Effectiveness of problem-based learning in introductory business courses

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ABSTRACT

Problem-based learning (PBL) is an instructional approach that provides learners with opportunities to identify solutions to ill-structured, real-world problems. Previous research provides evidence to support claims about the positive effects of PBL on cognitive skill development and knowledge retention. This study contributes to existing literature by exploring the influence of PBL on affective skill development: tolerance for ambiguity, problem-focused coping, and emotion-focused coping. Using a pre-test/post-test research design with students enrolled in introductory business courses, the results suggest PBL has a positive impact on students' perceptions of their ability to use emotion-focused coping, no influence on problem-focused coping, and a negative influence on tolerance for ambiguity. The results also suggest the effects of PBL on students' perceptions of skill development are moderated by team cohesion. This study highlights select benefits and limitations of PBL, and provides a cautionary note to instructors about the important role of team cohesion in the educational experience.

Keywords: problem-based learning, business education, student perceptions, skill development, attitude change

INTRODUCTION

Problem-based learning (PBL) is an instructional approach that enables learners to conduct research, integrate theory and practice, and apply knowledge and skills in order to develop a solution to a defined problem (Savery, 2006, p.9). According to Barrows (2002), the key components of PBL are (1) unresolved, ill-structured problems that will generate multiple thoughts about the cause and solution, (2) a student-centered approach in which students determine what they need to learn, (3) teachers serve as facilitators and tutors, and (4) problems are authentic and reflect professional practice. Barrows (1996) also suggests that learning in a PBL environment should be integrated from a wide range of disciplines or subjects such that students study and integrate information from diverse disciplines that might relate to understanding and solving a particular problem. In short, PBL is an approach to learning in which students work together to find solutions to complex problems (Ferreira & Trudel, 2012).

Previous research suggests PBL improves long-term knowledge retention (e.g., Strobel & van Barneveld, 2009), problem-solving skills (e.g., Kanet & Barut, 2009), analytical and reasoning skills (e.g., Michel, Bischoff, & Jakobs, 2002), interpersonal skills (e.g., Kumar & Natarajan, 2007), self-directed learning skills (e.g., Thomas & Chan, 2002), and attitudes towards the course subject (e.g., Ferreira & Trudel, 2012). In a comprehensive review of research, Hmelo-Silver (2004) argues that there is considerable evidence in the literature supporting claims that PBL helps students develop flexible knowledge, effective problem-solving skills, and self-directed learning skills, yet little research has been done to understand the influence PBL has on effective collaboration skills and instinctive motivation. Hmelo-Silver (2004) also cautions that too little research has been conducted outside of medical and gifted education and, therefore, understanding how goals are achieved with less skilled learners is important for future research.

Although previous research has contributed to understanding the positive effects of PBL on cognitive processes such as memory, learning, and problem-solving, there is little research about the influence on PBL on affective processes. Does PBL improve students' ability to tolerate ambiguity? Does PBL influence coping skills? In addition, previous empirical research has not examined changes in undergraduate business students' perceptions of skills before and after taking multi-disciplinary courses using PBL as an instructional method. Because PBL is becoming an increasingly common instructional method, answering these questions is an important step to exploring the effectiveness of PBL as an instructional methodology in multi-disciplinary approaches in higher education.

The purpose of this study is to examine the influences of PBL on students' perceptions of affective-related skill development. Specifically, the study analyzes differences in students' self-reported perceptions of their own tolerance for ambiguity and coping/self-efficacy skills before and after completing a set of business courses using PBL instructional pedagogy. As such, the goal of this study is to contribute to the current understanding of the effectiveness of PBL education by investigating students' attitude change and perceived skill development using a context of introductory-level business courses. In addition, the study contributes to the practice of higher education by showcasing the benefits and potential limitations of PBL in a business education learning environment.

LITERATURE REVIEW AND HYPOTHESES

PBL is an instructional pedagogy that provides students with the tools to solve problems through the use of real world issues. The PBL process begins with an unstructured problem that the students must solve. After reviewing the problem, students identify information they already know as well as information they need to learn in order to find a solution. The three necessary components are students as the learners, the instructor as the tutor, and the problem as the context (Carrió, Larramona, Baños, & Pérez, 2011). The key learning outcomes are learning and applying new information, structuring information for future use, developing cognitive skills, and becoming lifelong learners (Woods, 2012).

