The New Educational Review

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USA

Exemplary Uses of Technology in Education

Abstract

Traditional education in the United States has been largely influenced by the Industrial Revolution. Educational technology helped prepare students for the industry. The modern information technology revolution has created a need for a different type of education, one that helps the student acquire the skills to process and use information to solve problems. One approach to education that does this is constructivism, an approach to education that helps students learn the structure of knowledge. Exemplary use of educational technology can be used to accomplish this goal. Exemplary lessons stimulate higher-order thinking to solve problems. Examples are provided that demonstrate this.

Keywords: *Educational Technology, Constructivism, Higher-order Thinking*

The old educational paradigm

America's approach to education for the latter part of the nineteenth and much of the twentieth centuries was significantly influenced by the industrial revolution that occurred during this time. With the industrial revolution came a need to have workers who could work in factories and fulfill the needs of the industrial economy. This new economy needed not only workers who possessed the necessary knowledge and skills, such as basic literacy and numeracy, it also needed workers who possessed necessary work habits, such as industriousness, responsibility, punctuality, and deference for authority. Schools were therefore viewed as a way of preparing children for the industrial economy (Rury, 2002, p. 62, 89–90).

To do this, many schools emulated the efficiency of the industrial economy. Instead of a common school classroom, where all grades were combined to learn the basics, schools were structured in graded classrooms to transmit knowledge more efficiently. The curriculum was expanded from the basics to cover subjects that would be needed in an advanced industrial society, such as chemistry, physics and advanced mathematics. The purpose of the teacher was to convey the curriculum with as much efficiency as possible. Students were the recipients of this knowledge (Parkerson & Parkerson, 2001, p. 19).

With its large number of immigrants, the United States had a diverse population, with varying educational, cultural, and religious backgrounds. The quality of education and teaching varied greatly between schools. A major focus of this movement was consistent and equal education for all. The reforms were meant to create an educated populace, which could serve the needs of a growing, industrial country. The resulting educational system produced a citizenry possessing the needed knowledge and skills to serve the needs of the economy throughout the latter 19th and most of the 20th centuries. (Rury, 2002, p. 73)

The method of instruction that was developed and used by most schools is referred by Roblyer to as *directed instruction* (Roblyer, 2003, p. 52), not to be confused with the related concept, *direct instruction*, which is a very specific form of instruction. . According to this directed instruction model, teachers are experts who convey information to students, with students being the recipients of this information. Knowledge is considered *objective* in that it exists independently of the student. The body of knowledge to be learned is defined by objectives, which are statements of what students will learn after instruction. To achieve the objectives, teachers design a learning environment to maximize learning. They set up instructional events that will facilitate the learning. In other words, a teacher needs to set up a controlled situation that can best transmit the desired knowledge and skills. (Roblyer, 2003, p. 53)

This model of instruction was supported by behavioural and cognitive psychology, which grew out of the work of Skinner, Gagne and the information processing theorists. Their work ultimately contributed to the development of a formalized procedure for designing instruction called instructional design. According to the instructional design model, the instructional situation is analyzed in order to select the most efficient methods of conveying information. A more detailed description of this process is beyond the scope of this article. (Roblyer, 2003, pp. 56–62)

A traditional view of educational technology

From the beginning of the modern educational technology movement, the use of educational technology was influenced by this traditional view of education. According to this view, technology was to assist in the transmission of information from the teacher to the student. Technology facilitated directed instruction by extending the reach of the teacher. Educational technology was media, allowing the teacher and others to store information that the students were to learn so that students could have access to it, whether the teacher was there or not. Instead of receiving information from the teacher, the student could use a filmstrip, a cassette player, and later a computer, to learn. While the technology had the potential for helping the student discover and organize information on his or her own, it was generally used as another way of transmitting information from the teacher to the student. (Roblyer, 2003, pp. 18–20)

With the advent of the personal computer, educational technology could not only store and present information, it could be used as an interactive tool to instruct students through the process of individualized instruction. In some ways, educational technology could do a better job of instructing the students than the teacher. Whereas teachers often did not have the time to individualize instruction, technology could provide instruction tailored to students' needs. Educational technology could test students to determine their level of achievement. Each student could then be instructed at his or her appropriate achievement level by going through an instructional sequence, designed according to instructional design principles. After instruction, students could be tested to determine if they had learned. If a student had not learned, the computer could reinstruct the students. This process would continue until the student has learned. The computer had infinite patience and could re-teach and reinforce learning indefinitely. This is referred to as computer-assisted instruction. (Cotton, 1991)

