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The Effects of Computer Supported Problem Based Learning on Students' Approaches to Learning

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Abstract

The purpose of this paper is to investigate the effects of computer supported problem based learning on students' approaches to learning. The research was conducted as a pre-test and post-test one-grouped design used to achieve the objectives of the study. The experimental process of study lasted 5 weeks and was carried out on 78 university students. The Scale of Approaches to Learning was used as the data collection instrument, which was developed by researcher. The collected data were analyzed by paired simple t-test. According to the results, it can be stated that problem based learning has a significant effect on adopting a predominantly deep approach to learning by students.

Keywords: Problem based learning, approaches to learning, deep, surface

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The Effect of Computer Supported Problem Based Learning on Students' Approaches to Learning

Effective learning is a unique combination of the learning environment and the student's preferred orientation toward learning (Woods, Hrymak, & Wright, 2000). In the literature, it is suggested that the learning environment affects the student's approaches to learning. This assertion is supported by some research evidences (Ramsden & Entwistle, 1981; Biggs, 1987; Campbell & Smith, 1997; Webb, 1997; Dart, Burnett, Boulton-Lewis, Campbell, Smith, & McCrindle, 1999; Trigwell, Prosser, & Waterhouse, 1999; Dart, Burnett, Purdie, Boulton-Lewis, Campbell, & Smith, 2000; Hativa & Birenbaum, 2000; Lizzio, Wilson, & Simons, 2002; Goh, 2005; Groves, 2005).

It is generally believed that the use of deep approach to learning is associated with higher quality learning outcomes and surface approach with lower quality learning outcomes (Gijbels, Dochy, Van den Bossche, & Segers, 2005), and the deep approach will contribute positively to learning outcomes (Zeegers, 2001). Therefore, it is considered to be important to encourage students to adopt a deep approach. According to Felder and Brent (2005), a goal of instruction should be to induce students to adopt a deep approach on subjects that are important for their professional or personal development. It is suggested that problem based learning (PBL) is one of the learning environments to foster a deep approach to learning (Davis & Harden, 1999; Spencer & Jordan, 1999; Wood, 2003).

In PBL environment it is hypothesized that students focus on understanding rather than the memorization of facts. According to Groves (2005), PBL's capacity to stimulate intrinsic interest has been well documented. Although in the literature it is suggested that students in PBL processes are more likely to adopt a dominantly deep-learning approach to learning (Davis &

Harden, 1999; Spencer & Jordan, 1999; Wood, 2003), it is not clear what the available research says about this correlation. Therefore, this paper focuses on the relationship between PBL and students' approaches to learning

PBL

PBL is an approach of teaching and learning that requires the student to apply higher level learning processes. Students who are presented with a complex problem need to undertake higher level processes such as analyzing, comparing and contrasting, explaining causes, and hypothesizing, and to apply the outcome of these processes towards the development of a solution (McAlpine & Clements, 2001).

The historical underpinnings of PBL date back to the work of John Dewey (1963) at the University of Chicago and his commentary on experimental education (McDonald, 2002). In addition, PBL also builds on social constructivism as developed by Vygotsky (1978). Besides the idea of "psychological tools" that reflect the cultural instruments offered to learners to guide their learning (language, symbols, speech …), he especially emphasized the mediating role of the others (teachers, tutors, peer students) during the learning process.

Recognizing that Dewey's work could be used in medical school, Barrows, a physician and medical educator at McMaster University, wanted to develop methods of instructing physicians that fostered their own capabilities for reflection of school in ordinary life (McDonald, 2002). The medical faculty at McMaster University pioneered PBL in the 1960s as an innovative solution to make learning more relevant and effective. Since then, PBL has been implemented in several areas of higher education, including: medicine, business, education, architecture, law, engineering, social work, and in high school as well (Savery & Duffy, 1995; Wilson & Cole, 1996; Wee, Kek & Sim, 2001).

PBL is a student-centered learning model whose main attributes are related to real-world problems, student control, and group based processes. In PBL, learning occurs while working on problems in small groups and students determine their own learning objectives when trying to understand or resolve the problem. Therefore, it can be stated that PBL requires the student to develop a deeper understanding of the content and, to adopt the use of higher level learning processes.

Approaches to Learning

Researchers have done numerous studies of students' approaches to learning since Marton & Saljo's (1976) approaches to learning were first identified. The approaches to learning are considered by many educators to be a powerful means of modeling students learning and the quality of students learning outcomes (Duff, Dunlop & Connelly, 2002).

