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Problem-Based Learning in a Systems Analysis Course

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Abstract

This paper discusses on-going efforts to use Problem-Based Learning (PBL) in the first course of a two part Systems Analysis and Design sequence. The PBL class used a series of five group projects to focus student learning on major areas traditionally covered in a Systems Analysis course. Each project culminated in a group report or oral presentation. Peer and presentation evaluations were conducted on-line with summary data and comments available to each student. Students were also required to perform a self-assessment of their learning on each project. In addition to group work, students used a Lotus Notes/Domino discussion database as a tutorial aid and to discuss major topics of the course, post references for problems and to coordinate group activities. An analysis of student attitudes toward PBL and peer evaluations is provided and compared to the results from a previous study.

Keywords: Problem-Based Learning, System Analysis, Collaborative Learning, Peer Evaluation

1. INTRODUCTION

Problem-Based Learning evolved from Constructivist (Duffy 1997; Jones 1996; Novak 1999) that students learn more when they assume greater responsibility for their own learning. Cini and Vilic put it this way (Cini 1999): "...a well designed course...acknowledges that students are active constructors, not passive recipients, of knowledge. Thus, learners should be encouraged to take responsibility for their learning and become active learners."

PBL is based on the belief that "the ability to solve problems is more than just accumulating knowledge and rules..."(Jones 1996b). Teaching "the book", or excessive concern over "covering" the subject probably doesn't do the best possible job of preparing students for the future. Students who memorize material for an exam typically retain little use of that information (Jones 1996a). Even the problem solving taught in schools is frequently based on artificial situations with well-defined limits and a single correct answer. As Jones points out (Jones 1996b) "real-life problems seldom parallel well-structured problems; hence, the ability to solve traditional school-based problems does little to increase relevant, critical thinking skills students need to interact with life beyond the classroom walls."

Problem-based Learning has been used to overcome these limitations in medical education (Barrows 1992, 1996; Pross 1999, see also http://meds.queensu.ca/medicine/pbl/pblhom10.htm) and numerous undergraduate programs (see http://www.samford.edu/pbl/where.html for PBL search engine). While there are variations in what people call Problem-Based Learning, all approaches use problems to the focus the student's learning. As Duffy points out, the problem should be the "stimulus for learning" (Duffy 1997), not prior reading assignments or other required work. Stinson and Milter (Milter 1994) indicate that the problems should be ill structured, not the textbook cases commonly found in business schools. The problems should also be mirrored on professional practice (Milter 1994). Problems should be "contemporary" (Milter 1994) and "authentic" tasks (Novak 1999), based on real situations and similar to what the student will face on the job. Barrows tells students that they will "...learn as you work with...problems like those you are going to face in the future (Barrows 1996)."

Group work is another important feature in most PBL programs (Duffy 1997). As Barrows tells his students "much of the power behind PBL as an educational method lies in the discussion you and your group have as you work ... and study together" (Barrows 1996).

Another major component of most PBL programs is the use of tutors (Barrows 1996; Pross 1999; Rangachari 1996). Tutors "stimulate and guide discussions. They are not to be a source of information about any aspect of the problem..." (Barrows 1996). While tutors don't "teach" in the traditional sense, they are supposed to help the group stay "on target"

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and make "reasonable choices" (Pross 1999) on key issues related to the problem at hand.

This paper discusses efforts to introduce Problem-Based Learning in a Systems Analysis course. The Management Information Systems department at Ohio University divides the topics normally covered in Systems Analysis and Design into two quarter long courses, MIS 320 - Business Systems I, and MIS 420 - Business Systems II.

MIS 320 covers the early stages of the systems analysis and design cycle. Topics typically include traditional and modern approaches to systems development, requirements determination, project planning and management, feasibility analysis, information gathering tools and techniques, analysis tools and diagramming techniques (data flow diagrams, entity-relationship diagrams, etc), generation and evaluation of alternatives, cost-benefit analysis, and so forth.

In the past the course was taught using lectures, a standard textbook such as Whitten and Bentley (Whitten 1998), and a series of short group projects. The projects typically asked students to learn and use various software tools such as Microsoft Project or Microsoft Access (as a prototyping tool), create and administer information-gathering instruments, analyze problem statements and create data flow or entity-relationship diagrams, etc. Short-answer essay exams and project results determined student grades.