Types of software that are used to provide computer-assisted instruction to students include tutorials, drill-and-practice programmes, and integrated learning systems. Tutorials are programmes that provide instruction to students about a subject or subjects. Often those tutorials are limited in scope, focusing on one subject area. Drill-and-practice programmes help reinforce what was learned or help students to learn new information through repetition. Drill-and-practice programmes are excellent at helping students learn vocabulary, such as when the student is learning a foreign language, or to help them practise basic computation. The sheer repetition helps students to learn. Drill-and-practice programmes typically also test students to determine what they have learned, although there are also programmes that are exclusively used to assess what students know. (Roblyer, 2003, pp. 89-94)

An integrated learning system (ILS) is a comprehensive programme that tests, instructs and assesses. Whereas tutorials and drill-and-practice programmes often focus upon one or a limited number of topics, integrated learning systems typically address the whole spectrum of subjects. Like drill-and-practice programmes, they continually assess students' progress toward the educational goals, and use this information to provide comprehensive reports to teachers. However, the programmes tend to be large and expensive, and require a lot of training and maintenance. Whereas drill-and-practice programmes and tutorials may be used by only one teacher, integrated learning systems are adopted by the school or the school district. (Roblyer, 2003, pp. 103–104)

Although educational technology grew more sophisticated, it did not revolutionize the educational process. It just extended it. The instructional objectives were the same. The technology would present information as a teacher would, and the methods of assessing whether students had remained the same as in a typical classroom. While educational technology may have provided more information to the student, it did not change the way the information was learned.

A need for reform

Over the last thirty years, a revolution has been occurring in the workplace. The industrial society has been transformed into an information technology society. In the United States, and in other first-world countries, the industrial base has shrunk, with many of the factories being closed down or being shipped to other countries. As a result, the need for factory workers has decreased. However, over the same time span there has been a significant increase in multinational companies. This trend has resulted in a greater need for managers who are able to maintain control of and expand these growing, international companies.

In order to survive in the modern economy, companies need workers who can manage information. This process involves analyzing problems or questions to know what information is needed, gathering the needed information to address the problem or question, analyzing the data, making decisions based upon the analyses, and presenting the decisions to others. With the staggering amount of information that is available, these information managers need to be able to evaluate the information they collect critically. Because the decisions that will be made may involve large sums of money, and can jeopardize the viability of these large corporations, these information managers need to be skilled information users. (Community Consolidated School District 21, 1999, p. 2)

Interpersonal skills, such as the ability to communicate and work with others, are needed as well. Because of the multinational and multicultural nature of modern corporations, workers must be able to work with people from different cultures and ethnic groups. Part of working with others of diverse backgrounds is being able to communicate clearly, both orally and in writing. Because of the vast and diverse nature of these corporations, communication skills are critical to the success of an organization. (Community Consolidated School District 21, 1999, p. 2; Negroni, 1990, p. 2)

The one constant in modern life is change. In our post-industrial society, the workplace is changing constantly. Knowledge is constantly increasing and old assumptions are being overturned. Workers need to be able to deal with change and adjust to changing circumstances. Companies are no longer looking for specialists who are trained in one area. They are looking for "specialized generalists" who can adapt to the needs of the industry. Workers need to be flexible to accommodate changing needs. (Negroni, 1990, pp. 3–4)

The educational reform movement

Business and industry have been one of the primary movers behind the current educational reform movement in the United States. Companies recognize that the traditional education system is outdated and is no longer meeting their needs. They also recognize that a new approach to education must be used if the nation's industrial strength is to be preserved. (Community Consolidated School District 21, 1999, p. 2)

These reforms have focused upon changing education from a process of helping student acquire information to one of helping students become users and generators of information. Students are to become critical thinkers and know how to use higher-level thinking skills. They are not just to spit back information, but to learn to use information meaningfully to produce educational products. There is a recognition that it is impossible to teach students everything they will need throughout their lives. It is important, however, to teach students how to think about knowledge, so that students can learn to acquire knowledge on their own.

Rather than a direct instruction approach, some educators are advocating a constructivist approach to learning. Constructivism holds that students learn by constructing their own knowledge. Rather than viewing learning as an accumulation of facts, it is recognized that students learn by creating schema or knowledge structures in their minds. Any new knowledge is then fit into the schema. If the knowledge cannot be fit, the schema must be modified to accommodate this new knowledge. The purpose of education is then to help the student to create these knowledge structures.

