Utilizing Web Based Technologies In Problem-Based Learning

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Abstract: This instructional strategy utilizes a Problem-based learning (PBL) approach to curriculum development and delivery. Each student is tasked with designing, developing, and reflecting on an appropriate grade level project that is published as a Web based curriculum. The content of the PBL focuses on a current real world science topic while concentrating on specific concepts and skills in both science and technology. The purpose of this integrative approach is to have the learner demonstrate an understanding of scientific inquiry that effectively integrates Web based technologies.

An Overview of Problem-Based Learning

Problem-Based Learning (PBL) is an inquiry-based approach that can be defined as both a curriculum and a process. The curriculum consists of carefully selected and designed problems that engage the learner in the process of acquiring critical knowledge, developing proficiency in problem solving, engaging in self-directed learning, and participating in collaborative teams. So much fascinating information is at the fingertips of learners everywhere; and with the increase in the affordability and availability of technology, more and more learners have access to information sources. PBL approaches give students the ability to retain facts though critical thinking by working through problems logically and making connections to the real world.

How can teachers and the students they serve become more informed citizens regarding real world issues? A national report found that U.S. education had a "splintered vision": standards in science and mathematics education are not only unfocused, but aimed at the lowest common denominator (Schmidt et al, TIMSS, 1996). Compared to teachers in 50 other countries, U.S. teachers are expected to address a wide range of subjects, yet they seldom have the time to teach them in depth. As a result, students often take a piecemeal approach to learning and view content information as the boring memorization of facts that are seemingly irrelevant to their everyday lives.

Meaning is a human construction with a social situation. The learner is always defining meaning within the context of action and reflection. Yet, educators must beware of regarding the learner's point of view as fully complete and significant in and of itself. (Dewey, 1970). Each learner understands content and concepts differently based on his or her previous experiences. The students need opportunities to address misconceptions and to develop concepts in real world situations. "Students come to school with their own ideas, some correct and some not, about almost every topic they are likely to encounter" (Rutherford and Algren, 1990). Learning is the responsibility of the learner, but the teacher must guide the student into developing meaning from content material and classroom experience.

Problem-based learning (PBL) is a multidisciplinary approach that integrates effective teaching and learning practices with computer technology. This curriculum integration process engages students in collaborative research that can be shared in the classroom, across a community or around the globe. PBL features open-ended and cooperative activities that deal with real world issues and scenarios.

The Critical Thinking Curriculum Model

The curriculum approach follows the Critical Thinking Curriculum Model (CTCM), which is a multidisciplinary approach designed to encompass computer technology, relevant content information, and effective learning and teaching practices. As a PBL design model, it encompasses the political, social/cultural, economic, and scientific realms in the context of a real world issue. In this way, students realize the importance of their schooling by applying their efforts to an endeavor that ultimately will affect their future.

The Critical Thinking Curriculum Model consists of four equal and important organizational components that form the backbone of the model. The four parts of the model are the educational components, the technology

components, the assessment components and the community components. The model can be utilized with a great number of topics, but hinges on the preparation and willingness of the instructor to modify the traditional role of content delivery.