An approach to learning describes the nature of the correlation between student, context, and task (Biggs et al., 2001). Basically, two approaches to learning have been identified: the 'surface' approach and the 'deep' approach (Marton & Saljo, 1976). The surface approach describes the intention to reproduce information in compliance with externally imposed task demands, while the deep approach involves the intention to understand (Chan, 2003). The deep approach to learning is considered to be an appropriate approach as students learn for understanding, derive enjoyment from the learning task, and apply the acquired knowledge to the real world. On the other hand, the surface approach to learning is inappropriate as students rely on rote learning and memorization, avoid personal understanding and are unreflective about their learning experiences (Biggs et al., 2001; Tiwari et al., 2006). Biggs and Ramsden identified a third approach, called the strategic or achieving approach (Entwistle, 1998). The achieving approach implies that a student wish to achieve positive outcomes is characterized by students who intend to obtain high grades and organize their time (Biggs, 1987).

Which approaches to learning will be adopted by students is determined by a great deal of variables. Several studies about the influence of the learning environment and the personal characteristics of the learners on their approaches to learning are available in the literature (Ramsden & Entwistle, 1981; Campbell & Smith, 1997; Dart et al., 1999; Trigwell et al., 1999; Dart et al., 2000; Hativa & Birenbaum, 2000; Goh, 2005). Approaches to learning are influenced by student characteristics, the learning environment and learning outcomes. Therefore, approaches to learning cannot only be seen as mere student dependent characteristics. The approach to learning that will be adopted by students is determined by a large number of variables. When the relation of students' approaches to learning with these variables is considered, it can be argued that the learning environment is one of the most important variables. Therefore, if proper strategies are applied, it might be possible to move students learning approaches from a surface to a deep orientation.

Computer Supported PBL

The incorporation of PBL strategy into a computer supported learning environment provides the engaging, collaborative, and learner centered activities that are required to encourage a student to fully participate in the learning process (Gooding, 2002). The use of computer supported technologies in PBL plays a critical role in terms of organization of the PBL course and use of online resources to support a PBL course (Watson, 2002). In literature there is some research evidences about computer supported technologies impact positively on PBL process and learning outcomes (Cho & Jonassen, 2002; Dennis, 2003; Kerfoot, Masser & Hafler, 2005; An, 2006; Donnelly, 2006).

According to Sage (2000), PBL is an effective way to integrate technology into the classroom. Hoffman and Ritchie (1997) identified ways in which interactive multimedia might

be used to support PBL. The key benefits they anticipated were fidelity, representational richness, time and timeliness, individualization, assessment, efficiency, and increased power of agency (Albion & Gibson, 1998: 42). PBL builds on social constructivism as developed by Vygotsky (1978). He especially emphasized the mediating role of the others (teachers, tutors, peer students) in the learning process. In this respect, it can be stated that the integration of computer technologies to PBL may be considered to be a facilitative factor of interactivity. For these reasons, in this study PBL application supported online discussion boards and computer supported instructional materials.

Problem Statement

A review of literature indicated that the learning environment is one of the most important variables that affects student approaches to learning. In PBL, environment students are encouraged to take responsibility for their own learning (Strømsø, Grøttum & Lycke, 2004). In this respect, it can be stated that PBL environment may also have an effect on students' approaches to learning. Although in the literature it is suggested that students in PBL processes are more likely to adopt a dominantly deep-learning approach, it is not clear what the available research says about this relationship. Also, the effect of computer supported PBL environments on approaches to learning is quite ambiguous. For these reasons the current study aimed to investigate the effects of computer supported PBL on students' approaches to learning. The following research questions were addressed:

1. Does computer supported PBL environment effect on adopting surface approaches to learning by students?
2. Does computer supported PBL environment effect on adopting deep approaches to learning by students?

3. Does computer supported PBL environment effect on adopting achieving approaches to learning by students?

Methods

Research Design

In the current study, the pre-test and post-test grouped design was implemented to investigate the effects of the independent variable (computer supported PBL) on dependent variables (deep, surface and achieving approach).

Study Group

The experimental process of study has been carried out on 78 pre-service teachers (41 female and 37 male) who attended Information Technologies in Education II course in their second semesters. The study group ages ranged between 21-27 years old.

