WHAT TECHNOLOGY PLAYS SUPPORTING ROLE IN LEARNING CYCLE APPROACH FOR SCIENCE EDUCATION

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ABSTRACT
There has been a movement nationally over past several decades to integrate technology into extent curriculum. This is true both at the K-12 level and in higher education. The purpose of this study is to show what role science education has played in this effort (i.e., what documents, research or associations provide positions on technology usage) and what role technology should or could play in a learning cycle approach in the light of current research. In this study, first of all, the concepts of technology and educational technology including a rationale for the use of technology in education were examined in historical perspective and then what relationship between "Learning Cycle approach" and educational technology in science education was showed. As a result, how we can create technology-based curriculum in our learning cycle approach and how we, as teachers, can use technology in learning cycle approach will shown.

Keywords: Technology Integration, Science education, Learning cycle approach

INTRODUCTION

Technology has an impact on every aspect of modern life. However, technology has by passed the classroom. It is time to more fully integrate technology into the educational settings since skillful use of technology supports the development of process skills such as higher order skills, adaptability, critical thinking, problem solving, and collaboration that are essential to succeed in our rapidly changing information age. If we ask what technological tools in school are, most of people would say first computers and computers represent the only educational technology available. This, of course, is not true since there are many different kinds of technology in the classroom. While computers and their related devices (probeware, electronic databases, CD-ROMS, the internet, and multimedia presentations) are part of technology, and also overheads, televisions, VCR, digital cameras, videodiscs, and traditional science equipment are too.

Today's kids needed today's learning media to become engaged in the learning process. This thought was confirmed by a quote I found in the work of John Dewey, Educational Philosopher, written more than a century ago. "If we teach today as we taught yesterday we rob our children of tomorrow" (Dewey, 1916). Technology lets us better serve the diverse learning styles of our students and educate them for a wider range of intelligence.

TECHNOLOGY IN HISTORICAL PERSPECTIVE

There are many good examples of using of technological resources to enhance learning in science classrooms. There is no doubt that a rapid increase in technological resources has a revolutionary effect on teaching of science (Windelspecht, 2001). However, using technology in science classrooms is not common in schools yet. A little research on education history will show the reason behind this fact.

Before 1800, instruction at both elementary and secondary levels was predominantly individual. The standard practice was for the village schoolmaster to call one or several pupils to his desk, and teach individually. The Lancasterian monitorial system, developed by Englishman Joseph Lancaster, provided the basis for the eventual support of free public schools at the end of the 18^{th} century, and spread in the beginning of 19^{th} century. The method relied heavily on using the advanced students to teach the younger ones. By the Lancasterian system, large-group instruction started and classrooms were constructed that would make the most effective use of instructional media and student grouping. Under this system, one master taught a select group of older pupils, the monitors, and these in turn taught the rest. Lancasterian system is "a system which is, in education, what he neat finished machines for abridging labor and expense are in the mechanical arts" (Spring, 1990).

In the early 1900s, the educational community in modern countries found a new ideology, called the meritocracy movement. The Meritocracy movement claimed that education and educational phenomena could best be studied through the use of current scientific paradigms. Moreover, this new ideology suggested that human intelligence itself could be effectively measured through the use of scientific techniques. At that time, there were limited technological tools, blackboards, desks, pencils, notebooks, basic mathematical tools, used in American schools.

By the early 1900s, many important technological inventions, such as telephones, electrical lighting, automobiles, had occurred. Electricity especially opened a huge door in the education. Teachers were able to give their lectures at night, even though students had been working at night already. By the 1950s, photography, photojournalism, sound motion pictures, and broad radio firmly established American educational traditions. These inventions were very useful for education, because, in the 1920s and 1930s, industries were successful in convincing the educational community that film and radio were especially capable of shaping public morality, improving educational teaching perspectives, and firmly entrenching American educational goals. However, these new technologies did not turn educators away from print-based cultures (Engle, 2001). Print-based culture started with the invention of the Gutenberg press in 1492. Steinberg (1961) asserted, "The history of printing is an integral part of the general history of civilization" (p. 89). By many educational historians, the importance of the printing process is clearly confirmed in the many stages of education. World education was negatively influenced by World War II. Business interests, the scientific community, and military leaders criticized the education system in their countries in the 1940s and 1950s. In 1958, American Congress passed the National Defense of Education Act, in hopes of constructing the indifference of American schools towards the declining scientific and technological progress in education, caused by financially driven factory-style schools. By through 1960's, network television was adopted in the modern countries life. Two-thirds of Americans reports and most of their information about the world were being watched via television, but many researchers and educators realized that the rise of the television society left education in a poor position. By 1970's, science teachers began to use the overhead projector, which show diagrams, charts, or figures that clearly indicate analysis of the topic, pictures. This device has now become a traditional use of technology in the classroom. Slides, slide shows, and documentary videos are also very useful technological tools for students, especially for editing, observing, interviewing, and investigating.

