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The Introspection of Problem-Based Learning Pedagogy Applied in Interdisciplinary Study for Non-Business Majored Students

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Abstract

Taiwan's past education system similarly emphasized knowledge and memorization, leading students to become "giants of knowledge and dwarfs of life." In the midst of this wave of educational reform, educational authorities aimed to address this phenomenon. Many universities in Taiwan stared to apply Problem-Based Learning (PBL) to curriculum design and implement. This research explored the theoretical foundations, content, curriculum design, and teaching processes of problem-based learning, with the hope of contributing to the effective implementation of the business curriculum for non-business majored students.

As students work through problems, they practice information retrieval, analysis, and synthesis, which strengthens their overall cognitive functioning and understanding of the subject matter. The results shows that it enhances students' ability to use diverse information, critical thinking ability, encourage students' self-directed learning, and higher motivation and attitude of learning.

Key words: critical thinking, self-directed learning, group interaction, teacher performance, motivation and attitude of learning

1. Introduction

Since the beginning of the 21st century, countries around the world have been engaging in educational reforms to enhance the quality of their citizens and their national competitiveness. They have been reviewing past curriculum content and teaching methods. Scholars have found that the traditional emphasis on memorizing knowledge not only disconnects teaching from everyday life but also reduces students' motivation to learn. Furthermore, traditional teaching methods often lack a focus on students taking responsibility for their own learning, which results in students being passive recipients of knowledge (Barrows, 2000; Chang, 2021). Such teaching approaches tend to neglect the application of knowledge and the development of higher-order thinking skills, such as critical thinking and problem-solving. In traditional classrooms, students spend most of their time in static activities at their desks, with very few inquiry-oriented activities (Guerrera, 1995).

A similar situation is observed in medical education. Howard Barrows, a teacher at McMaster University Medical School in Canada, recognized the shortcomings of traditional medical education, which mostly involved memorizing a large amount of medical knowledge without the ability to apply it in clinical situations(Gijbels, Dochy, van den Bossche, & Seger, 2005). Therefore, in the late 1960s, he advocated for "problem-based learning" (PBL) in medical education. PBL starts with real-world problems of an unstructured and open nature, and through a specific teaching process, the curriculum is designed to revolve around these problems, leading to significant innovation in medical education. Problem-based learning has not only sparked educational reform movements in university levels but has also been widely applied in various fields, including health sciences, social works, engineering, architecture, business, law, economics, management, mathematics, and primary and secondary education (Barrows, 2000; Schwartz, Mennin, & Webb, 2001).

Taiwan's past education system similarly emphasized knowledge and memorization, leading students to become "giants of knowledge and dwarfs of life." In the midst of this wave of educational reform, educational authorities aimed to address this phenomenon. Starting from the academic year 2000, Taiwan implemented a nine-year integrated curriculum. This shift moved away from content-focused teaching to a student-centered approach based on life experiences, with the goal of cultivating ten essential abilities necessary for solving real-life problems (Ministry of Education, 2000).

From this perspective, problem-based learning aligns well with the spirit of the integrated curriculum implemented by the Ministry of Education (2000). Recognizing this alignment, this research explored the theoretical foundations, content, curriculum design, and teaching processes of problem-based learning, with the hope of contributing to the effective implementation of the business curriculum for no business majored students. More specifically, this study sought to evaluate the relationship between critical thinking, self-directed learning, group interaction and active participation, case problem evaluation, teacher performance evaluation, and motivation and attitude of learning. Furthermore, it explored the motivation and attitude of learning within PBL context whether or not affect behavior intention.

2. Literature Review

2.1Problem-Based Learning

Various scholars have offered their perspectives on the definition of problem-based learning, which tend to have similarities. Here are the opinions of some scholars:

Barrows and Tamblyn (1980) states that problem-based learning is a method of learning. This method initially presents a problem scenario, followed by students applying a systematic set of steps to solve the problem. Fogarty (1997) points out that problem-based learning is a curriculum model that utilizes real problems as the driving force for learning. It employs non-structured and open-ended questions as guides.