The positive impacts of PBL have been well documented. First, PBL allows the learner to take an active role in his/her education, encourages concept application, and provides intellectual growth through strategic decision making (Yeo, 2008). Specifically, PBL holds students accountable for their own learning and the learning of the classmates (Chagas et al., 2012), allows students to explore more than one right answer (Karantzas et al., 2013), and encourages students to use learned knowledge to arrive at a solution (Mykytyn et al., 2008). Second, PBL can enrich students' learning outcomes, which will better prepare them for the work environment (Deeter-Schmelz, Kennedy, & Ramsey, 2002). When knowledge is deficient, PBL encourages students to identify the missing information that must be utilized to complete their task (Mykytyn et al., 2008). As such, PBL requires active engagement of material rather than regurgitation of lectured concepts (Yeo, 2010). Third, PBL provides tools necessary to handle future challenges (Yeo, 2008). In contrast to traditional lecture-based learning, which requires students to demonstrate understanding by replicating materials provided by the faculty member on exams (Kuruganti, Needham, & Zundel, 2012), PBL has been found to be a better instructional pedagogy to "bridge the gap between theory and practice" (Hsieh & Knight, 2008, p. 29).

Due to its well-known benefits, PBL has been successfully employed in a wide variety of disciplines including business education (e.g., Buff, 2011; Kanet & Barut, 2009; Mykytyn et al., 2008), medical education (e.g., Prince, van Eijs, Boshuizen, van der Vleuten, & Scherpbier, 2005), social work education (e.g., Pearson, Wong, Ho, & Wong, 2007), health education (e.g. Chagas et al., 2012), and engineering education (e.g., Hsieh & Knight, 2008; Woods, 2012).

Tolerance for Ambiguity

Ambiguity tolerance refers to the way an individual or group perceives and processes information about ambiguous situations or stimuli when confronted by unfamiliar, complex, or incongruent cues (Furnham & Ribchester, 1995, p. 179). Persons characterized as intolerant of ambiguity tend to view ambiguous situations as a case of psychological uneasiness or anxiety while persons characterized as tolerant of ambiguity tend to have the ability to recognize and analyze ambiguous conditions in a practical, adaptive manner (Stoycheva, 2003). In business, tolerance for ambiguity has become an increasingly valuable attribute due to widespread global and cultural influences (Banning, 2003) as well as a general increase of uncertainty within a rapidly-changing society (Visser, 2003).

Although evidence about the effect of teaching methods on tolerance for ambiguity is limited, previous studies suggests tolerance for ambiguity improves through select teaching methods including business cases (e.g., Banning, 2003), business simulation exercises (e.g.,

Tompson and Dass, 2000), and classroom group work (e.g., Myers et al., 2009). Based upon Kolb's (1984) theory of experiential learning, exposing students to ambiguous situations similar to those experienced by decision makers allows learning through discovery involving unfamiliar, ambiguous cues and situations. Conceptually, Visser (2003) argues that the lack of convergence in strategies and solutions associated with ill-structured problems forces learners to accept and manage a high degree of ambiguity. Banning (2003) also suggests that "if simulations involving ambiguous cues can increase students' tolerance for ambiguity, it is possible that other teaching methods that use ambiguous and misleading cues could also increase the tolerance of ambiguity" (p. 558). As such:

H1. Problem-based learning will have a positive effect on self-reported tolerance for ambiguity.

Self-Efficacy and Coping

Self-efficacy can be defined as "people's beliefs in their capabilities to mobilize the motivation, cognitive resources, and courses of action needed to exercise control over events in their lives" (Wood & Bandura, 1989, p. 364). In general, Wood and Bandura (1989) proposed three processes by which an individual's self-efficacy is influenced: (1) mastery experiences (i.e., personal success in past performance), (2) modeling (i.e., vicarious learning by observing others), and (3) social persuasion (i.e., realistic encouragement). Self-efficacy has been hypothesized to influence choice of behavioral activities, effort expenditure, persistence in the face of obstacles, and task performance (Multon, Brown & Lent, 1991). According to Cheng, Lam, and Chan (2008), people who believe that they can exercise control over significant events (i.e., persons high in self-efficacy) will have greater incentive to act, to expend effort and to persist at a given task.