Instruments

The Learning Approaches Questionnaire (LAQ), developed by researcher, was used to measure each student's approach to learning on a scale ranging from deep, surface, and achievement. The questionnaire contained 39 items. Students responded to each item on a five-point Likert scale, where 1 point was given for "never true" and 5 points were given for "always true". The scores for each subscale (surface, deep and achieving) were determined by adding up all items and taking the average. Subscale reliabilities ranged between 0.85 and 0.94.

PBL Implementation

PBL implementation lasted 5 weeks. Initially, students were informed about PBL and the pre-questionnaire was administered. Then students were introduced to complex, ill-

structured problem with no obvious solutions by means of computer supported instructional material. Students worked in small, heterogeneous groups to identify what additional information they needed based on the initially given facts. They then brainstormed ideas and hypotheses related to the problem, decided on the key issues, and identified the resources to be used. After these meetings each student conducted an independent search for information regarding issues related to the problem. The process of research and group discussion continued until all groups were satisfied that they had learned sufficient basic knowledge to solve the problem. For interaction within groups and between groups, online discussion boards were used. The last week, study groups presented their report to the others and the post-questionnaire was administered. Throughout the implementation process, the researchers monitored and facilitated group activities.

Data analysis

Paired simple t-test was conducted to see the effects of online PBL on approaches to learning. At the inception of interpreting significance of the results, the probability value was set as α=05.

Results

The results of pre-test and post-test scores of surface approach subscale were compared with t-test and given in table 1.

Table 1.

T-test-surface approach

	Scores	N	Mean	SD	df	t	p
Surface	**Pre-test**	**78**	**45.87**	**15.52**	**77**	3.58	.001
	Post-test	**78**	**39.38**	**8.60**			

As seen from Table 1, there is a significant difference between students' pre-test and post–test mean scores [t(77)=3.58, p<.01]. While mean score of surface approach subscale was 45.87 before PBL implementation, it declined to 39.38 after PBL implementation. These findings show that PBL might negatively affect adopting of surface approaches to learning by students.

Table 2.

T-test- deep approach

	Scores	N	Mean	SD	df	t	p
Deep	**Pre-test**	**78**	**39.92**	**7.55**	**77**	-5.74	.000
	Post-test	**78**	**46.23**	**8.29**			

As seen from Table 2, there is a significant difference between students' pre-test and post–test mean scores [t(77)=-5.74, p<.00]. While the mean score of deep approach subscale was 39.92 before PBL implementation, it increased to 46.23 after PBL implementation. These finding shows that PBL might positively affect adopting of deep approaches to learning by students.

Table 3.

T-test- achieving approach

	Scores	N	Mean	S	df	t	p
Achieving	**Pre-test**	**78**	**33.64**	**8.42**	**77**	**-2.00**	**.056**
	Post-test	**78**	**35.58**	**7.78**			

As seen from Table 3, while the mean score of achieving approach subscale was 33.64 before PBL implementation, it increased to 35.58 after PBL implementation. But the scores were not found to be significantly different [t(77)=-2.00, p>.05]. These finding shows that PBL have no effect on adopting of achieving approaches to learning by students.

Discussion

The current study revealed that computer supported PBL environment has both a positive effect on adopting deep approaches to learning by students and a negative effect on adopting surface approach to learning. These findings are consistent with previous publications (Newble & Clarke, 1986; Spencer & Jordan, 1999; Woods et al., 2000; Wood, 2003; Waters & Johnston, 2004; Tiwari et al., 2006). PBL enhances motivation, because when learners work on problems whose relevance is clearly related to their professional work, they are much more likely to tackle them wholeheartedly rather than when they are working on more abstract or theoretical situations. This increased motivation may be considered an important component of connection between PBL and deep approach to learning.

In a PBL environment, a student who does not apply higher level processes (such as analyzing, comparing and contrasting, explaining causes…) simply cannot complete the task as lower order processes, because memorizing, describing, or following a simple procedure are insufficient (McAlpine & Clements, 2001). This characteristic of PBL process, and also the positive impact of computer supported technologies on PBL process, might be considered to be a factor in encouraging the adoption of deep approach to learning. However, future research is needed to examine which contextual elements in the PBL learning environment foster deep learning.

There are several characteristics of computer supported PBL environment that help to understand why deep learner can be expected to be fostered. PBL entices student control, complex problems, group work and collaborative tasks, and a focus on process assessment. But future research is needed to clarify what mixture of ingredients and which mediators (other student characteristics) in the PBL learning environment encourage deep learning.