Levesque (1999) summarizes related literature by stating that problem-based learning is a student-centered curriculum delivery method. Students choose various ways to obtain information, including group interactions, various technologies, or self-study, to solve presented problems. Diaz-Camacho (2002) notes that problem-based learning is an instructional technique that presents students with problem scenarios for exploration. It doesn't demand a single correct answer but requires students to interpret the problem, gather relevant information, propose various possible solutions, evaluate these methods, and then select the best approach to solve the problem and present the results. Pilliner (2003) asserts that problem-based learning is an instructional method that uses non-structured real-world problems as the central context for in-depth exploration.

The theoretical foundations of problem-based learning include information processing theory, constructivism, and met cognition (Trop & Sage, 1998; Huang, 2002), which will be discussed in the following sections.

2.1.1Information Processing Theory

The Information Processing Theory refers to a cognitive framework that explains how humans process, store, and retrieve information. It views the mind as a complex system that takes in sensory input, processes it through various cognitive processes (such as attention, perception, memory, and problem-solving), and produces output in the form of behavior or responses. In the context of problem-based learning, the information processing theory suggests that learners actively engage with new information by connecting it to their existing knowledge and mental structures. Problem-based learning encourages students to analyze and solve real-world problems, which requires them to access and apply relevant information from their memory, make connections between different concepts, and develop strategies to address complex situations.

Zhang (1994) explains how individuals in an environment go through internal mental processes such as perception, attention, recognition, transformation, and memory to absorb and utilize knowledge. Trop & Sage (1998) highlighted that in the context of the central concepts of the information processing theory, the learning situation should: 1. activate prior knowledge to facilitate new learning, 2. align with the knowledge needed in the real world, and 3. enhance learners' opportunities to recall and apply their stored memories.

In problem-based learning, the learning context and application context are directly related. Students immerse themselves in the learning process through role-playing. For example, when learning to be a doctor, they explore how to communicate with patients. This type of learning accumulates various clues that reinforce memory and stimulate knowledge related to the learning context, resulting in effective learning outcomes (Trop & Sage, 1998).

2.1.2Constructivism

Constructivism is a theory that suggests our understanding of perceptual experiences is not just direct responses to stimuli, but rather the result of organizing sensory impressions based on individual cognition and emotions (Zhang, 1994). In the learning process, cognitive changes occur as a result of learners' social interactions with others (Trop & Sage, 1998).From a constructivist perspective, problem-based learning provides learners with experiential processes (hands-on and mental) to construct their own knowledge systems. Through assistance from teachers, peers, negotiation, reconciliation, and interactive processes, learners enhance their learning and self-cognitive structures (Trop & Sage, 1998; Zhang, 2001). This integration of theory and practice enables learners to acquire skills in applying knowledge to real problem-solving situations, which can be highly beneficial for their future performance in the workplace (Huang, 2002).

2.1.3 Metacognition

Metacognition refers to the higher-level cognitive processes that involve monitoring, controlling, supervising, and evaluating one's own cognitive activities. It can also refer to a higher level of knowledge about existing knowledge (Zhang, 1994). Generally, metacognition includes both metacognitive knowledge and metacognitive control (Cheng, 1997).

From a metacognitive perspective, problem-based learning requires learners to understand personal, task, and strategic knowledge. Learners should be capable of conducting prior assessment and planning of their learning, monitoring their progress, testing, reviewing, and engaging in remedial activities throughout the learning process. This type of learning approach makes students active participants in their learning, where they take responsibility for their learning and gradually become self-directed learners (Huang, 2002; Cheng, 1997).

By exploring the theoretical foundations of problem-based learning as discussed above, it's evident that problem-based learning combines the advantages of information processing theory, constructivism, and metacognition. This approach not only effectively promotes learning and enhances social interaction but also empowers learners to take control of their cognitive processes, transforming them into independent learners.

2.2Characteristics of Problem-Based Learning

Based on these attributes, the author defines problem-based learning as follows:

"Problem-based learning is a student-centered, systematic instructional form. It starts with ill-structured and open-ended real-world problems and employs diverse teaching processes, encouraging students to engage in further exploration of the problems."