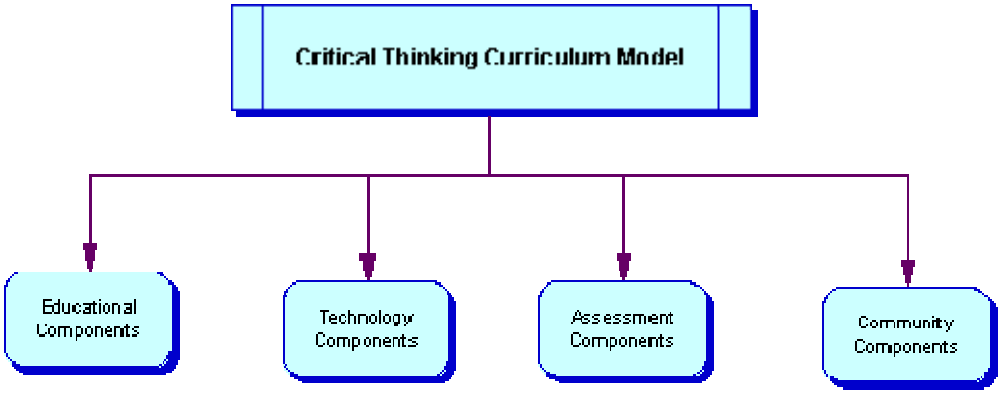

Figure One: The Critical Thinking Curriculum Model

Selected topics may deal with issues that are global in nature or local in focus, but are inherently multifaceted and naturally controversial in scope. It would be easy to deliver content from a singular perspective, but as the intent of the model is to foster critical thinking, it is best to refrain from such traditional content delivery methods. The intent is for students to investigate the issues through research, both through traditional resource materials and through the Internet. The teacher wants students to ask probing questions, to differentiate between differing perspectives while considering the impact that political, economic, and social decisions have on the world, not just a nation. By doing so, students' gain a better understanding of the position that our national leaders take within the world community.

The Critical Thinking Curriculum Model allows for a deeper search into a topic, whether it is terrorism, the future of "things nuclear", volcanoes in the universe, or macro-invertebrate analysis in local streams and rivers. The teacher guides students in developing questions for further investigation, recommending resource sites, and probing student understanding of a given topic. (Wasley, 1991) The teacher becomes a colleague, as students give direction to the research. (Duffy et al. 1986) Collaboration, whether it be in person or through telecommunications, is vital to motivating students and providing relevance to their classroom activities.

The CTCM utilizes a student-centered Internet-based research approach. A networld, a collaborative area where students exchange information and resources, is vital to this design. "Students in the networld engage in group learning projects with peers from other regions and countries. They share ideas and resources, access information on current events or historical archives; and interact with experts" (Harasim, 1993). Teachers involved in the CTCM based approach report that this strategy enhances the learning opportunities for their students.

The framework for the Critical Thinking Curriculum Model centers on the student taking responsibility for their own learning, and that the learning experiences should build upon previous knowledge (Dewey, 1970). The learning environment in a constructivist educational approach is one that fosters thinkers who ask questions, and look for their own answers. The teacher takes the role of facilitator, guiding each student as they encounter new subject matter through their research of the topical issue. A CTCM based curriculum engages the learner actively, requires cooperation and collaboration, and is not fundamentally built upon grades and competition (Shepard, 1989). The differences of others become valuable during group activities, as the teacher matches the tasks to the variety of learners present in the class (Apple, 1993).

Just as scientists constantly communicate with one another in order to solve problems, students should be engaged in the higher order thinking skills that include synthesis, evaluation and application of information, not memorization (Shepard, 1989). Situations in the real world are unique and often require new methods or techniques to solve them. Problem solving strategies often change along with the underlying concepts (Bruner, 1962).

Students should be encouraged to publish their work on the World Wide Web (WWW), and the Internet should be a comprehensive part of the research and dissemination of student products. Informal evaluations have shown that students who publish their work on the Web increase their reading and writing abilities (Herman, Osmundson, Pascal, 1996). One reason may be that their work is available for the entire world to see at any time. It stands to reason that a student who knows this will prepare their work to a greater degree, and in effect increase their writing and reading abilities.

Ultimately, students should be engaged and participating both in and outside of class, as this is crucial to learning and the construction of purposes and meanings (Wiggins, 1989). The teacher should actively promote and encourage positive group interactions and cooperative behaviors that foster the types of thinking interactions that enhance the learning process (Bossert, 1989). The CTCM design incorporates this approach and provides a method for understanding the content.

Enhancing PBL with Student Built Web Sites

In an effective classroom, learning requires more than connecting new material to old ways of thinking, but far better, to new ways of understanding. "Students come to school with their own ideas, some correct and some not, about almost every topic they are likely to encounter" (Rutherford and Alhgren, 1990). Students need experiences that help them to develop new views and make better sense of their world. Learning is the responsibility of the learner, but the teacher guides the student toward developing meaning from content material and classroom experience. Communication from and between multiple peoples and perspectives is important and vital to learning. In describing and explaining ideas to others, the learner synthesizes material in a way that requires higher-order thinking. A person who successfully explains a body of knowledge to others may be said to have mastered this knowledge.