Future research needs to be geared toward developing and testing the complex nature of the interrelations between the processes and variables studied. In this context, path-analysis and structural equation modeling could be helpful in studying the impact of mediating variables, and to consider the multiple co-variations that are regularly observed in analysis results. The testing and validation of more complex models could also help to research the feedback loop in the complex set of variables since dependent variables could feedback to the way independent variables are being perceived, interpreted, etc.

Current study was focused on effects of computer supported PBL on students' approaches to learning. Future research is also needed that clarifies how approaches to learning adopted by students affects their learning outcomes in PBL process, such as: performance, motivation, and problem-solving skills. Also, the effects of formative feedback provided by teachers during the PBL process on students' approaches to learning should be analyzed in following studies.

References

Albion, P. R. & Gibson, I. W. (1998). Designing multimedia material using a problem-based learning design. In R. M. Corderoy (Ed), *Australian Society for Computers in Learning in Tertiary Education. Ascilite'98 Conference Proceedings.* (pp. 39-47). University of Wollongong, NSW.

An, Y. J. (2006). Collaborative problem-based learning in online environments. Unpublished PhD dissertation. Department of Instructional Systems Technology. Indiana University, Indiana, USA.

Biggs, J. B. (1987). *Students approaches to learning and studying* Hawthorn: Australian Council for Educational Research.

Biggs, J.B., Kember, D. & Leung, D.Y.P. (2001) The Revised Two Factor Study Process Questionnaire: R-SPQ-2F. *British Journal of Educational Psychology. 71*, 133-149.

Campbell, J., & Smith, D. (1997). *Effective teaching for students with differing approaches to learning.* Paper presented at the Australian Association for Research in Education, Brisbane.

Chan, K.W. (2003). Hong Kong teacher education students' epistemological beliefs and approaches to learning. *Research in Education, 69*(1), 36-50.

Cho, K. L. & Jonassen, D. H. (2002). The effects of argumentation scaffolds on argumentation and problem solving. *ETR&D, 50*(3), 5–22.

Dart, B. C., Burnett, P. C., Purdie, N., Boulton-Lewis, G., Campbell, J. & Smith, D. (2000). Students' Conceptions of Learning, the Classroom Environment, and Approaches to Learning. *Journal of Educational Research, 93*(4), 262-270.

Dart, B., Burnett, P., Boulton-Lewis, G., Campbell, J., Smith, D. & McCrindle, A. (1999). Classroom learning environments and students' approaches to learning. *Learning Environments Research, 2*(2), 137-156.

Davis, M. H. & Harden, R. M. (1999). Problem-based learning: A practical guide. *Medical Teacher, 20*(2), 317-322.

Dennis, J. K. (2003). Problem-based learning in online vs. face-to-face environments. *Education for Health, 16(*2), 198-209

Dewey, J. (1963). Education and experience. New York: Collier.

Donnelly, R. (2006). Blended problem-based learning for teacher education: Lessons learnt learning. Media and Technology, 31(2), 93–116.

Duff, A., Dunlop, A. & Connelly, P. (2002). The relationship between approaches to learning and goal orientation: Two empirical studies in academic and work domains. Presented at *The 7th Annual ELSIN Conference*, Belgium.

Entwistle, N. & Ramsden, P. (1983). Understanding Student Learning. London. Croon-Helm.

Felder, R.M. & Brent, R. (2005). Understanding Student Differences. *Journal of Engineering Education, 94*(1), 57-72.

Gijbels, D., Dochy, F., Van den Bossche, P. & Segers, M. (2005). Effects of problem-based learning: A meta-analysis from the angle of assessment. *Review of Educational Research, 75*(1): 27–61.

Goh, P. S. (2005). *Perceptions of learning environments, learning approaches, and learning outcomes: a study of private higher education students in Malaysia from twinning programmes.* Professional Doctorate Thesis, Adelaide University, Australia. Retrieved August 18, 2006 from http://thesis.library.adelaide.edu.au/public

Gooding, Ken. (2002). "Problem based learning online". In: McNamara, Sue and Stacey, Elizabeth (eds): Untangling the Web: Establishing learning links. Proceedings ASET Conference 2002. Melbourne. Retrieved December 17, 2009, from http://www.aset.org.au/confs/2002/gooding.html

Groves, M. (2005). Problem-based learning and learning approach: is there a relationship?. *Advances in Health Sciences Education, 10*(4):315–326.

Hativa, N. & Birenbaum, M. (2000). Who prefers what? Disciplinary differences in students' preferred approaches to teaching and learning styles. *Research in Higher Education, 41*(2), 209-235.