Problem-based learning has the following characteristics(MarKarnmani, 2015; Huang, 2002):

1. Student-Centered: Problem-based learning emphasizes active student participation and self-directed learning. Students play an active role in the problem-solving process, leading their own learning journey.
2. Real-World Context: Learning starts with real-world problem scenarios. These problems are often vague, open
3. Interdisciplinary: Problem-based learning encourages students to examine and solve problems from multiple disciplinary perspectives, helping them build interdisciplinary knowledge and skills.
4. Collaboration and Interaction: Students typically collaborate in groups to solve problems, fostering opportunities for interaction, discussion, knowledge sharing, and collective learning.
5. Critical Thinking: Problem-based learning encourages students to engage in critical thinking, evaluating the pros and cons of different solution methods, thus cultivating their critical thinking skills.
6. Deep Learning: To solve problems, students need to delve into relevant topics, prompting them to gain a deeper understanding of concepts and principles.
7. Self-Directed Learning: Problem-based learning requires students to manage and guide their own learning, nurturing their self-directed learning and problem-solving abilities.

8. Knowledge Transfer: By solving problems in various domains, students can better apply what they've learned to practical contexts, promoting knowledge transfer and application.

In summary, problem-based learning not only focuses on knowledge itself but also emphasizes deep thinking, collaborative interaction, and practical application throughout the learning process.

Implementing problem-based learning requires the following accompanying measures to ensure its successful execution (Cheng, 2006):

(1) Clarifying Roles of Teachers and Students: In the process of learning activities, the teacher assumes the role of a coach, often acting as a facilitator, guide, co-investigator, and observer. On the other hand, students become explorers, learning assessors, and even teachers and knowledge producers themselves.
(2) Arranging Learning Resources: When planning activities for students' learning research, teachers need to arrange and design relevant resources (such as experts,
(3) Planning Learning Assessment: Lastly, teachers should develop a comprehensive assessment plan to understand whether students have achieved the expected goals in problem-based learning, the progress of problem-based learning, and to judge the curriculum effectiveness of problem-based learning.

From the above, it can be seen that to design effective problem-based learning curricula, one must simultaneously consider the contextual circumstances, students' existing experiences, national curriculum guidelines, and also the teaching content decided in conjunction with the textbooks selected by the school. Importantly, during the curriculum design process, collaboration and open communication are vital, to ensure both the quality and feasibility of the curriculum. Furthermore, in order to implement the curriculum successfully, teachers must define their own roles, arrange relevant learning resources and spaces, and develop assessment plans to evaluate the effectiveness of the curriculum implementation.

Fogarty (1997) proposed the instructional process of problem-based learning as follows:
(1) Encountering the Problem: Students face the presented problem using various methods such as reading, role-playing, or other approaches that engage multiple intelligences. The problem is presented in a non-structured, open-ended real-life scenario. This scenario can often include some facts or brief descriptions of the environment.
(2) Defining the Problem: Once students grasp an understanding of the problem and become participants, they attempt to express in their own words what the problem they need to solve is. They then explore the direction of solving the problem and seek information related to the problem.
(3) Gathering Facts: In this stage, students utilize their prior experiences and multiple intelligences to identify information relevant to the problem. This includes:

What do we already know? (K - What we know?)
What do we need to know? (N - What we need to know?)
What do we need to do? (D - What we need to do?)
(4) Hypothesizing: At this stage, students employ "logical-mathematical intelligence" and reasoning skills to make hypotheses about the problem. They use "intrapersonal intelligence" to express what they're thinking, what they want to investigate, and the steps they plan to take.
(5) Research: The form of research depends on the nature of the problem. It could involve reading textbooks, having personal discussions, searching online, visiting libraries for information, interviewing relevant institutions, or seeking topics related to the research process. The use of multiple intelligences is evidently essential in this process.
(6) Restating the Problem: As the research progresses, the questions to be explored might deviate from the initial scenario. Having students restate the problem using linguistic intelligence can help them stay closely connected to the original question.
(7) Generating Possible and Optimal Solutions: Students can be guided to categorize solutions into three types: most likely, possibly, and optimal. This process encourages participants to evaluate the value of each perspective.
(8) Advocating the Chosen Solution: At this stage, students can utilize multiple intelligences to debate their ideas through written or spoken means.