Previous research suggests mixed results regarding the effects of PBL on self-efficacy. On the one hand, Mills (2009) found significant increases in student self-efficacy in the areas of communication, cultures, connections, and comparisons after participation in a project-based learning curriculum in a language learning course. Schaffer, Chen, Zhu and Oakes (2012) found significant self-efficacy increases in the areas of identification, recognition, and integration after participation in a cross-disciplinary team project-based setting. On the other hand, Papinczak, Young, Groves, and Haynes (2008) reported a decrease in self-efficacy over a year-long medical course designed around project/problem based learning. Interestingly, Dunlap (2005) suggests that the quality of project based learning experiences directly impacts students' self-efficacy. In sum, previous research may suggest positive experiences will lead to an increase of self-efficacy, while stressful or fearful experiences will lead to a reduction of self-efficacy (Schaffer et al., 2012).

Coping is defined as behavioral or cognitive efforts to manage situations that are evaluated to be stressful (Lazarus & Folkman, 1984). Lazarus and Folkman (1984) argues that there are two types of coping responses: (1) problem-focused coping, which targets the causes of stress in practical ways that remove or minimize a stressful event or its impact and (2) emotion-focused coping, which involves a person's attempts to reduce the negative emotional responses associated with stress. In other words, problem-focused coping is a strategy used when people believe something can be done to alter their situation whereas emotion-focused coping is a strategy used when one perceives that a stressful event or its impact must be endured (Folkman & Lazarus, 1980). On the one hand, Struthers, Perry, and Menec (2000) found that college

students who engage in problem-focused coping were more likely to be to be motivated and perform better than students who engaged in emotion-focused coping. On the other hand, McLeod (2010) argues that problem-focused coping may not be plausible in a situation in which it is beyond the individual's control to remove the source of the stress. Within the context of the PBL environment, the learning model may force students to engage in problem-solving in a context in which they lack the control to remove the cause of the stress (i.e., a problem to be solved) yet simultaneously encourages students to manage emotional responses to the stressful situation. As such:

H2. Problem-based learning will have a positive effect on the ability to use (a) problem-focused coping and (b) emotion-focused coping.

Team Cohesion

Team cohesion refers to the tendency of a group to stick together and remain united when pursuing its goals and objectives (Carron, 1982). Shaw (1981) argues that highly cohesive teams are cooperative, friendly, and democratic; by contrast, low cohesive teams are hostile, aggressive, and autocratic. Research suggests low cohesion teams are more likely to experience greater relationship conflict that diverts attention from tasks involved with the group decision-making (Troth, Jordan, & Lawrence, 2012) while high cohesion teams tend to be more united, committed, and successful (Mach, Dolan, & Tzafrir, 2010). Using a context of student groups, Deeter-Schmelz et al. (2002) found that team cohesion plays a direct role in effective teamwork as a process and an indirect role in team goal achievement. As such, in the context of PBL, team cohesion should moderate the influence of PBL on individual skill development and team performance. Specifically, the positive influences of PBL should be greater for members of highly cohesive teams, as a result of fewer task distractions and greater emotional support with group interactions, as compared to members of less cohesive teams. As such:

H3. Perceptions of higher team cohesion will demonstrate higher scores for (a) tolerance for ambiguity, (b) problem-focused coping, (c) emotion-focused coping, and (d) team goal achievement as compared to perceptions of lower team cohesion.

METHODOLOGY

The hypotheses developed in this study were examined by collecting data from undergraduate business majors participating in a unique, problem-based course taught at a medium-sized, Midwestern university. The course combines four introductory classes in Marketing, Management Information Systems, Finance, and Management that are taught by a team of faculty members from each discipline. Instead of attending four distinct class sessions with different students in different rooms, students in this course spend four hours each day together in the same room and work with the same team of faculty members. Although students are individually evaluated in each subject area, a majority of the final course grade in each subject is based on three team-based, applied projects throughout the term. The final project is a live client, problem-based assignment where student teams conduct research and develop recommendations for a business or non-profit organization.