While this seemed to be a fairly typical approach to the first systems class, the author was never satisfied with the results. Systems analysis and design is a complex area of study. Numerous approaches to information system development have been proposed and tried over the years and many are still valid today in different situations. Students, however, only seemed interested in what was covered in the book or discussed in class. They didn't spend time exploring and discussing alternatives because the evaluation system used in the class didn't encourage or reward this behavior.

Group projects presented another problem not uncommon to other courses. How do you assign grades to individual members of the group? Do all group members get the same grade on the project? What if one member did very little while another worked many extra hours to compensate for the first? Some courses assume that peer pressure will solve this problem while others simply ignore the problem. Past attempts to deal with this problem in MIS 320 and MIS 420 calculated individual project grades by weighting the group grade with the result of a peer evaluation. While the peer evaluation approach seemed to work and to be reasonably fair, the logistics of administering and tabulating the results, calculating individual grades and providing feedback made the whole process quite cumbersome.

2. PROBLEM-BASED COURSE

The Problems

MIS 320 was converted to a problem-based course in the fall of 1997 using knowledge the author gained from problem-based learning initiatives at Ohio University including the full-time MBA (Milter 1994), MBA Without Boundaries (Stinson 1998) and Business 2020 (Perotti 1998). The 10-week course was divided into a series of five problems based on the major objectives of the course. Problem were developed by looking at the topics normally "covered" in a systems analysis course, identifying key concepts and writing problem statements to focus student activity towards those concepts. The intent of the problems was to have students analyze a client's problems, investigate approaches to understanding and solving the problem and then select an appropriate approach to the problem. The problems are ill structured because there isn't a single correct answer. The problems also mirror real life with the need to work from limited information, investigate possible solutions and make an informed choice, all in a very short time frame. Figure 1 shows the problem statement used for the first problem in the winter of 1998 and repeated in Winter of 1999. The problem statement format is based on sample problems provided to College of Business faculty during training sessions conducted at Ohio University by H. S. Barrows, Tom Duffy and John Stinson in the summer of 1997.

If should be noted that there were no assigned readings or predetermined lectures related to this, or any, problem. Students were expected to investigate the subject on their own, collaborate with their peers and seek assistance when needed. Each problem builds on the previous problem and all problems relate to the same business or organization. Problems in the fall of 1997 focused on information processing needs of the College of Business Alumni Relations Office while the winter 1998 and winter 1999 courses used a fictionalized company called Megamart. Megamart is also used in a database class that most students took concurrently with MIS 320. We hoped that the use of the same example organization in the two courses would strengthen the correlation between the two courses in the student's mind. MIS320 used the PBL format to study the development of an information system for the local Emergency Management and Red Cross Family Assistance programs during the fall term in 1998.

At the beginning of the fall 1999 class students were randomly assigned to groups of 5 or 6 students. All groups investigated the same problem but half of the groups were responsible for making a formal oral presentation of their findings while the other half were assigned the task of producing a written report and questioning the presenters.

In the first versions of the PBL class, presentations were made to the class as a whole but the format was changed for the 1998-99 school years to use small group, consultant/client presentations. The new format had the presenters acting as consultants making a report to a group of knowledgeable

clients (students who produced the written report). Group roles were reversed on the second project. Students were assigned to new groups for the final projects and the process was repeated.

Each problem was completed over a period of four or five classes, or about two and a half weeks. During the first class meeting students were given the problem statement and time was provided time for an open-ended, in-class discussion. Team meetings followed this where small groups of students continued discussion of the problem and formulated an initial problem solving strategy. Portions of the second and third class periods were available for individual and group project work and in-class discussion. Written reports and oral presentations were due at the forth class as were peer evaluations. Self-assessments of individual learning were due by the fifth class period and this period was also used for a short project quiz and a debriefing session. Individual tutoring was available any time during the project with the Learning Issues Database carrying some of the tutoring and mentoring load.

