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ABSTRACT

In 1997, Southwest Missouri State University faculty tried delivering coursework via the Internet. The first step in the process was to assess the medical model of problem-based learning for its adaptability to use on the Internet. The faculty determined that problems could be developed, put on the Internet, and monitored without denigrating the educational process. The next step was to find the right type of course and develop appropriate mechanisms for inquiry. The choice was an upper level curriculum course dealing with administration, development, and evaluation of a school district's curriculum. The course was flexible, with process generally more important than content. The next step was problem development. Faculty generated research-based problems using expected student outcomes from the course syllabus. The next step was developing structures or embedded parameters and using them to give some direction to students without tarnishing the problem-based delivery model. The final component was monitoring student progress and providing Socratic questioning, often via e-mail, fax, teleconferencing, and telephone. Project evaluation included exit interviews, surveys, participant debriefing, and comparison of examination scores with scores from a control group. Results indicated that experimental group members' scores compared favorably with those of the control group. Participants had positive feelings about course methodology. (SM)

# Utilizing a Problem-Based Approach on the World Wide Web

by

Dr. Scott B. Wegner, Dr. Ken Holloway and Dr. Allan Crader

## Introduction

During the Spring semester of 1997 several faculty members at Southwest Missouri State University, intrigued by the possibilities of delivering course work via the Internet, embarked on a pilot project designed to test the effectiveness of such a delivery system. Before this effort, primary use of the Internet had been through an extensive departmental web site which supported communication, advisement and basic student research through educational research links but had not been utilized greatly for instructional purposes. As is the case with most educational institutions, there was great interest at Southwest Missouri State University for increasing the use of the Internet and other technologies beyond the sporadic use of interactive television, e-mail, fax and some web site usage.

Even though the professors had the capabilities and appropriate attitudes, as well as the support of the college and university, there remained the issue of finding an "appropriate" instructional use for the World Wide Web. Too much of what had been promoted by technology company representatives resembled nothing more than the old programmed learning materials of the 1960's. Simply dumping one's course lecture notes on a web site with a few worksheets thrown in for good measure, for the sake of claiming that a class was being delivered technologically was professionally revolting and therefore was not considered as an option. There would simply not be a commitment to a technology based delivery system until it was perceived as enhancing the teaching/learning process. There had to be a proper marriage of technology with methodology. Anything less would be unacceptable. It wasn't until the faculty analyzed the medical model of problem-based learning that they felt that use of the Internet and its attendant technologies could be maximized.

**Problem-based Instruction**

Problem-based learning models have been in place in the medical field for decades and some authors speculate that the model is used in well over 80% of all medical schools in the United States (Bridges and Hallinger 1993). Problem-based learning in these settings had been found to not only enhance active learning on the part of the participants but also better simulate the actual workplace decision-making processes therefore strengthening positive transfer of knowledge and skills. (Bridges, 1990)

While definitions of problem-based leaning vary greatly from one instructional context to the next, the EAD instructional team felt that problem-based instruction could best be defined as:

> ...learning that results from the process of working toward the understanding or resolution of a problem. The problem is encountered first in the learning process and serves as the focus for application of problem solving or reasoning skills, as well as the search for or study of information or knowledge needed to understand the mechanisms responsible for the problem and how it might be resolved. (Barrows and Tamblyn, 1980)

The key is in providing the problem first and letting students develop an understanding of the facts, the problem-solving strategies and the eventual problem resolution on their own. This "discovery" approach to ill-structured problems fitted perfectly with the capabilities of the Internet, a medium which gave students easy access to the identified problems as well as a plethora of research engines and information sites. It was the belief of the instructional team that problems could be developed, put on the Internet, and student progress monitored without denigrating the educational process inherent in the methodology. Function was not sacrificed for the sake of form.

**The Process**

After determining that the problem-based approach was indeed a feasible one, the next challenge was to find the right type of course and to develop the appropriate mechanisms for inquiry. Since the decision had been made that an entire course would be committed to Internet, careful consideration was to be given regarding course selection. The faculty involved in the project used the following process.

The faculty first looked for a course where process was generally more important than content and where there was a great deal of flexibility to the products which could be developed. This was done to insure that any required products could be made applicable to the students' current job setting. Additionally, this criteria was used because the memorization of large amounts of specific, predetermined facts or knowledge level information was considered to be better suited to instructional paradigms other than problem-based instruction which focuses more on skills such as problem identification, solution prioritization, group processing, organization and other more authentic skills. Further, since problem-based instruction promotes a high level of learner autonomy, the faculty looked for a course which would support a multitude of acceptable answers and products. For this project, the faculty chose an upper level curriculum course that dealt with administration, development, and evaluation of a school district's curriculum. The course contained some discrete knowledge and processes but had a great amount of flexibility in product construction. The participants of a class at this level were generally well motivated and eager to engage in processes which would manage and support curriculum at the district, school and classroom level. Students at this level generally possessed good prerequisite skills in research, problem-solving and organization, as well as general leadership and administrative skills. Additionally, since the products to be developed were going to have utility and were relevant to the students' current employment situations, it was felt that participants would have a vested interest in the course outcomes. Again, although problem-based instructional models have proven to be successful at almost every level of schooling, the faculty wanted to select a course which would avoid any situation which might undermine the first venture into problem-based instructio on the Internet.