Norton and Wiburg (2003, p. 73–76) talk about the distinction between content knowledge and knowledge structures. While content is important, it is secondary to the structure of knowledge. Teaching knowledge structures allows students to structure existing knowledge and helps them integrate new knowledge in a systematic fashion. It helps students learn and retain knowledge, but also use this knowledge to solve problems and change their world.

Vygotsky, a psychologist whose work is often cited as part of the theoretical foundation for constructivism, used the term *zone of proximal development* to show the difference between a child's and an adult's level of cognitive functioning. Education takes students from a child's level of understanding to that of an adult's. Teachers serve as guides to help students achieve that higher understanding. Teachers construct learning experiences that are at an appropriate level for the student and which guide them to a higher understanding. The process of guiding students is referred to as *scaffolding* since teachers are supporting students' learning. Initially the teacher models the desired behaviour. Students then perform the task with the assistance of the teacher. Gradually, the teacher removes the support, and the responsibility for learning shifts to the students. When the students first demonstrate learning, it is at a relatively primitive level. As they go through the learning process their thinking and learning is gradually raised to a much more sophisticated level, the adult level. (Roblyer, 2003, p. 64)

In constructivist teaching, students are given problems to solve. These problems are anchored in real-life situations. Problems are often given to groups of students to solve by working together. Frequently each person in the group has a different role. Students must communicate and work together to find a solution. The result of the work is often a product, such as a PowerPoint presentation, an audio or video, or a picture. This product communicates the results of the process of problem solving and helps students express what they have learned.

In constructivism, knowledge in one subject is not something that is isolated from other subjects. Students are taught to see the interrelationships between subject areas. For example, being able to communicate is an important skill that is valued in all subject areas. Mathematics is not seen as an end in itself, but as a way to solve problems in a variety of different subjects.

Knowledge is also not something static, but it is dynamic and constantly changing. There is no set body of knowledge, which is the focus of the curriculum. The curriculum is an ever-changing, growing body of knowledge. Being able to think about knowledge is important since it allows the students to accommodate new knowledge as it is generated. One can never learn all there is to know in school. Learning how to learn and valuing learning are very important in constructivist thinking.

A new view of educational technology

One's view of educational technology changes when one adopts a constructivist approach to education. Educational technology is not just a means of transmitting information. It is used as a way of stimulating student thinking to help students challenge their thinking and construct their own perceptions of the world. Exemplary use of technology in education will actively engage students in the learning process. Students are not just passive recipients of knowledge through technology. They are active participants.

Exemplary technology lessons meet the student where he or she is and then guide them to a higher level of thinking. In these lessons, students are challenged to think about knowledge. They then use technology to help them understand the structure of that knowledge and to organize their thinking. They are asked to apply these knowledge processes to solve problems, which they solve by applying technology. These knowledge processes include analyzing problems, developing solutions, and evaluating and implementing those solutions. Students learn to work with others to find these solutions. They then use technology to produce products, which document their work.

Technology is not just a tool to teach students. Technology is a tool that students can use to learn *on their own*. Giving students the ability to use technology as a learning tool is a primary focus of constructivist thinking. When used in an exemplary manner, technology lessons allow students to direct the learning at an appropriate level, while challenging their thinking. By giving students control over the learning process, these exemplary lessons empower students and motivate them to want to learn more.

Exemplary uses of educational technology

Webster defines *exemplary* as *deserving imitation* (Merriam-Webster, 2006a). What one considers exemplary, what one believes deserves imitation, depends upon one's orientation. Those advocating a direct instruction approach will have a different idea about exemplary use of technology than those who advocate a constructivist approach to education. Exemplary use of technology in a direct instruction approach would provide the most efficient transmission of information from teacher to student. Exemplary use of technology based upon the constructivist paradigm would do one or more of the following:

- *Actively engage the student in the learning process by meeting the student at his or her level*

- *Help students see the relationship between content areas*
- *Help students to learn knowledge processes, the higher level thinking skills, which govern the knowledge*
- *Ask students to apply these knowledge processes to solve problems*
- *Help students produce tangible products*
- *Help students to collaborate with others to learn and apply these knowledge processes to solve problems*
- *Critically evaluate their own learning, including solutions which they derive*
- *Help students to communicate their knowledge with others using content-appropriate vocabulary*
- *Help students to take control of their learning by teaching them how to learn and motivate them to want to learn more*

The following are descriptions of how educational technology is being used in an exemplary fashion based upon the constructivist approach to education. The methods described include 1) telecollaboration through the Internet, 2) using electronic spreadsheets to analyze data, and 3) using webquests, inquiry-oriented problem-solving activities. For each of these methods, examples will be provided which show how these principles are applied.

