- Academic classification at the beginning of the fall semester (please circle one)

Freshman Sophomore Junior Senior Graduate Post Graduate

- Grade Level you would like to teach (please circle one)

Kindergarten First Second Third Fourth Fifth Sixth Don't Know

Technology Survey

Please use the following scale to respond to the statements below.
A= Strongly Agree B=Agree C=Disagree D=Strongly Disagree

1.	The Internet is a valuable tool for teachers to get new information.	A B C D
2.	The Internet is a valuable tool for students to get new information.	A B C D
3.	The Internet is a valuable tool to connect with scientists.	A B C D
4.	Most schools have equipment to connect to the Internet.	A B C D
5.	I am proficient at doing research using the Internet.	A B C D
6.	I am proficient at communicating with others using the Internet.	A B C D
7.	I use the Internet to teach elementary science.	A B C D
8.	I have used the Intel microscope.	A B C D
9.	Intel microscope is valuable tool for observation.	A B C D

10. I use the Intel microscope to teach elementary science.	A B C D
11. PowerPoint is a valuable tool for teachers to use for instruction.	A B C D
12. PowerPoint is a valuable tool for students to use in doing presentations.	A B C D
13. I am proficient in using PowerPoint.	A B C D
14. I use PowerPoint to teach elementary science.	A B C D
15. I am familiar with several examples of elementary science software.	A B C D
16. Science software can be a valuable tool for teaching science.	A B C D
17. I use software to teach elementary science.	A B C D
18. I am familiar with several instructional television programs.	A B C D
19. Instructional television is a valuable tool to teach elementary science.	A B C D
20. I use instructional television to teach in teaching elementary science.	A B C D
21. I am proficient at Microsoft Excel.	A B C D
22. Microsoft Excel can be a valuable tool to teach elementary science.	A B C D
23. Elementary students should use Excel (or other spreadsheet software).	A B C D
24. I use Excel (or other spreadsheet software) to teach elementary science.	A B C D
25. I am familiar with Inspiration software.	A B C D
26. Inspiration can be a valuable tool for teaching science.	A B C D
27. I use Inspiration to teach elementary science.	A B C D
28. I use various technologies to teach within my classroom.	A B C D
29. I encourage others to use technology in their classrooms.	A B C D

Please describe any especially useful or valuable methods of technology used within the 517 class.

What are your challenges to using these technologies within the classroom?

Please describe any technologies in which you have been trained since taking the TEDU 517 class.