The next step was problem development. For this stage of the problem-based instructional model, a synthesis of research was used. The research revealed that:

1. The starting point of the learning is a problem. (Bridges and Hallinger 1993)
2. The problem should be one that students are apt to face in the future.(Bridges and Hallinger 1993)
3. Subject matter is organized around the problem rather than by discipline. (Bridges and Hallinger 1993)
4. The student has the major responsibility for learning and instruction. (Bridges and Hallinger 1993)
5. Small groups are desirable to individual study. (Bridges and Hallinger 1993)
6. The teacher best supports the lesson through problem formulation.
7. Open-ended and divergent questioning on the part of the instructor is crucial to the problem-solving process. (Whitman and Schwenk, 1986)

Using the above as a guide, the faculty first generated problems using the expected student course outcomes from the syllabus, as well as knowledge of current workplace problems as a guide. The three problems which constituted the curriculum class offered at SMSU, featured such areas of study as: needs assessment, mission statement development, curriculum long and short-term planning, assessment and staff development. These areas of curriculum were integrated and converted into problems to be solved in response to a local Board of Education's demands for a quality curriculum. The problems were coupled with a scenario which presented the typical constraints encountered by curriculum administrators such as state accreditation standards (in this case the Missouri State Improvement Program), desires and attitudes of the local community, teacher morale and national standards.

**The Problem of Structure**

At this time the faculty was faced with a mild dilemma. While process skills were the main feature of the course selected, there was still a concern that students should be exposed to the same critical mass of content to which students in the "regular" course or control group were exposed. Providing "structures" or embedded parameters used to give some direction to students is some what of a controversial issue in problem-based instrucitoin. For purists, problems are to be ill-structured, "messy situations" subject to change as information comes available. ( Illinois Mathematics and Science Academy) To attempt to provide additional structures would result in something other than true problem-based instruction. The faculty took a more liberal view. Structure was seen as a tool to assure that certain key components, such as certain vocabulary and, most importantly, knowledge that met administrative certification, national standards and the departmental Knowledge Base considerations were addressed. Did the introduction of structures tarnish the problem-based delivery model? The faculty did not believe so. In most cases the structures were aimed at parameters which students would encounter as curriculum administrators anyway. The structures simply made sure the parameters were considered. In the remaining cases, the structures were used to make sure students encountered terminology and concepts to which the control group would be exposed. It also helped students to avoid "Pseudodiagnosticity" or the tendency to seek data which is unhelpful or harmful to problem solving, (Kern and Doherty, 1982) thus better utilizing time. The fgaculty was also careful to make sure that the structures were "encountered". The experimental group was never told to pay special attention to nor "learn" the concepts or terms represented in the structures, they were simply exposed to them.

The faculty, besides providing conditions in each of the problems, developed structure in a number of other ways. For instance, each problem was followed by a list of focusing questions to act as a springboard for group discussion and research. These questions were linked to expected student outcomes which were, in this case, more process-oriented than content driven. They did not dictate how to proceed, they were designed only to provide an initial push. The faculty were assisted in the development of the focusing questions by local school curriculum directors. These public school officials helped immensely in establishing relevance to the products and the processes developed by the students. Additionally, structure was provided through the development of product specifications. Product specifications were general descriptions of the product to be generated after the prescribed time of study. In the course in question, the products related to district planning documents, guides, communication tools, assessment plans etc. These type of documents were of the type usually expected to be found in most districts, demanded by Boards of Education and communities and staffs in the "real world" and, in some cases, required for state accreditation.

Final structures developed by the faculty to assist students included a list of key terms and concepts, a list of resources (including web links to national standards, Missouri Department of Elementary and Secondary Education curriculum documents, virtual libraries and research search engines), and a rubric for the assessment of the product.