MEGAMART is an electronic goods retailer with 20 branches in various parts of Ohio. It's home office and adjoining warehouses are in Athens. Branches are grouped into five regions (northeast, northwest, southeast, southwest, and central) for sales management purposes. MEGAMART is interested in purchasing a computer system to automate its operations. Initially it is primarily concerned with a system to handle the purchasing, distribution, and sale of its products. Eventually, they would like to add systems to handle their accounting and human resource functions after the product tracking system is in place and functioning.

Your task is to create a plan for development of an information system to meet MEGAMART's needs.

The deliverable for your team will be a written plan of how you would proceed to develop the information system required by MEGAMART.

Target Outcomes

- The student will analyze approaches to information systems development and select an approach for solving this problem.
- The student will describe basic activities at each step in the chosen solution in enough detail to facilitate preliminary scheduling and budgeting.
- The student will demonstrate the use project management/planning tools & techniques for scheduling and budgeting.
- The group will produce a plan in sufficient detail to allow preliminary budgeting and scheduling estimates for the project.
- Students will enter issues related to this project in the Learning Issues database with each person involved in an on-going discussion of the issues.

Figure 1.

The Learning Issues Database

As indicated by the last Target Outcome in Figure 1, each student was expected to participate in a Learning Discussion database. The discussion database, developed in Lotus Notes and using the Lotus Domino interface, gave students an opportunity to explore the issues associated with the current problem in an on-going dialog. This approach is consistent with Cini and Vilic's belief that the on-line environment is well suited to active forms of learning (Cini 1999). It was also hoped this discussion database could help fill the role of tutor and mentor for a large number of students at one time. Finally, the discussion database provided a way for students to branch out and explore different aspects of the problem and to share their findings with the rest of the class.

As each new problem was introduced the problem statement was posted in the discussion database as shown in Figure 1. To make the discussion easier to follow in the database, each Target Outcome was listed as Response to the original problem statement and students were asked to respond to the Target Outcomes (see Figure 2) or create new subheadings as they saw fit. Students were encouraged to use the Learning Issues database to share their findings with their classmates and to help prepare their group presentations and reports .

Students were told that their participation in the discussion database would be evaluated using the following scale developed by John Stinson for the MBA Without Boundaries program (Stinson 1998) and that they were expected to have at least one Level 2 entry each week.

- Level 1: Express an opinion based on past experience
- Level 2: Report results on inquiry or research - Acceptable contributions require some analysis or synthesis of information (simply quoting someone else's work is not sufficient).
- Level 3: React to and build on other's postings (not just repeating but building)