3. Methodology

To create a questionnaire aligned with the problem-based learning assessment scale established by Lin et al. (2010) and Hsu (2013), and adapted to fit the objectives of your current study. The instrumentation used in this research is "Introspection of Problem Based Learning Pedagogy" which has 38 statements and is divided into 7 sections. First section is Personal Information, and other sections are in the format of a typical five-level Likert Scale. Other sections are displayed as following: 1) critical thinking; 2) self-directed learning; 3) Group interaction and active participation; 4) Evaluation of Case Problem; 5) Teacher Performance Evaluation; 6) motivation and attitude of learning; and 7) Behavioral Intention. All items except "Personal Information" are rated using a five-point scale, with 1 corresponding to "total disagreement" and 5 corresponding to "total agreement. The research framework is illustrated as **Figure 1**.

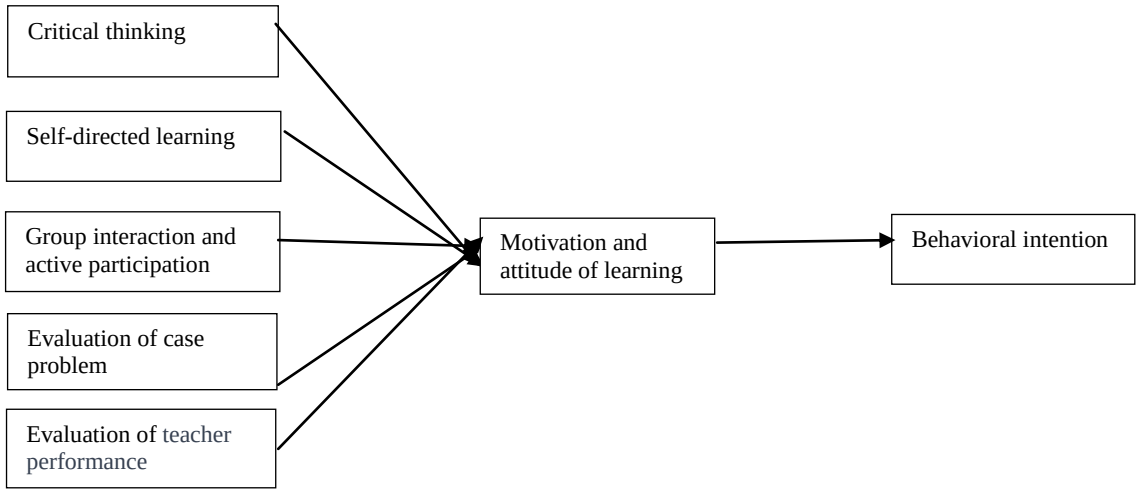

Figure 1. Research Framework

The data were acquired from undergraduate students of Department of Applied English enrolled in Marketing Management course in this department using a questionnaire. The 31 participants were volunteers who were assured of confidentiality. The value of Cronbach α of this questionnaire is 0.82. Discriminant validity refers to the degree to which a construct is truly distinct from other constructs. Average Variance Extracted (AVE), a factor-based method for assessing discriminant validity was proposed by Fornell and Larcker (1981) and they suggested that the levels of square root of the AVE for each construct should be greater than the correlation involving the constructs. As can be seen from Table 1, the diagonals indicate the square roots of the AVE. These are all greater than the correlation coefficients in the corresponding rows and columns. This result implies that each construct shared greater variance with its subordinate items than with other items subordinate to other constructs. This result therefore suggests that discriminant validity is established. **Table 1** shows the values of Pearson Correlations and predicts independent variables are all significantly strongly correlated. They identify adequate levels of reliability and construct validity.

Table 1. Pearson Correlations of all variables.

	critical thinking	self-directed learning	group interaction and active participation	case problem evaluation	teacher performance evaluation	motivation and attitude of learning	behavioral Intension
critical thinking							
self-directed learning	(.370)**						
group interaction and active participation	.247**	(.589)**					

case problem evaluation	.469**	.380**	(.419)**				
teacher performance evaluation form	299**	.515**	.563**	(.398)**			
motivation and attitude of learning	.318**	.336**	.403**	.390**	(.363)**		
behavioral intension	.627**	.250**	.225**	.507**	.264**	(.384)**	
square root of AVE from observed variables (items)	.80	.91	.88	.86	.84	.81	

N = 31, alpha reliabilities are given in parentheses. *p < 0.05; **p < 0.01.