Heppner, P.P. & Peterson, C.H. (1982). The development and implications of a personal-problem solving inventory. *Journal of Counseling Psychology, 29,* 66-75.

Hoffman, B. & Ritchie, D. (1997). Using multimedia to overcome the problems with problem based learning. *Instructional Science, 25*(2), 97-115.

Kerfoot, B. P., Masser, B. A. & ve Hafler, J. P. (2005) Influence of new educational technology on problem-based learning at Harvard Medical School. *Medical Education, 39*, 380-387.

Lizzio, A., Wilson, K. & Simons, R. (2002). University Students' Perceptions of the Learning Environment and Academic Outcomes: implications for theory and practice, *Studies in Higher Education Volume 27*(1), 27-52.

Marton, F. & Saljo, R. (1976). On qualitative differences in learning, outcome and process. *British Journal of Educational Psychology, 46*, 4-11.

McAlpine, L. & Clements, R. (2001). Problem based learning in the design of a multimedia project. *Australian Journal of Educational Technology, 17*(2), 115-130.

McDonald, J. T. (2002). Using Problem-Based Learning In A Science Methods Course. Annual International Conference of the Association for the Education of Teachers in Science. Retrieved May 7, 2007 from http://www.ed.psu.edu/CI/Journals/2002aets/f5_mcdonald.rtf

Newble, D. & Clarke, R. (1986). The approaches to learning of students in a traditional and in an innovative problem-based medical school. *Medical Education, 20*(4), 267–273.

Race, P. (2000). Task-based learning. *Medical Education, 34*, 335-336.

Ramsden, P. & Entwistle, N.J. (1981). Effects of Academic Departments on Student's Approaches to Studying. *British Journal of Educational Psychology, 51*, 368-383.

Sage, S. M. (2000). A natural fit: Problem-based learning and technology standards. *Learning & Leading with Technology, 28*(1), 6-12.

Savery, J. R. & Duff, T. M. (1995). Problem-based learning: An instructional model and its constructivist framework. *Educational technology, 35*(5), 31-38.

Spencer, J. A. & Jordan, R. K. (1999). Learner centered approaches in medical education. *British Medical Journal, 318,* 1280-1283.

Strømsø, H. I., Grøttum, P. & ve Lycke, K. H. (2004).Changes in Student approaches to learning with the introduction of computer-supported problem-based learning. *Medical Education, 38* (4), 390-398.

Tiwari, A., Chan, S., Wong, E., Wong, D., Chui, C., Wong, A. & Patil, N. (2006). The effect of problem-based learning on students' approaches to learning in the context of clinical nursing education. *Nurse Education Today, 26*(5):430-438.

Trigwell, K., Prosser, M. & Waterhouse, F. (1999). Relations between teachers' approaches to teaching and students' approach to learning. *Higher Education, 37*, 57-70.

Vygotsky, L.S. (1978). *Mind in Society*. Cambridge: Cambridge University Press.

Waters, L., & Johnston, C. (2004). Web-delivered, Problem-Based Learning in Organisational Behaviour: A New Form of C.A.O.S. *Higher Education Research & Development, 23*(4), 413-432.

Webb, G. (1997). Deconstructing deep and surface: Towards a critique of phenomenography. *Higher Education, 33*(2), 195-212.

Wee, K. L., Kek, Y. C. & Sim, H. C. (2001). *Crafting effective problems for problem-based learning*. Australian Problem Based Learning Network ISBN 07259 11387 Retrieved April 2, 2007 from http://pbl.tp.edu.sg/C1/Problem%20Crafting/Articles/ WeeKekSim.pdf.

Wigfield, A. & Eccles, J., (2000). Expectancy-Value theory of achievement motivation. *Contemporary Educational Psychology*, 25, 68-81.

Wilson, B. & Cole, P. (1996). Cognitive teaching models. In D. Jonassen (Ed.), *Handbook of research for educational communications and technology*, (pp.601-633). Washington, DC: Association for Educational Communications and Technology.

Wood, D. F. (2003). ABC of Learning and Teaching in Medicine: Problem based Learning. *British Medical Journal, 326*, 328-330.

Woods, D.R., Hrymak, A.N. & Wright, H.M. (2000). *Approaches to Learning and Learning Environments in Problem-based versus Lecture-based Learning*, Proceedings of 2000 ASEE Annual Conference, St. Louis, Missouri, June 18-21.

Zeegers, P. (2001). Approaches to learning in science: a longitudinal study. *British Journal of Educational Psychology, 71*, 115–132.

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