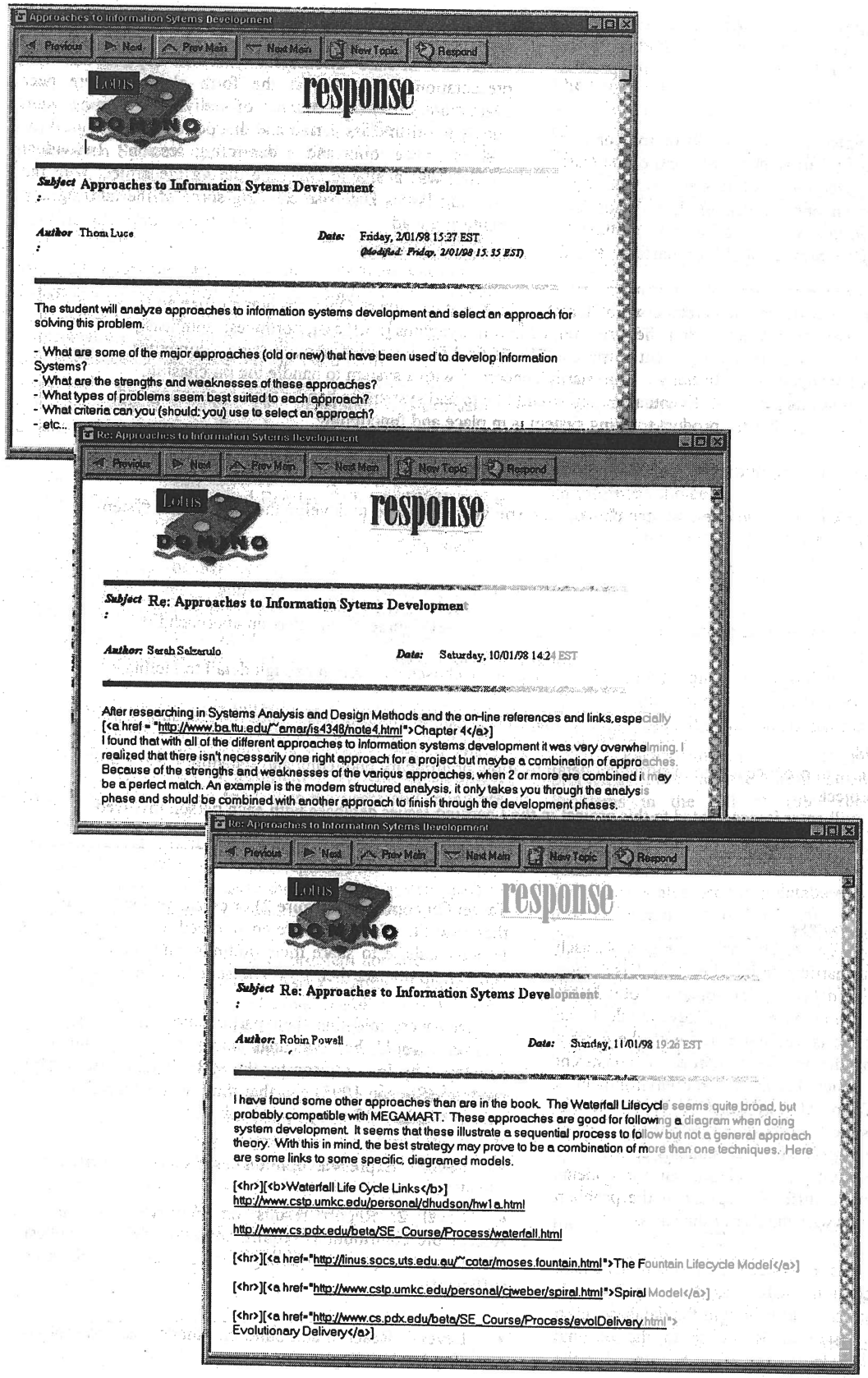
Approaches to Information Sytems Development
Previous
Next
Prev Main
Next Main
New Topic
Respond
Lotus
DOMINO
response
Subject Approaches to Information Sytems Development
Author Thom Luce
Date: Friday, 2/01/98 15:27 EST
(Modified: Friday, 2/01/98 15:35 EST)
The student will analyze approaches to information systems development and select an approach for solving this problem.
- What are some of the major approaches (old or new) that have been used to develop Information Systems?
- What are the strengths and weaknesses of these approaches?
- What types of problems seem best suited to each approach?
- What criteria can you (should: you) use to select an approach?
- etc...
Re: Approaches to Information Sytems Development
Previous
Next
Prev Main
Next Main
New Topic
Respond
Lotus
DOMINO
response
Subject Re: Approaches to Information Sytems Development
Author: Sarah Salzarulo
Date: Saturday, 10/01/98 14:24 EST
After researching in Systems Analysis and Design Methods and the on-line references and links,especially
[Chapter 4]
I found that with all of the different approaches to information systems development it was very overwhelming. I realized that there isn't necessarily one right approach for a project but maybe a combination of approaches. Because of the strengths and weaknesses of the various approaches, when 2 or more are combined it may be a perfect match. An example is the modern structured analysis, it only takes you through the analysis phase and should be combined with another approach to finish through the development phases.
Re: Approaches to Information Sytems Development
Previous
Next
Prev Main
Next Main
New Topic
Respond
Lotus
DOMINO
response
Subject Re: Approaches to Information Sytems Development
Author: Robin Powell
Date: Sunday, 11/01/98 19:26 EST
I have found some other approaches than are in the book. The Waterfall Lifecycle seems quite broad, but probably compatible with MEGAMART. These approaches are good for following a diagram when doing system development. It seems that these illustrate a sequential process to follow but not a general approach theory. With this in mind, the best strategy may prove to be a combination of more than one techniques. Here are some links to some specific, diagramed models.
[<hr>][Waterfall Life Cycle Links]
http://www.cstp.umkc.edu/personal/dhudson/hw1a.html
http://www.cs.pdx.edu/beta/SE_Course/Process/waterfall.html
[<hr>][The Fountain Lifecycle Model]
[<hr>][Spiral Model]
[<hr>][
Evolutionary Delivery]

Figure 2.