Clearly, the most important invention is the computer and now the most popular tool. Konrad Zuse invented the first computer in 1936 but it was not used until World War II in public. In addition, computer did enter the classroom after the 1980's. In the last decade, we have seen an explosion in using the computer in education. A Nation at Risk in the US (1983) cited computer competence as a fourth basic skill that was both an important and empowering experience in the world in which we live. Accordingly, computer skills are needed for both subsequent formal educations as well as for one's individual life experiences (Gilder, 1993). Currently, three major national projects are underway in the United States that are designed to restructure science education and develop scientific literacy. The Project 2061 (American Association for the Advancement of Science, 1993), the National Science Education Standards (National Research Council, 1996), and National Educational Technology Standard (International Society for Technology in Education [ISTE], 2002) emphasized how important of educational technology and increased the awareness and interest of science for educators, students and average citizen. According to The Office of Technology Assessment, in 1988, 95% of all American schools have one or more computers (Mistler-Jackson and Songer, 2000). There is no doubt an increasing trend of using technology in the U.S. education system, especially since computers that collect, display evidence, and summarize, as a part of these standards, started to be seen the most important tool to improve student learning (Pedersen & Totten, 2001).

If technology is to become an integral part of K-12 and higher education, then it must also become an essential part of instructional tools and teacher preparation programs. Although educators know how important and useful technological tools are in the classroom, they still lack technology efficiency in science classes. Davis and Falba (2002) stated that traditionally, technology has not been central to teacher preparation experience in most colleges of education. Similarly, Pedersen and Yerrick (2000) reached the same conclusion in that; inadequate preparation of technology continues to be problem. Many teachers need training and support in the use of new methods and new media, in their research. According to Czerniak and Lumpe (1995), only 16% of teachers reported using technology almost everyday and 28% reported using it several times a week. Most frequently, teachers are using technology for communication such as email and telephone system (Frank & Zhao, 2003). Odom, Settlage and Pedersen (2002) had found almost same results that small differences were found for telecommunication and word processing. However they found large differences in teaching students at a distance, database applications, support research efforts, and desktop publishing areas of using technology as an instructional tool in their research. These results mean that our teachers know enough information about using technology in telecommunication and word processing but they need to be taught in other areas of using technology.

In spite of this, the trend of using technology in schools is rapidly increasing. Brownell, Haney, and Sternberg (1997) stated that 77 percent of the teachers and building administrators have a positive attitude toward classroom technology. Odom, Settlage and Pedersen (2002) concluded "the varieties of technology that could

potentially be incorporated into science instruction and teacher preparation seem to be increasing at rapid rate" in (p.397).

In traditional education, every science teacher have been using textbooks and generally a single textbook guides the curriculum (Pedersen & Totten, 2001), after entering computer in science classroom, most textbooks come with a supplemental CD-ROM. At this point, Simon's research (2001) explains clearly why technology integration is important in students learning. He created the web page with students' contributions. The course web site included many useful learning tools such as, sample problems, lecture notes, glossaries, assignments, test results, and graphics. His students stated course web site had better than using textbook. According to the studies conducted by Iding, Crosby, and Speitel (2002), and Rizza (2000), pre-service teachers who using computers for their own personal use were at least moderately proficient with computers, and had access to computers at schools and in individual classrooms. Also Beyerbach, Walsh, & Vannatta (2001) reported similar results for teachers who were interested in learning more about using computers and technology for instructional and educational purposes.