4. Results and Discussion

A total amount of 31 students was collected to do the survey questionnaire and run data analysis. The personal data of most respondents is displayed as following: (1) The most gender of sex is female (60%); (2) The age is between 18-22 years old (94%); (3) the educational background is college sophomore (100%); (4) On average, most students (80%) spend 1-2 hours on reading business-related information (including books and electronic media); most students (87%) respond that Marketing Management: is his/her first foundational business-related course.; all students (100%) have never taken a course applying Problem-Based Learning (PBL) teaching method; and less students (32%) have working experience (including part-time job) before.

In section 1 (critical thinking), most respondents strongly agree that after reading case that the instructor gave to they will explain, analyze, and apply relevant theories, concepts, and facts. Also, they will connect with prior related readings, experiences, or knowledge. The fewest respondents (10%)verify the accuracy and effectiveness of the information they find. In section 2 (self-directed learning), most respondents strongly agree that they will utilize appropriate resources to meet my learning needs, undertake effective actions to satisfy my learning requirements, and show initiative during case studies and seek information. The fewest respondents (6%) would provide well-organized information relevant to the case.

In section3 (group interaction and active participation), most respondents strongly agree that they can pay attention to listen to different opinions from group members, participate in case discussions and complete tasks agreed upon by the group, focus and engage in group learning activities without distractions, and be willing to cooperate and collaborate with others. The fewest respondents (19%) would provide feedback to the group (reflections, ideas, and suggestions) and also accept different opinions from classmates. In section 4 (case problem evaluation)**,** most students strongly agree that the case questions can encourage students to explore and acquire specialized knowledge related to the subject of study, prompt students to integrate educational expertise acquired in the past, contribute to enhancing students' thinking and reasoning abilities, connect students' learning with life experiences, sparking their interest in learning, and are clearly described and possess guiding elements.
In section 5 (teacher performance evaluation)**,** most students strongly agree that the instructor guides group cooperation, interaction, and discussion, listens to student questions with patience, focus, and respect, and guides students to collect information for problem-solving from diverse sources. The fewest respondents (16%) agree that the instructor appropriately praises and acknowledges students' contributions. In section 6 (motivation and attitude of learning)**,** most students strongly agree that they would feel that their learning outcomes are good, and the overall learning outcomes of the class are also positive, have confidence in their learning abilities in this course, often engage in active thinking during class, and discuss the matter objectively without resorting to personal attacks facing controversial issues. Some students(48%) strongly agree that they would be able to concentrate in class and willingly participate in activities guided by the teacher. The fewest respondents (16%) agree that they can facilitate reaching a consensus among everyone when group members have differing opinions. In section 7 (behavioral intension)**,** most students strongly agree that they are willing to continue experiencing this PBL teaching method in other courses and share the benefits of this teaching method with other classmates.

For “Hypothesis 1: Personal background would be positively influence on behavior intension”, the results indicated that residential area, hours spend on reading business-related information, Marketing Management is his/her first foundational business-related course, and have working experience (including part-time job), have significantly positive related to behavioral intension because the results of ANOVAs (Scheffe method) for these variables show that all of their p values are smaller than 0.05. On the contrary, applying T-test (Levene method) to exam gender independent variable, the value ($F=6.16$, $p>0.05$) displays that sex variable does not have significantly difference in behavior intension. Moreover, the value ($F=1.224$, $p>0.05$) shows that there is no significant difference related to students who have never taken a course applying Problem-Based Learning (PBL) teaching method These information predicts that students who spend more hours on reading business-related information, have working experience, and had ever taken other business courses would have more willingness to continue experiencing this teaching method in other courses and share the benefits of this teaching method with other classmates.