- Level 4: Synthesize or summarize, reflecting analysis, bringing ideas together to test for completion

Evaluation

Presentations and written reports were evaluated on how well the group met the objectives of each problem, how well they presented their findings and participation in the presentation discussion. Because a fundamental driving force behind the move to problem-based learning was a desire to have students broaden their exposure to the subject matter, there were no predetermined right and wrong answers to the problems. Groups were evaluated on their ability to find alternative solutions, evaluate those solutions and demonstrate the application of the solutions. Grades were assigned to each group product and then individual grades were calculated based on the group grade and peer evaluations.

Students were required to complete an on-line peer evaluation that was available over the World Wide Web at the completion of each project. The evaluation instrument asked them to rate the members of their team on a number of criteria. On each criterion item the student could assign a score ranging from 0.7 to 1.3 to each group member. The evaluation instrument was developed with the assumption that "doing the task right" had a value of 1.0 and would earn the student full marks on the project. Scores above 1.0 indicated effort "above and beyond" other team members, while scores less than 1.0 indicated a lack of effort. The on-line evaluation instrument required the evaluator to enter an average score of 1.0 for each item. This was based on the assumption that if one person didn't do their part then someone else had to do more, and that if one person did extra work, someone else must have done relatively less well. While any student could give all his or her peers a score of 1.0 on all items, the restrictions on point distribution prevented members of a group from giving each other all above average scores. Each student was able to use the Web to see his or her average evaluation scores.

In addition to collecting numeric evaluations, the on-line evaluation instrument allowed students to enter written comments on the performance of their peers and it forced them to make comments on all scores of less than 0.9 or greater than 1.1. This helped assure that each student would receive written feedback for any strong positive or negative evaluation. Each student was able to see the comments made about his or her performance but could not determine who made the comments. While most students wrote favorable comments, constructive criticism of a student's performance was often seen.

Finally, students were asked to submit a non-graded self-assessment of their learning at the end of each problem. The self-assessment was followed by a short, in-class written evaluation covering the Target Outcomes of the problem. This evaluation instrument was included primarily to help the instructor identify problem areas in the learning process and to help assure that each student participated in the problem.

3. FEEDBACK

At the end of the quarter students were asked to complete an Internet based questionnaire. Prior to completing the questionnaire students were assured that their answers were confidential and could not be traced back to them.

Table 1 summarizes the questions related to Problem-Based Learning. Questions one and two indicate that the students overwhelming felt they had gained a great deal of useful information from the projects. More than 80% of the students felt they learned more with the problem-based approach than they would have in a traditional class (question three) while less than 15% felt they would have done better in a lecture based class. This reflects are large change from the previous year where just over 50% of the students thought they had learned more with the PBL approach. Questions four and five show that while students were unclear of where they were going at the beginning of a problem, they knew what they had achieved at the end of the problem and question six indicates that the self-assessments helped them reach this point.

Questions eight shows some mixed reactions to the amount of guidance given at the beginning of problems but question nine indicates that the perceived lack of guidance forces them to learn more on their own. Question ten has the very encouraging result that two-thirds of the students felt they would retain more as a result of problem-based approach than had they taken a traditional course. The perceived value of this approach is again seen in question seven where almost 90% of the respondents indicate that, given a choice, they would take a problem-based course again.