Telecollaboration

Webster defines collaboration as working "jointly with others or together especially in an intellectual endeavor" (Merriam-Webster, 2006b) Telecollaboration is collaborating with others through the Internet using "e-mail, synchronous chat, threaded discussion, and MOOs … in order to support social interaction, dialogue, debate, and intercultural exchange." Belz (2003) E-mail and threaded discussions are asynchronous, both parties do not have to be on the Internet at the same time, while chat and MOOs are synchronous, requiring both parties to be online simultaneously. Synchronous communication is more immediate and personal, while asynchronous communication is easier to use because it does not require students to be online at the same time.

Judi Harris has divided telecollaboration projects into three general categories: interpersonal exchanges, information collection and analysis, and problem solving. Interpersonal exchanges are activities involving electronic communications between individuals, between individuals and groups, and between groups. Information collection and analysis involve students collecting, compiling, and sharing information. Problem-solving activities involve collaborating with other students to solve problems by collecting, analyzing and sharing information. (Harris, 2005)

A keypal exchange is an example of an interpersonal exchange. Keypal exchanges typically pair up students and ask them to exchange information about themselves. Keypal exchanges involving interactions with students from different countries can be excellent for challenging students' assumptions about the world. These exchanges are also good for motivating students to learn more about other cultures. However, because they do not involve a specific task or problem to solve, they generally do not require students to apply higher level thinking skills.

Bucket Buddies, an example of an elementary school information collection and analysis project, requires students to collaborate with other students over the Internet to answer the question: Are the organisms found in pond water the same all over the world? In this project, students or groups of students collect samples from ponds, analyze the samples to determine what organisms are found in the sample, and post the results of their analysis on the Internet. Once all students or classes have posted their results, each class analyzes the complete data set and creates a report. All reports are then posted on the project website. (Stevens Institute of Technology, 2006)

Like the keypal exchange, this activity would challenge assumptions of the students about the world; that the world is the same everywhere. In addition, students must apply higher level thinking skills to analyze the data, which is then expressed in the report that students create. As students go back and view reports from other classes, they can critically evaluate their own work in comparison with others. Because their report will be published on the Internet, students must write differently than if they were handing in the report in to the teacher. They will need to think about how to communicate in a way others will understand. Part of the communication will involve expressing the results using graphs and charts. Thus, students will see the relationship between language arts and mathematics. It will also require students to express their finding in content appropriate vocabulary.

Problem solving takes the collaboration a step further. Not only is there data collection and processing across classrooms, but there is a problem to solve with that data. Marsville is a project, which requires groups of students to collaborate with other groups of students pretending as if they were preparing for a mission to Mars (Rhodes, 2006). Specifically, students are working to design a livable settlement on Mars. They need to work collaboratively with other classes across Canada to design a life support system for the station. Students use higher-level thinking skills to analyze the problem and design the system to solve it. Working with other students requires students to communicate with others using the appropriate vocabulary. Because students are working with others, their solutions are under continual scrutiny. Ultimately, they learn that by working with others they can produce a better product. By participating in this project, they also learn that they can use their learning to produce something significant, which motivates them to want to learn more.

Electronic spreadsheets

Spreadsheets have long been used as tools by accountants to help make future projects for companies. Before the advent of the computer, spreadsheets were done on large sheets of paper. Starting with the first commercial electronic spreadsheet programme, VisaCalc, created in 1979, company data was entered into electronic spreadsheets, which could be easily analyzed. The development of spreadsheets applications significantly reduced the amount of time it took to analyze the data and make projections for accountants.

The use of spreadsheets is not limited to the world of finances, however. Spreadsheets can be used as a way of analyzing any type of numerical data. With their relative ease of use, spreadsheets can be used even by elementary school students to analyze simple data sets. Students can use spreadsheets to calculate quickly most statistics. However, one feature that makes it particularly appealing for analyzing data by students is its ability to display data using graphs and charts. Once data is entered, spreadsheets can easily create graphic representations of the data. Graphs and charts can help students to understand the data visually, which is easier for many students. However, graphs themselves can facilitate data analysis by helping students see patterns in the data. A picture is worth a thousand numbers.