There are also negative perspectives about using technology in the schools. Extensive amount of research conducted to investigate teachers' experiences about the use of technology in their instruction suggest that the majority of teachers do not feel well prepared to integrate technology into their teaching because of time that to learn, plan, and implement educational technology is too long, especially for computers. Zammit (1992) found that a major obstacle to successful technology integration was the lack of teacher confidence and skill when using technology. Main problem, according to many teachers and educators, is a severe lack of resources, which are software, laptop and desktop computers, connections from computer to TV, digital cameras, and funding (Simon, 2001). Driscoll (2001) reviewed previous surveys and studies about technology integration by teachers and concluded that there was little consistency or consensus among groups in defining how technology was utilized in some schools. In some cases, participants stated that technology could be used to enhance learning, but the majority of the subjects tended to refer to technical aspects of technology. Hannafin and Savenye (1993) listed some research-based possible explanations why teachers are hesitant to use computers. These reasons consisted of poorly designed software, doubt that computers improve learning outcomes, resentment of the computer as a competitor for student's attention, unsupportive administrators, increased time and effort required of the teacher, fear of losing control of center stage, and fear of looking stupid in front of the class. They stated that the interactive nature of the computer and its capacity to enable student-centered exploration require a fundamental shift in the role of the teacher. The teacher can no longer be an active giver of information to relatively passive learners. They pointed out that terms like manager of information, coach, guide, organizer, initiator, and diagnostician appear in the literature to define the technology-oriented teacher's new role.

LEARNING CYCLE APPROACH AND TECHNOLOGY

A basic understanding of scientific concepts and process is essential in order to be successful and to make informed decisions about variety of complex questionjs. Learning cycle approach is an inquiry-based learning. Teachers need to know how to create a physical environment that engages all students. Learning cycle approach's goal is to enhance learning and provide students with more authentic science experience that imitate those real scientists and are in accordance with the nature of science. In addition, science education reforms have placed important on the need for integrating technology into science teaching, learning and assessment. There is no doubt about high connection of between learning cycle approach and infusing technology.

One of the biggest contributors to learning cycle approach is Dewey. According to Dewey, the basis for learning would be the natural impulses to inquire or to find out things (inquiry); to use language and thereby to enter into the social world (communication); to build or make things (construction); and to express one's feelings and ideas (expression) (Bruce & Levin, 1997). Based on Dewey's theory, our inquiry unit will focus on human experience that is continuous and interactive. Piaget, Vygotsky, and Brunner support learning environment and activities that are developed to allow for the viewing of students as thinkers who are emerging at different rates (Brooks & Brooks, 1993). In the light of these perspectives, learning cycle approach has three important phases, (1) exploration; means gathering and recording data, experience through a discussion session in which the child will begin to discover the science concept through his or her questions, (2) term introduction; teacher takes an active role in leading the students to develop the concept and students explain the concept with guidance from the teacher, students make their own meaning out of the observations, (3) concept application; students continue to expand the concept by conducting more activities and using additional resources for investigation, teacher should make an assessment of the students' abilities and thinking habits in investigating science ideas. In the curriculum of learning cycle, teachers should use a multidisciplinary approach that integrates technology with effective learning and teaching practices. Witfelt (2000) observed that it was really important to combine several learning theories such as constructivism, cooperative method, postmodernism, multiple intelligence, and even

behaviorism in our science classrooms with technology. In every phases of learning cycle, every kinds of technological tool can be used by teacher. This approach provides students and teachers an opportunity to address current real-world issues.

How can we create technology-based curriculum in our learning cycle approach? First of all, we have to "create the learning objectives and exploring lesson plan". This plan should fit national and state standards, which fits a current or past learning expectation we have covered. Then we can go through to "design our technology-based lesson". We have to explore the possibilities of technology-based activities our students can accomplish to meet the curriculum standard we have chosen, and then strive to choose the best technology activity for the lesson plan tasks, such as Microsoft office software. Generally our students need to be taught how to use computer and/or some software. That is we must determine any prerequisite skills students need and at what levels allowing for some review if needed. Third rule is "implementing the lesson". Implementation is the process of putting our lesson design into practice. With regard to technology, it should always be used as a tool in your design to augment the lesson's objectives. The main point is that technology itself does not make learning happen. The teacher is still the most important factor in the classroom and technology should be used in implementation to support the teacher. David and Falba (2002) said "learning cycle curriculum enables teachers and students to make sense of science in their daily lives, use technology that they see used around them, and engages in authentic science practice" (p. 323). The role of teacher in learning cycle approach is a facilitator and students are like scientists (Witfelt, 2000) and teachers are using technology as a tool in exploration phase. In the technology-based curriculum, assessments should be hands-on, real-world exercises in data collection (exploration phase). Also the purpose of exploration phase should be to help students learn generalized, systematic ways of thinking that can be transferred to other disciplines. MacKinnon (2002) gave same examples of how teachers integrate technology into their curricula such as "I use the computer in my class as a reinforcement of topics we have covered. Students use the internet to find information for their reports. My students must turn in their homework in word-processed form. I use PowerPoint to make all presentations to my class (p. 57)."