Many students used written comments to reinforce their confusion at the beginning of a problem. Several comments asked for more guidance or a little more structure at the beginning of a project. A few students also asked to be told what the instructor was looking for ("the answer") once the presentations were complete. But the following quote from a self-assessment shows that some students understood the PBL approach:

> *"This class is set up different than any other class I have taken. It really challenges you to take the time to learn on your own, without much professor control. I have enjoyed the challenge so far."*

Table 2 provides some insight into the group dynamics of the course. Questions one and two show that the groups did work well together but that the groups formed at mid-term weren't as successful as the original groups. Whether this is due to personality conflicts, heavy commitments in other courses or some other cause isn't clear. Question three indicates that most students thought they were actively involved in their group but the number of students who felt they had to push their team members is a bit distressing. However, The Ohio University College of Business uses group work extensively throughout the curriculum. It is not

unusual for students to be members of 4 or 5 or more groups at the same time. This often causes schedule conflicts and may be partially explain for the results found in question three.

Table 1

	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average Winter 1999	Average Winter 1998
1	I learned a lot about information systems from working on the projects	0	1	1	19	15	4.33	4.16
2	The projects helped me gain practical knowledge of information systems development techniques	0	2	1	17	16	4.31	4.17
3	I would have learned more about information systems development in a lecture class	10	19	3	3	1	2.06	2.70
4	I was often confused about what I should do at the beginning of a new project	0	5	4	20	7	3.81	4.02
5	I was often confused about what I had learned at the end of a project	4	24	5	3	0	2.19	2.48
6	The self-assessments helped me focus on what I learned in the project	1	5	7	21	2	3.50	3.34
7	Given a choice, I would take a problem based class again	0	0	4	19	12	4.23	3.81
8	I often felt that the instructor should be providing more guidance on projects	0	13	9	12	2	3.08	3.44
9	The amount of guidance provide by the instructor forced me to learn things on my own	0	0	4	22	10	4.17	3.81
10	I will probably forget the things I learned in the project sooner than if I had learned them in a lecture class	12	11	5	7	1	2.28	2.34

Table 2

	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average Winter 1999	Average Winter 2000
1	My first group functioned well as a team	0	2	0	9	25	4.58	4.14
2	My second group functioned well as a team	2	3	8	14	9	3.69	3.73
3	I often had to push my team to get the work done on time	2	17	6	8	3	2.81	2.59
4	I normally let someone else lead the group	1	15	14	6	0	2.69	2.44
5	I learn better by myself than when I work with a group	3	19	8	3	3	2.56	2.64
6	The group work helped me develop and practice interpersonal communication skills	0	2	3	20	10	4.09	4.09

The findings in question three are reinforced in question four which indicates that a large number of students thought they were taking a leading in the group. Students generally felt that the group process was both helpful to their learning of the subject material (question 5) and that it helped in the development of their interpersonal communication skills (question 6). The following quote from a self-assessment summarizes how many students felt about the group process:

"My group has also taught me a lot throughout this project. Although I have been a party to many group project during my studies in the COB, this is the first time that myself and the other members of my group have worked so closely together. No one person was responsible for a specific area of the project, nothing was delegated. We all worked side by side helping each other, which was very interesting! At first, I was quite frustrated. I have always been a leader, and in the beginning I was eager to pass out tasks to each member. It was intriguing to see how our group accomplished tasks together, supporting each other. Everyone learned from each other, and no one was an expert in a specific field! This is the first time that I have not felt completely clueless in one aspect of the project. I am very pleased with the efforts of each group member and our group as a whole."

Table 3 looks at the value of the Lotus Notes/Domino Learning Issues database. Two-thirds of the students felt the Learning Issues helped them understand the subject while only 17% thought it did not help. Regardless of how much it helped them personally, over 80% of all students felt the Learning Issues helped them share what they had learned. The perceived value of the Learning Issues is reinforced in questions five and six where students say they clearly understood why they were required to work with the Learning Issues and felt that it was worth their time.

Table 3

	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average Winter 1999	Average Winter 1998
1	The learning issues discussion database helped increase my understanding of information systems development	0	6	3	20	6	3.74	3.70
2	The learning issues database helped me share ideas and research with others	0	4	1	19	10	4.03	4.02
3	I normally read all the comments posted in the learning issues database	3	7	4	15	5	3.35	3.20
4	I normally looked at all the links posted in the learning issues database	1	9	3	18	4	3.43	3.27
5	The learning issues database was a waste of my time	9	19	3	4	0	2.06	2.05
6	I never understood why I was suppose to use the learning issues database	10	16	3	6	0	2.14	1.88

Questions three and four attempt to get information on how the Learning Issues were used. Just over 50% of the students said they read all the postings while a slightly higher percentage of said they looked at all the posted links in the database. This may indicate that some students were only using the discussion database for links to other web pages and weren't paying attention to the postings of their peers.