**Questioning**

One component included in the SMSU approach to problem-based instruction that did not appear in a great deal of the literature was the use of Socratic questioning. Whitman and Schwenk (1986) stated that problem solving left unattended by the instructor could lead to a multiplicity of poor decision-making and problem solving habits such as premature closure and the concept of anchoring (See Voytovich, Rippey and Suffredini, 1985). They stressed that application of Socratic questioning is critical in the development of good problem-solving skills. In their summary of research concerning the lack of quality questioning upon the part of instructors and subsequent paucity of student involvement they stated the obvious, "We agree completely with Foley and colleagues (1979) that students will become better problem solvers when they are actively involved in problem solving. If teacher do most of the talking, one must question who is doing most of the learning!" (Whitman and Scwenck, 1985 p. 458)

This final component of monitoring student progress and providing Socratic questioning raised some interesting problems. Since the students did not come on campus and were long distances away, technology would have to be relied upon to maintain contact. In cooperation with the local school district, students were provided with video-conferencing capabilities (surprisingly affordable), email and fax and of course telephones. These technologies gave the class ample opportunity for the exchange of information as well as convenient contact with the professor. Most of the software utilized, was downloaded free from various Internet sites, thus keeping costs down. There were the usual frustrating moments of hardware mis-configuration, software incompatibility, and Internet limitations (read "The future isn't now with video-conferencing" by J. Strauch (1997) before contemplating video-conferencing) but overall the technology arrangements were workable.

## Pilot Project Results

Results from the pilot project were encouraging. The experimental group members were debriefed, given exit interviews, filled out surveys and took the exact final examination as the control group which was held simultaneously on campus. Final exam scores for the control group averaged 92.5 while the Internet class scores averaged 90.4, an insignificant difference. A item analysis showed that three short answer questions accounted for preponderance of difference in the scores. The experimental group actually out performed the control group on both the objective portion of the test! The student's final project was comprehensive and usable comparing favorably with products completed in the control group, though side by side comparisons were impossible due to differences in the two groups' assignments. (The experimental group's assignment was much larger in scope than the control group's assignment.)

Student remarks in the debriefing as well as in the exit survey were grouped under is 5 general headings. A summary of the positive and negative remarks given by students in each of the general areas included below.

| AREA | POSITIVE | NEGATIVE |
|---|---|---|
| Problem-Based Approach | 1. Allowed me to perform.<br>2. Work was beneficial, not "busy work".<br>3. Gave me a taste of the "real world".<br>4. Project was something worth doing. | None |
| Technology | 1. Novel, something different.<br>2. Access to research was convenient.<br>3. Internet work was interesting. | 1. Some participants need more technology training<br>2. Internet training needed.<br>3. Make access to Internet topics easier. I did too much "surfing"<br>4. Make sure everything works. |
| Lack of Professor Direction | 1. Got frustrated but we worked it out<br>2. Professor was there when an if we thought we needed it.<br>3. Guiding questions helped ease the need for the professor to be there. | 1. Would like to have had more.<br>2. Missed affirmation of our work. |
| Problem-Based v. Traditional Approach | 1. The product.<br>2. More practical skills.<br>3. We made our own meaning.<br>4. The learning came from us. | 1. Missed some of the facts.<br>2. The other students got more philosophy and history.<br>3. Professor's expertise and experiences. |
| General Comments | 1. We got a sense of group, a kind of camaraderie.<br>2. Working together as a team was fun.<br>3. We were able to break the problem down and attack it as a team.<br>4. Focusing on a product was helpful. | 1. EAD 657 should be a prerequisite.<br>2. Could you put your lectures on-line?<br>3. Put the terms and their definitions on-line. |

As one can see, the problem-based instruction model received high marks from the students as well as the use of the cohort method. Not surprisingly, technology received mixed reviews. The technologies which were used most were e-mail (19 contacts )and the telephone (27 contacts). Video-conferencing was attempted 14 times with only six successful linkups, most of limited quality. Students cited the Internet as a valuable source of research and suggested alternatives to video-conferencing for future trials. Bottom line was the technology could be improved but it did work.

**Conclusion**

It is the feeling of the EAD faculty at Southwest Missouri State University that problem-based instruction and its application to the Internet is both workable and productive. Bolstered by the results of the initial pilot project, three more cadres of students have been asked to serve as subjects for the 1997 Fall term in a continuation of the pilot. Better technologies and more advanced software will be utilized to hopefully maintain better professor-student contact and support the Socratic questioning which the faculty feels is critical to the problem-based instructional approach. In addition, closer monitoring of the type and quality of student-professor exchanges and their relationship to product quality and knowledge attainment will be attempted. Further successes may have a profound effect on not only the way the department teaches but how courses are delivered.

As stated previously, the Internet is not necessarily the best way to provide instructional delivery in every instance. Simply putting your notes or lectures on the web will not replace the interchange of ideas nor the dissemination of knowledge by a qualified teacher in the majority of cases. However, the Internet does provide an opportunity for expanding the repertoire of the teacher to the ever-growing number of students who have access to the Internet. With a world of information at their fingertips, the guidance of a skilled instructor and a challenge to solve carefully constructed "real" problems, one can only imagine what students will be able to accomplish.

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