Computers and other new information technologies can be used to support the full range of learning. Dewey's suggestions are obviously match with learning cycle approach. Teacher should make available to students appropriate technological resources with which they can gather, evaluate, and record (in exploration phase), and analyze data and develop (in term introduction phase) and broaden their science understanding (in concept application phase) (Davis & Falba, 2002, p. 303).

The relationship between learning cycle approach and technology is very close, in this connection; technology can be seen as an integral part of the cognitive tool. Mokros and Tinker (1987) concluded that use of the technology may be a "bridge between concrete and formal operations" (p. 381). Moreover technology provides a multi-modal approach to learning, thus, addressing learning style differences in students. Many studies showed that students who used technology in conjunction with hands-on instruction had increases in knowledge and attitudes about science (Gardner, Simmons, & Simpson, 1992). So technology is an ally to leaning cycle teachers, and should be effectively integrated into all three phases of learning cycle. Today, learning cycle teachers have seen technology is the eyes and ears of science, and, whether it is computer or a calculator, is vital to data collection (exploration) ,teaching the concepts (term introduction), and expanding knowledge (concept application).

How we, as teachers, can use technology in learning cycle approach. Jonassen & Reeves (1996), and Beyerbach, Walsh, & Vannatta, (2001) made a distinction in educational uses of technology between learning from computers and learning with computers. Much of the early research and development with technologies considered enhanced learning that could be achieved when computers played an important role in delivering content and creating learning opportunities to help students make meaning and develop an understanding. The integration of technology into instruction does not mean to teach students how to use technology. The purpose of technology integration does also not mean to teach student by drilling and testing. Instead, effective technology integration is a plan to use technological resources as tools to assist students to construct meaningful knowledge. In this type of technology use, planning, decision-making, and self-regulation of learning are the responsibilities of the learner, not the technology.

Means and Olson stated (1997) that

> When students are using technology as a tool or a support for communicating with others, they are in an active role rather than the passive role of recipient of information transmitted by a teacher, textbook, or broadcast. The student is actively making choices about how to generate, obtain, manipulate, or display information (p. 125).

The crucial thing is that some activities are better done without the use of technology while others are greatly enhanced by its use. Teachers should not forget that technologies never guarantee that technology will lead directly or indirectly improvement in students learning and to modification in our science classroom practices and even inappropriate uses of technology can make learning much more difficult (Kumar & Altschuld, 1999). Teachers need to see the difference so they can make informed decision whether when they should use technology. The integration of technology in our science curriculum support students and teachers, as they collect, record, organize and analyze what they found. Thus a complementary relationship between technology and learning within learning cycle approach seems sound and advantages to teachers and students.

CONCLUSION

An understanding of relationship among teaching, learning, and technology are important aspects that educators need to keep in mind when integrating technology in their classrooms. Today's studies proved that we want preservice teachers to experience technology, to teach students with using technological tools, and to use inquiry-based learning environments in schools and colleges. Thus, technology infusion is situated within the larger context of inquiry-based learning. If computers and other technologies were used to their full capabilities, then learning goals in a classroom would not only be clearer, but also the resources and student outcomes would be positive. With computer software and the Internet, students are able to get information from around the world in a few minutes. There are so many resources right in front of us when we are in front of a computer. Word processing tools, which allow you to write a paper and fix mistakes later rather than rewriting the whole thing, Power Point programs that let you make presentations easily.

On the other hands, I don not believe that technology is the perfect solution for educator's woes. Throughout history there have been many innovations, which were popular in their time, and these innovations were thought the solution for all educational problems. Remember the beginning of the television and VCR for classroom use? These devices were supposed to be revolutionary devices that would improve all classroom teaching, making teachers more efficient (King, 1999). Teachers have to scratch technology can only help teachers to teach and students to learn in their brains.

The real concern is how teachers should implement this technology in their classroom. Teachers' attitudes toward technology appear to be in constant state of change, but the data indicates that in recent years more teachers are using technology to support learning contexts as a result of appropriate training. Therefore, pre-service teachers need training to learn new skills for facilitating learning in a technology-rich constructivist learning environments (Schifter, 1996).

Learning cycle approach asserts that learning is the active process of constructing rather then passively acquiring knowledge from directly teacher and using technology can increase instructional effectiveness, can reduce time and costs needed for learning. As the National Science Education Standards (NRC, 1996) stated that the major of science education is to produce students that are scientifically literate and technologically informed. Briefly, science and technology should be seen as tools that enable citizens to investigate and understand the problem of everyday life and to serve all communities (Davis & Falba, 2002).

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