A number of written comments dealt with mechanical issues related to the discussion database (responding to a posting rather than starting a new topic, changing the subject from the default "RE:...", etc.) Many other comments indicated displeasure with the portion of the final grade determined by database participation (about 10%)

Table 4 looks at the peer evaluation process and, by association, the method used to assign individual grades to problem work. Question one indicates that two-thirds of the students felt that the system produced a fair distribution of grades. Unfortunately 17%, did not feel this was the case. Related to this finding, 19% of the students thought that every member of the group should receive the same grade.

Table 4

	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average Winter 1999	Average Winter 1998
1	The peer evaluation system facilitates a fair distribution of grades to group members	2	4	4	14	11	3.80	3.45
2	I prefer a grading system where everyone in a group gets the same grade	7	17	8	3	0	2.20	2.55
3	I was honest in my evaluation of my peer's performance	1	1	2	21	10	4.09	4.02
4	I was evaluated fairly by my peers	0	4	4	18	9	3.91	3.77
5	The on-line peer evaluation system was easy to use	0	0	1	16	18	4.49	4.47
6	The on-line peer evaluation system was not flexible enough to allow for adequate evaluation of my peers	3	18	4	7	2	2.62	2.58
7	The on-line evaluation system provided adequate feedback of my performance as judged by my peers	1	3	2	23	6	3.86	3.69
8	I was worried that someone might be able to trace my comments on peer evaluations back to me	12	14	2	6	0	2.06	2.11

Regardless of their feelings about the distribution of grades, almost 90% of the students said they were honest in how they completed the evaluation and that they were, in turn, fairly evaluated (77%) by their peers. It would seem logical to assume that the students who felt their peers unfairly evaluated them are the same students who were unhappy with the grade distribution in question one and this was confirmed by the data.

Three of the four students who thought they received unfair evaluations also felt that the distribution of grades was unfair but only one of the four thought that everyone in the group should receive the same grade. Three of the four students in question also felt that the peer evaluation system failed to provide adequate feedback on their performance in the group.

In terms of usability, almost everyone felt the peer evaluation system was easy to use but about 26% of the students felt that it wasn't flexible enough to allow for an adequate evaluation. Approximately 83% of the students felt the system gave them adequate feedback on their performance and about 70% were comfortable that the feedback was anonymous.

Most written comments on the peer evaluation system were about the 0.7 – 1.3 scale and the requirement that all scores average 1.0. Most students didn't understand why they had to take points away from one person in order to give them to another. Some students also felt that it was inappropriate to give extra points to one person just so they could take them away from a non-performing member.

As indicated previously, the class presentation format changed in 1999. Table 5 shows results from survey questions added to examine these changes. One very pleasant finding was that two-thirds of the students felt they were better prepared for the presentations then they would have been for more traditional presentations.

Table 5

	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Average Winter 1999
1	My group was better prepared for our small group presentation than we normally would have been for a presentation to the whole class	0	2	10	16	7	3.80
2	The small group presentations gave me a taste of what it is like to be a consultant presenting to a client	0	1	0	17	17	4.43
3	I wasn't any better prepare to be a "client" in the small group presentation than I would have been for a presentation to the whole class	3	13	12	5	1	2.65
4	If we have to do presentations, I would prefer to do them in front of the whole class instead of using the small group format	23	11	0	0	1	1.43
5	My group spent time preparing for our role as "clients" in the presentations	3	9	8	12	2	3.03

As question two indicates, almost everyone felt the presentations gave them a feel for consulting. The following quotes taken from student self-assessments elaborate on this point:

"The format we use in this class gives you invaluable experience in a simulated client presentation. I believe this class has already prepared me more for any future field I might enter after graduation. The experience of preparing for and actually presenting to a client is like the field I hope to enter. Unlike any other classes I have taken I actually feel like I learned something worthwhile"