Measures

The variables under review in this research were measured using previously developed and validated scales. Table 1 (Appendix) provides a summary of the measures, including each scale's source and sample items for each scale. Tolerance for ambiguity was measured using the Measure of Ambiguity (MAT-50) instrument developed by Norton (1975). The MAT-50 includes eight sub-scales that assess ambiguity in different settings or dimensions. Based on the study of PBL pedagogies in this research, an eight-item sub-scale measuring tolerance for ambiguity during problem-solving was used (Norton, 1975). The MAT-50 requires students to self-rate their ambiguity tolerance using five-point, Likert-type questions.

Ability to cope was assessed by using two sub-scales from the Coping Self-Efficacy (CSE) scale originally developed by Chesney, Neilands, Chambers, Taylor and Folkman (2006). Two dimensions of coping, problem-focused coping and emotion-focused coping, were assessed using five-point, itemized rating scales with anchors between Not Confident at all through Very Confident (Chesney et. al., 2006).

Team cohesiveness was measured utilizing a scale originally developed by Price and Mueller (1986) and adapted for classroom settings by Deeter-Schmelz et al. (2002). The adapted five-item scale contains five semantic differential questions. Team Goal Achievement was measured using a two-item scale developed by Deeter-Schmelz et al. (2002). In addition to these measures, respondents were asked several demographic questions, including major, grade point average and gender.

Data Collection

An on-line survey tool was used to collect data. During the first week of the term, students in all four sections of the course were asked to participate in the research project. Extra credit was offered to the students to encourage participation. During the first week of the term, 156 out of 158 enrolled students (98.7%) completed the pre-test survey, while 115 students (72.8%) completed the post-test survey at the end of term during finals week. To protect anonymity, students were asked to provide an alpha-numeric code based on their birth date and the name of their first pet. This code was used to develop a combined dataset so that a pre-post test comparison could be made to evaluate each of the hypotheses. Unfortunately, only 60 of the 115 responses in the post-test (52.1%) could be paired with data in the pre-test due to missing answers and the inability of some students to follow instructions to replicate the same alpha-numeric code.

The average grade point average for the sample was 3.22, which is consistent with other student-based research projects within the college. The frequencies for the reported majors in the class were also consistent with the distribution within the college overall. The male/female distribution was 59%/41% in the pre-test and 61%/39% in the post-test when the response rate was lower (n=115).

Validity and Reliability

Validity was assessed for the two coping self-efficacy sub-scales using confirmatory factor analysis with a Varimax rotation. The analysis was performed on both data sets. Except for a minor issue with cross-loading in the pre-test data set, items loaded properly on the

expected factor component in both data sets. Factor loadings for problem-based coping ranged from .805 to .840 in the pre-test and .718 to .820 in the post-test, while loadings for emotion-based coping ranged from .402 to .837 in the pre-test and from .743 to .899 in the post-test.

Reliability analysis was assessed for all multi-item scales using Cronbach's alpha. Reliability was assessed in both the pre-test and post-test samples for ambiguity tolerance, problem-based coping, and emotion-based coping, while team cohesiveness and team goal achievement were assessed only in the post-test sample because these items were not included in the pre-test survey. Table 1 (Appendix) provides coefficient alphas for all scales, which were strong and consistent with previous usage.

Data Analysis and Results

Hypotheses 1, 2a, and 2b posit that personal characteristics of students improve over time if PBL is utilized in a course. Summated scores were calculated for each multi-item scale in the pre-test and post-test for each respondent. To assess individual changes in tolerance for ambiguity, problem-based coping, and emotion-based coping over the duration of the course, paired sample t-tests were conducted. Results can be found in Table 2 (Appendix).

Hypothesis 1 theorized that a student's Tolerance for Ambiguity during problem-solving would improve during a course that used PBL pedagogies. Because each item in the Ambiguity Tolerance scale was reverse worded, ambiguity tolerance for each student is higher as the scale sum decreases. As Table 2 (Appendix) indicates, Tolerance for Ambiguity significantly decreased during the class, which is opposite of the direction hypothesized (p=.028).

Hypotheses 2a and 2b stated that a PBL experience in the classroom would positively affect problem-focused coping skills and emotion-focused coping skills respectively. Hypothesis 2a was not supported; no significant difference in reported problem-focused coping skills was found in students over the term (p=.235). Hypothesis 2b was supported; students reported a significant increase in their ability to emotionally cope with stressful situations by the end of the course (p=.003).