Although spreadsheets can be used as substitutes for calculators, the strength of spreadsheets is in its ability to find answers to *what-if* questions. (Ervin, 1998) What-if questions ask: what will happen if the data or the parameters of the data change? Although this could be done using calculators, the spreadsheet makes this process very easy. In general, spreadsheets can help address four types of questions:

1. Description: What is the data showing about the current or past situation?
2. Correlation: What factors are related to the data?
3. Projection: If circumstances do not change, what will happen in the future?
4. Manipulation: If circumstances change, what will happen in the future?

A lesson plan from the website, Population Reference Bureau, will demonstrate how spreadsheets can be used in the classroom in an exemplary fashion (Population Reference Bureau, 2006). According to this lesson, students would download the following:

1. A spreadsheet showing frequencies of causes of death in the United States from 1950 to 2002

2. A spreadsheet showing the incidents of AIDS among different demographic groups in the United States from 1987 to 2002
3. A spreadsheet showing the incidents of HIV/AIDS by state
4. A spreadsheet showing incidents of HIV/AIDS by metropolitan region

Students are then asked to analyze the data to address the following questions:

1. How have the major causes of death changed over time?
2. How have HIV/AIDS rates changed over time?
3. How have the rates of HIV/AIDS changed over time for different sex, racial and ethnic groups?
4. How have the incidents of AIDS/HIV changed by state and metropolitan area over time?

Students are expected to determine trends in the data and to discuss why the trends have been occurring. Although not stated in the lesson plan, students can also discuss what will happen if the trends continue as they are. Ultimately, data could be obtained and compared with the predictions to see if the trends continued as predicted.

This activity actively engages students because AIDS is a health concern that many students are aware of, and which may affect their lives. It is exemplary in that it asks students to apply higher-level thinking skills to a problem by asking them to analyze the data to determine trends. As students look at the trends, they will begin to think about factors associated with these trends. Students become analysts, rather than just consumers of already analyzed information. They also see how mathematics can be useful in describing a problem and showing trends therein. Overall, they learn to think critically about the AIDS. They begin to realize that things can and need to change.

In the Democracy Project, a lesson is described in which students use spreadsheets to show how congressional representatives are apportioned to each state (The Democracy Project, 2004). In this project, students use spreadsheets to create three graphic representations. In the one, students graph the populations of some or all of the fifty states. For the second, students graph the size in square miles of some or all of the states. And in the third, the student graphs the number of congressional representatives for some or all of the states. Students then compare the graphs. Once they compare the graphs, they will see that the graph of the representatives most closely matches the graph showing the size of the population over the size of the state.

In this activity, students discover the relationship between the congressional representation and population size by analyzing the graphs. Students are not just told what is true; they discover it on their own, which requires them to apply higher-level thinking skills. By using graphs as opposed to correlation coefficients, students are able to make sense of the data without having to understand sophisticated math concepts, so it meets students at their level.

A spreadsheet can also help students to understand how vast our solar system is. Students could be asked to design a model of the solar system according to scale. The planets would have the same relative size and would be the same relative distances from one another as they are in our solar system. The teacher would set up a spreadsheet that would calculate the relative size of each of the planets and the distances between the planets to scale if the size of the earth in the model is entered. Prior to using the spreadsheet, students would be asked to hypothesize how big the sun, and other planets, would be in the model if the model's earth were a certain size, such as that of a baseball. They would then measure and enter the size of the baseball into the spreadsheet to determine what the sizes and distances would be. One might also ask the student to determine what the size of the earth would have to be for the model to fit into the classroom.

The same procedure could be extended to address issues of space travel. Students could set up a spreadsheet to determine how long it would take to travel to various planets for a given rate of speed. They could also be asked to calculate how much food, oxygen, and other supplies the ship would need to make this journey after being given certain parameters. Students could calculate the amount of space that is needed to carry all the supplies and how much fuel would be needed to transport all this. Groups of students could work together to design a whole space flight, as was done in the Marsville project described above (Rhodes, 2006) The possibilities are myriad and are only limited by the ability of the student to understand the concepts.

Because students "discovered" the information on their own, these examples of the use of the spreadsheet allow students to understand more quickly and more intimately the structure of the knowledge than if the teacher had lectured about them. In addition, students begin to see the power of technology to understand concepts and solve problems. The calculations involved are many and would make the process of designing the flight without a spreadsheet very difficult. It also gives the students the flexibility to change the parameters and quickly update all calculations.