"In most presentations that I have done, I would just read a recited speech in front of the class. In this case it was a lot different. I really felt like I was in the real world trying to sell a product to the client. Instead of standing at a podium we sat in chairs and presented our information. That was very different for me. This was one of the most realistic presentations that I have ever done. More classes should do presentations like these. It would prepare them better for the business world. Another part of the presentation that was very interesting to me was the question and answer session. In this portion, you have no way to prepare for it. I am not used to anything like this. In presentations in the past, I try to know everything that I am going to say. I am not very good at being put on the spot with questions so it was definitely an experience for me. I am looking forward to doing presentations like these in the future."

Another pleasant surprise came from the student's reaction to being the "client" at the presentation. Forty-six percent said they were better prepared for this role than they would have been for a traditional presentation. This is strongly reinforced by the 97% response in favor of the small group presentation format.

Perhaps the most disappointing aspect of this approach is the response to question 5 where about as many students said that their group spent time preparing to be the client as said that they did not. It should be noted, however, that the client groups did prepare a written report. Some students and some groups may have considered this to be ample preparation.

4. DISCUSSION

The five class period cycle used for problems in MIS 320 seems to have worked well. Students felt that they learned a great deal, that they would retain that learning and even that the length of the problems was right. The author's non-quantifiable opinion is that students came away from the class with a much better understanding of the underlying concepts than was previously attained in the more traditional style course, even if they were unable to reproduces bullet lists of various key points. As a result of the problem-based approach, students demonstrated both a broader knowledge of systems development in general and more depth in selected areas than did previous students. The author attributes the depth component to the structure of the problems that required students to 1) investigate a concept, 2) select one or more alternatives that they felt were most appropriate to the current situation and 3) defend the selection.

The questionnaire results indicate that the group dynamics worked quite well in general. Unfortunately both personality and scheduling conflicts caused problems in some groups but this is not an uncommon situation with group projects. This may, however, require special attention in a problem-based environment where the bulk of the learning occurs not in the classroom but rather as students and groups work through the problem solving process.

The Learning Issues database shows potential as a tool for both tutoring and mentoring in larger classes. Students felt that it helped both their own learning and their ability to share ideas with their classmates. However this investigation sheds no light on whether students did actually learn more because they worked with the discussion database or whether this was just their perception. The initial implementation of problem-based learning in MIS 320 used the Learning Issues database to help with tutoring and mentoring but did not attempt to determine the most effective use of a discussion database for these tasks. Many questions remain in the author's mind about how best to use on-line discussions to facilitate the tutorial process, especially the tutorial process as described by Barrows (1).

The on-line peer evaluation system used in MIS 320 solved many of the problems experienced by the author with previous group evaluation approaches. The peer evaluation system seems to have been at least a partial control for problems of "free riding" students mentioned by Kirch and Carvalho (8) because it gave team members a way to let the free rider, and the faculty, know when someone wasn't contributing. However, this approach clearly does not satisfy all students and, according to some students, does not eliminate the influence of personality conflicts.

5. CONCLUSIONS AND RECOMMENDATIONS

The results of this study are very encouraging for the use of PBL in systems development classes, However it is not clear what portion of the positive response is a result of the instructor's enthusiasm for PBL and how much a result of the problem-based pedagogy itself. While the similarity between 1998 and 1999 results are very encouraging it would be interesting and useful to repeat the study with two different teachers and compare the results.

This study reports positive and encouraging perceptual differences between PBL and traditional pedagogy from the student's point of view but does not provide empirical evidence for these differences in terms of exam scores or the practical application of the tools and techniques of systems analysis. Additional studies using these measures to compare courses taught by the two approaches should prove informative.

The use of a discussion database as a substitute for the tutorial process is another area that warrants additional study. Can the discussion database "stimulate and guide" in a manor similar to a trained tutor? Do students treat as a valuable learning tool or just another thing that has to be done to get through the course? What is the human tutor's role in the discussion database? Is it significantly different from his/her "traditional" role? These questions are increasingly important, not only for problem based learning, but as more and more classes move from traditional classrooms to the Internet and eLearning environments.

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