For “Hypothesis 2: People who spend more time on reading business-related business information would have strongerSelf-directed learning”, most students (80%) choose 1-2 hours weekly and the value ($F =13.76$, $p<0.05$) means People who spend more time on reading business-related business information(including books and electronic media)each week has significantly positive relation with self-directed learning. Due to students from Department of Applied English, they spend most of time on improving English proficiency. Only few students abide by the teacher's guidance and trying to read more business books and surf online information. Reading widely in the field of business can help them gain valuable knowledge and insights. By the way, these students have great attitude for learning and self-improvement.

For “Hypothesis 3: Students who have working experience (including part-time job) would have significantly influence on group interaction and active participation, the results show the positive relationship with group interaction and active participation. Although students (32%) have working experience (including part-time job), it tell the truth that these students actually have better communicative and cooperative ability than students who do not have any working experience in dealing with group discussion and giving feedbacks..

Furthermore, applying ANOVAs (Scheffe method) to explore the significance between section 1, 2, 3, 4, 5 and section 6(motivation and attitude of learning)**,Table 2** summarizes the results of the research hypothesis testing. Two hypotheses are rejected: H4, and H7, because their p-values are larger than 0.05, which do not meet the requirement. According to the findings, the section “critical thinking” has no effect on motivation and attitude of learning in the research model. In other words, there is no distinction between the items of Critical thinking for motivation and attitude of learning. Additionally, P-value of Case problem evaluation equals to 0.577 (> 0.05) demonstrating that Case problem evaluation has no effect on the relationships between motivation and attitude of learning. In other words, there is no distinction between the items of Case problem evaluation for motivation and attitude of learning.

Three hypotheses are accepted: H5, H6, and H8, because their p-values are smaller than 0.05, which do meet the requirement. The section of self-directed learning, group interaction and active participation, and Teacher performance evaluation have a positive impact on students’ motivation and attitude of learning. In other words, there are distinctions among items of self-directed learning for motivation and attitude of learning. In addition, there are distinctions among items of group interaction and active participation for motivation and attitude of learning. Finally, there are distinctions among items of teacher performance evaluation for motivation and attitude of learning.

Table 2Summary of hypothesis testing results

Hypothesis		Hypothesis Testing
H4	Critical thinking has a positive impact on motivation and attitude of learning	Sig=0.344 > 0.05, Reject the hypothesis
H5	Self-directed learning has a positive impact on motivation and attitude of learning	Sig=0.000 < 0.05, Accept the hypothesis
H6	Group interaction and active participation has a positive impact on motivation and attitude of learning	Sig=0.002< 0.05, Accept the hypothesis

H7	Case problem evaluation has a positive impact on motivation and attitude of learning	Sig=0.577 > 0.05,Reject the hypothesis
H8	Teacher performance evaluation has a positive impact on motivation and attitude of learning	Sig=0.000 < 0.05,Accept the hypothesis

For "Hypothesis 9: "Students' motivation and attitude of learning would have significantly influence on behavioral Intension", the result (F =5.081, p<0.05) of ANOVA (Scheffe method) means that the section of Students' motivation and attitude of learning has significant effect on behavioral intension section. There are distinctions among items of Students' motivation and attitude of learning for behavioral intension. Students who concentrate in class and willingly participate in activities guided by the teacher would be more willing to continue experiencing this teaching method in other courses and share the benefits of this teaching method with other classmates.

5.Conclusion

Overall, this study highlights the importance of critical thinking, self-directed learning, group interaction and active participation, case problem evaluation, teacher performance evaluation, and motivation and attitude of learning when applying PBL method to non-business majored students. From this research, students are engaged in problem-solving activities, students are more likely to enhance their cognitive skills, critical thinking abilities, and problem-solving strategies. This approach aligns with the information processing theory's emphasis on the active construction of knowledge through meaningful interactions with the classmates and instructor in learning environment. As students work through problems, they practice information retrieval, analysis, and synthesis, which strengthens their overall cognitive functioning and understanding of the subject matter. Moreover, they practice to evaluate instructor's case and classmate's performance during discussing process. It promotes peer cohesion and emotional support. Moreover, this course can enhance students' ability to use diverse information, critical thinking ability, and encourage students' self-directed learning. Finally, the results of higher motivation and attitude of learning lead to be willing to continue experiencing this teaching method in other courses and share the benefits of this teaching method with other classmates.

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