Hypothesis 3 posited that high levels of reported team cohesiveness would lead to higher levels of tolerance ambiguity, problem-based coping, and emotion-based coping in individuals, while also leading to increased goal achievement by the team. Summated scores for team cohesiveness were calculated for each respondent in the post-test (n=115). The average level of team cohesiveness was 20.35. To assess whether there are differences in teams with higher and lower levels of cohesiveness, tertiary analysis was conducted to remove teams with moderate levels of cohesion. Team cohesiveness scores were ordinally ranked for the entire dataset and natural break points were identified for the bottom and top third of tiers of cohesiveness. Thirty-nine respondents were eliminated from the middle tier, leaving 35 respondents in the high cohesiveness tier (Scores=23-25) and 41 in the low cohesiveness tier (Scores=12-19).

Independent samples t-tests were conducted comparing the high and low cohesiveness groups on the four variables in Hypothesis 3. As Table 3 (Appendix) indicates, significant differences were found in each t-test. Hypothesis 3a was not supported as respondents in the low cohesiveness teams reported significantly higher levels of ambiguity tolerance than teams with higher cohesiveness (p=.011). The remaining three team cohesiveness hypotheses were supported as expected. Hypotheses 3b and 3c were supported as teams with higher cohesiveness reported higher levels of problem-based coping (p=.004) and emotion-based coping (p=.000)

than teams with lower levels of cohesiveness. Finally, Hypothesis 3d was supported as teams with higher cohesiveness reported significantly higher levels of team goal achievement (p=.000).

DISCUSSION

The goal of this study was to examine the effectiveness of PBL in a business education learning context. Using a pre-test/post-test research design, the results suggest PBL positively influences student perceptions regarding their own ability to use emotion-focused coping. As expected, the process of managing the student-center approach to learning and the realistic context of the problem allows students to improve abilities to manage negative emotional responses associated with increased stress. Contrary to expectations, the results also found no significant improvement in student perceptions of their own ability to use problem-focused coping. Consistent with McLeod (2010), problem-focused coping may not be effective in a situation in which it is beyond the individual's control to remove the source of the stress. As such, the lack of improvement in problem-focused coping reflected the lack of control students have to remove the cause of the stress (i.e., a problem to be solved).

Surprisingly, the results suggest a decrease in students' tolerance for ambiguity. Arguably, this decrease may be considered a positive outcome of the PBL process. Although students perceived improvements in their ability to use emotion-coping strategies, the PBL learning process also teaches students to recognize the limitations of their emotional responses. Prior to the PBL experience, students may naively report a higher tolerance for ambiguity because they simply lack experience with highly ambiguous situations. If problems are ill-structured and require students to determine their own knowledge needs (Barrows, 2002), students embedded within highly ambiguous situations will begin to recognize limitations to their own tolerance for ambiguity. As such, this self-realization may be viewed as a positive outcome because it demonstrates students' ability to identify anxieties associated with lack of structure.

As expected, groups with high team cohesion reported higher levels of problem-based coping, emotion-based coping, and team goal achievement as compared to teams with lower levels of cohesiveness. If teamwork is conceptualized as a process involving team activities such as planning and coordinating information (Deeter-Schmelz et al., 2002), then highly cohesive teams provide an environment that enhances learning and effective problem-solving. By contrast, teams with lower cohesion were less likely to establish the supportive environment necessary to promote and support individual skill development because group conflict and an inability to work together distract individuals' attention.

Surprisingly, the results also suggest teams with higher cohesiveness reported significantly lower ambiguity tolerance than teams with lower cohesiveness. Paralleling the previous argument, this difference may be considered a positive outcome of the PBL process where highly cohesive teams may provide a better environment for self-reflection, which in turn allows students to better evaluate their real ambiguity tolerance limitations. By contrast, learning distractions associated with lower cohesion teams prohibit self-reflection, which results in over-inflated tolerance for ambiguity. However, another plausible explanation is that teams with lower cohesiveness experience greater ambiguity than teams with higher cohesiveness because these teams are required to deal with problem-based ambiguity as well as team ambiguity resulting from lack of communication, uncertainty about interpersonal relationships, and/or team conflicts. As such, low cohesion teams may have real improvements in individuals' ambiguity

tolerance as a direct result of the negative aspects of the teamwork process. Unfortunately, fully understanding the underlying processes involved is beyond the scope of this study. Further research is necessary.