Within this approach, each student is tasked with designing, developing, and reflecting on an appropriate grade level problem-based learning curriculum that focuses on a current real world topic and integrates specific science concepts. Each student posts their materials on a self-developed Web site that encompasses the development of a problem-based learning curriculum unit following a provided outline and design template. The purpose is to have the learner demonstrate an understanding of problem-based learning as associated with inquiry based science that is facilitated in a Web environment.

In order to have a successful PBL, the learning environment should promote the use of telecommunications for research and collaboration with other participants. For example, students can demonstrate their acquired knowledge through a functional and well designed Web site. This helps to bring the issue alive and engages the students in active learning. Appropriate software and training is essential in providing a positive telecommunications environment for all students, while sound technical support is vital in keeping the lines of communication open.

Web based technologies in this example can be defined as computers with Internet access, multi-media tools, and other software programs that will aid in the acquisition, collaboration and communication of information. The use of technology to foster and develop skills of critical thinking is an area of great potential in education. Researchers have indicated that technology as has been defined above, when integrated properly into a Web based curriculum, may very well improve the problem solving skills of students, as well as their abilities to apply critical thinking in reference to the information that can be accessed on the Internet.

Technology can be an ally to the modern teacher, and should be effectively integrated into the presentation and demonstration of the curriculum. This takes a different style of teacher, one who learns from students and also models the use of technology in the classroom (Duffy et al. 1986). Today’s student needs to be stimulated, and since technology is an integral feature of the modern world, to not use it in the classroom is a real disservice to the student. In science, "technology provides the eyes and ears of science - and some of the muscle too" (Rutherford and Alhgren, 1990). Technology, whether it is a computer or a calculator, is vital to teaching the concepts associated with data collection, computation and measurement. It is also something that is recommended by educators in such volumes as the National Science Standards and the National Mathematics Standards. It is at this point that the Internet is most powerful, and the motivation to do good work becomes intrinsic and not driven by the pursuit of a

grade. It is one thing to do a project and turn it into a teacher in your school, it is quite another to publish your work on the Internet for anyone with access around the world to read and consult.

Students utilize the Phases of Educational Web Site Design and Development as an organizing framework for integrating technology tools into their curriculum development process. This framework is centralized into five basic areas; planning, research, development, refinement and implementation. These five areas work as organizational frameworks for instruction and learning, Web site development and implementation, student progress and presentation. The scope and sequence of the content area matches the phases and allows for the integration of software tools for concept mapping, word processing, Web browsing, HTML code editing and file transferring. Students develop a functional Web site that integrates content and graphics into a variety of Web interface strategies. Topics include HTML, tables, links, graphics, templates, page layout as well as exploring related software packages, including MS Frontpage or Macromedia Dreamweaver, Inspiration, WS FTP and Internet Explorer.

The textbook is a classroom resource, but not the only resource, and the nature of knowledge should incorporate multiple viewpoints and sources that include textbooks, the Internet, multimedia and other sources of current information. Knowledge is as much about process as it is about content, and the two must be integrated effectively so that the learner sees the value of the content in a conceptually correct context (Hoehn, 1990). Students should explore multiple examples from many cultures and time periods, and be given the time to make sense of it all. The goal is to engage the learner in higher-order thinking that includes analysis, synthesis and evaluation of material and information (Hoehn, 1990).

For the student, the content is included within the Web site as links and consists of research papers, associated activities that fit into the scope and sequence of their project, and appropriate reference materials. Students develop the Web sites using the appropriate technology, post their information on the Internet and present this information in class for assessment. The purpose is to have the student demonstrate an understanding of the concepts associated with problem-based learning within a real world science topic that is appropriate for their current classroom. Each student must include appropriate research and supporting activities within the content of the Web site.

Conclusion

Utilizing Web based technologies in problem-based learning provides an opportunity for learners to develop competencies that are necessary in order to become effective science instructors. This approach allows the learner to develop a curriculum that integrates needed content information, conceptually correct understandings, effective pedagogical strategies, and the necessary technical skills needed in order to create and facilitate problem-based learning in a Web environment.

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