Webquests

The Webquest concept was invented in early 1995 by Bernie Dodge and Tom March at San Diego State University. They recognized the power of the Internet as a learning tool, but felt that its power was being wasted by those who were simply using the Internet as an encyclopedia. Dodge and March felt it was important for students to take this information and use it in a meaningful way. As a result, students would have to process the information in a different way than they would if they simply looked up the information on the Internet. A webquest is an activity that is designed to do just that. (Dodge, 1995)

A webquest is defined as an "*inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the Internet*." (Dodge, 1995) A webquest gives students a task to do. Ideally, this task is an authentic, real-life problem. To solve the problem, students would need to analyze it and decide what information is needed. Students will then be required to find the information they need on the Internet. The information would then be used to produce a solution to the problem. Solutions are often expressed in the form of a product, such as a report or a PowerPoint presentation.

A webquest is frequently a group activity, with each student participating equally in the process. When a webquest is a group activity, students are assigned different roles. Each student may research a different part of the topic, or each student may be assigned a different function within the task. For example, one student might be the person primarily responsible for doing the research, while another group member may be primarily responsible for writing the report. Although each may have a different role, the activity is structured so that all must be collaborative on the project. The webquest requires students to cooperate with one another, which will help them to learn to work together to solve a problem.

An exemplary webquest is *All Men Are Created Equal…?* (Lamb, 1997) In this webquest, students research and take the role of a Cherokee, Japanese, or African-American person and perform an activity related to a time in which these groups were being discriminated against. These activities ask the students to put themselves in the shoes of a minority person and vicariously experience what it must have been like to suffer discrimination.

This webquest goes beyond learning facts about the circumstances of the discrimination. Although the students learn about what happened to these people, they understand more in-depth their experiences through the process of writing from their perspectives. One thing that occurs is that they begin to challenge their assumptions that all people in the United States throughout history have had equal rights. They also begin to understand what the term discrimination really means in a much more concrete way. Because they are required to express their concerns about the discrimination in writing, they learn to use the terminology associated with discrimination, which helps them clarify their understanding of it.

In the *Student Press Law and Ethics WebQuest*, students are asked to work with a team of students as if they were an editorial team to address ethical dilemmas that might confront a newspaper staff (Cabral, 1997). The team has to decide whether to publish articles that might involve conflicts of interest. The team members are expected to go onto the Internet and access sites that address ethical issues in journalism. These sites include professional journalism organizations. The team then needs to come to a consensus regarding the decision.

This activity requires students to work collaboratively to come to a decision. It requires a team of students to evaluate the issue, consider the pros and cons of different ways to address the issue, and come to a consensus decision based upon ethical principles. As a result, the webquest requires students to think about ethics in a completely different way than if they learned it theoretically. By letting students see the issues first-hand, they see the importance of ethics and learn about ethics in a much deeper way than if they were lectured about it.

In the American Presidents Online Adventure, each student in a class takes on the role of a President. Students will research three areas: biographical information, political career and years as chief executive (Ronan, 1998). Each "President" will then hold a "press conference." Other students will then serve as reporters at the press conference. In the press conference, they will ask questions that pertain to the issues that each President had to deal with. The President is expected to respond to the questions asked in character.

By having students assume the role of a President and experience a press conference, students will do their research differently than if they were writing a report. Information becomes more personal when it is used to defend a position. Students begin to see the historical context of the information and apply the information within that context. They can begin to see the implications of the decisions that the President made, and that Presidents make today. Students begin to think critically about the decisions that were made by the President. They begin to think politically.

Conclusion

One's definition of exemplary use of educational technology depends upon one's orientation to educational technology. One's orientation to educational technology is affected by one's approach to education in general. Those who lean toward a direct instruction approach see educational technology as a way of delivering instruction more efficiently. Those with a constructivist approach to education view technology as a way of helping students take control of their education. Constructivist-oriented teachers structure technology-based learning experiences so that students apply higher-order thinking skills across different subject areas to solve problems or produce products, often in collaboration with other students. Students are expected to communicate with others using content-appropriate vocabulary that demonstrates that they have learned. The focus of instruction is not upon the transmission of knowledge, but upon the learning of the content-dependent higher-order thinking skills.

In exemplary lessons using educational technology, the focus is not upon the technology. Technology is simply used as a tool to help facilitate the lesson. It makes the process of teaching easier. It also extends the world of the students, to let them explore beyond the classroom. The teacher is the guide to this world; he or she is to structure the students' learning experiences so that they are not lost in this world, but are able to develop the knowledge structures and the confidence to go boldly where they have never gone before.

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