This study provides two distinct implications for instructions. First, the results suggest instructors should consider explicitly encouraging tolerance for ambiguity and coping skills as part of the learning process. For example, instructor could help students by managing students' expectations about the doubts and struggles they will encounter during the learning process, by encouraging students to view uncertainty as an opportunity to learn and be creative, by reinforcing the usefulness of exploring different, often contradictory solutions, and by providing students with techniques for effectively managing stress. Second, the results also suggest that instructors need to provide students with techniques to effectively improve team cohesion. For example, instructors could help students by integrating team building activities that teach interpersonal communication skills, goal development, and team commitment. In addition, because lower team cohesion detracts from individual learning, instructors should also monitor and evaluate teams for conflict in order to intervene as necessary.

Limitations and Directions for Future Research

Although this research contributes to understanding the influences of PBL on students' perceptions of affective-related skill development, the study is characterized by several limitations that may provide opportunities for future research. First, the sampling procedures demonstrated a loss in matching pairs between the pre-test and post-test as a result of the technique used to provide respondent anonymity. Unfortunately, the loss of subjects may have had a significant influence on the results. Future researchers may determine a better technique for retaining subjects between pre-test and post-test experimental designs while maintaining respondent anonymity. Second, there may be reason to believe that some skill development (i.e., tolerance for ambiguity) may evolve more slowly over a longer-period of time. Future researchers should examine the impact of PBL on skill development over longer periods of time ranging from a year to four years. Third, measures used in this study relied upon subjective, self-report measures rather than objective measures of both skill development and goal achievement. Future research should validate the findings associated with perceived skill development by comparing them to results associated with objective skill development.

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APPENDIX

Table 1: Measurement Reliabilities (α)

Measure	Source	Sample Item	Reliability Pre-Test	Reliability Post-Test
Tolerance for Ambiguity	Norton, 1975	In a decision-making situation in which there is not enough information to process the problem, I feel very uncomfortable. (Strongly Disagree – Strongly Agree)	.689	.820
Problem-Based Coping	Chesney et. al. 2006	Break an upsetting problem into smaller parts. (Not Confident at all – Very Confident)	.780	.835
Emotion-Based Coping	Chesney et. al. 2006	Stop yourself from being upset by unpleasant thoughts. (Not Confident at all – Very Confident)	.819	.827
Team Cohesiveness	Deeter-Schmelz et. al. 2002	To what extent did you trust the members of your team? (Not at All - Very Much)	n/a	.870
Team Goal Achievement	Deeter-Schmelz et. al. 2002	Did your team achieve the goals you had hoped to achieve? (Strongly Disagree to Strongly Agree)	n/a	.890

Table 2: Hypothesis Test Results

Hypothesis	n (pairs)	Pre-Test Mean	Post-Test Mean	Sig.
H1. Problem-based learning will have a positive effect on self-reported tolerance for ambiguity.	60	26.00*	27.42	.028
H2a. Problem-based learning will have a positive effect on the ability to use problem-focused coping.	59	19.81	20.38	.235
H2b. Problem-based learning will have a positive effect on the ability to use emotion-focused coping.	60	11.22	12.31	.003

* Items were reversed so ambiguity tolerance increases as scores decrease

Table 3: Hypothesis Test Results by Team Cohesiveness

Hypothesis	Team Cohesiveness	Mean	Sig.
H3a. Perceptions of higher team cohesion will demonstrate higher scores for tolerance for ambiguity.	Low Group High Group	27.61 30.97	.011
H3b. Perceptions of higher team cohesion will demonstrate higher scores for problem-based coping.	Low Group High Group	19.44 21.54	.004
H3c. Perceptions of higher team cohesion will demonstrate higher scores for emotion-based coping.	Low Group High Group	11.10 13.20	.000
H3d. Perceptions of higher team cohesion will demonstrate higher scores for team goal achievement.	Low Group High Group	7.22 9.11	.000