

Effective Problem Based Learning Presented in a Blended System: One Step toward Adaptive Learning

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ABSTRACT

In the era of industrial revolution 4.0, the use of technology and the internet was almost implemented in all fields including education, especially in the learning process. The use of information technology in learning becomes a necessity because it facilitates students and lecturers in carrying out the learning process. Furthermore, problem-based learning sourced from authentic problems are effective and motivating. This study aims to explore the effective implementation of a problem-based learning implemented in a blended system, as a teaching and learning strategy toward adaptive learning method. This experimental research was followed up by identification of students' responses toward the implementation of the strategy. Respondents were 160 students taking a marketing management course; samples were selected through purposive sampling technique. Findings show that there were significant differences between control and experiment groups, confirming the higher significant progress of students learning through problem-based presented in a blended learning system than of students learning through conventional strategy. Nearly all respondents agreed that the problem-based learning presented in the blended system was interesting, motivating and assisting to gain the targeted learning outcomes. This strategy was also one step toward the implementation of adaptive learning method that put individualized learning in a computerized system.

Keywords

Problem Based Learning; Blended System; Adaptive Learning

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Introduction

Currently, the development of technology and science is related to the industrial revolution 4.0, one of which is shown by the use of technology and the internet in almost all fields including education. This is because technology and the internet make it easier for people to do work and activities of daily life. The use of technology that combines the physical and digital worlds will fundamentally change the pattern of human life and interaction [1]. Besides, by entering the era of the industrial revolution 4.0, there will be a merger between digital and physical domains based on Cyber-Physical Systems [2]. In the world of education, technological developments and the increasing number of people using the internet will directly affect the need to improve the quality of learning. In facing this industrial era 4.0, it is important to make fundamental changes in the education process so that later college graduates can compete in the world of work. The development of the industrial revolution 4.0 has made it easier for humans to carry out their work activities because most (75%) of all current activities already use technology and the internet, including in learning [3].

The use of technology in learning is currently needed such as gadgets, smartphones, and androids can be used as media that can make it easier for students to learn independently in mastering a concept [4]. Besides, the use of information technology in carrying out learning is a necessity because it makes it easier for students and lecturers to carry out learning that is not limited to space and time [5]. This is supported by the use of the internet in learning which will enable students to obtain the latest knowledge and information [6]. A paradigm shift in learning in the 21st century demands a change in thinking, namely that students

can have high order thinking skills (HOTS) critical thinking skills, find solutions, be creative, innovate, communicate, collaborate, and have information and media skills [7,8]. Higher-Order Thinking Skills (HOTS) is one of the important skills that every student has to master it in the 21st century [9]. In addition, Apino [10] stated that one of the success indicators to encourage human resources in education is the good indicator of student's higher-order thinking skills because learning purpose in the 21st century is to develop and enhance student's higher-order thinking skills.

In vocational education such as polytechnic education, skills are highly demanded to be better prepared to face the world of work. At present, especially in the Marketing Management course at Malang State Polytechnic-Indonesia, there are still many lecturers who use the learning method with the lecture method in the classroom so that it can be categorized as Teacher-Centered Learning (TCL). This situation becomes a problem because the ability of students in general in the field of skills is lacking and there is still low interest and readiness of students in learning because with the lecture method students tend to be less active and more listening. For this reason, to improve student motivation and ability in learning, it is necessary to change the learning model, one of which is to use the blended learning model.

In the application of the blended learning model, face-to-face learning is combined with e-learning. Blended learning is a new concept in learning where material delivery can be done in class and on-line [11]. Staker and Horn [12] defined that blended learning as a formal education program where students learn at least part of course materials online, with some of the course instructions being delivered online. The effectiveness of blended learning relies on appropriate

division of learning between online and face-to-face mode [13]. The blended learning method which is accompanied by the enrichment of several kinds of learning methods that require active students and critical thinking will turn it into student-centered learning or often known as Student-Centered Learning (SCL). Cannon and Newbie [14] argued that Student Centered Learning (SCL) as a way of thinking and learning that emphasizes the responsibilities and activities of students in learning rather than what the teacher does. Basically, the essence in Student Centered Learning is that students have responsibilities and activities. The SCL learning method that can be integrated into the blended learning model includes problem-based learning accompanied by practice rehearsal pairs.

The learning with a problem-based learning approach has been widely carried out in vocational education environments in various universities [15]. Problem-based learning is one of the learning methods of Student Centered Learning which is in line with the various teaching and learning methods currently practiced in the teaching and learning process. This is because problem-based learning is a learning method that challenges students to “learn to learn,” and to work cooperatively in groups to find solutions to real-world problems [16]. Problem-based learning allows students to solve real-world problems, learn to think at a higher level and motivate students in learning activities [17]. Borhan [18] defined problem-based learning as an innovative teaching approach capable of developing students with interdisciplinary knowledge and problem-solving strategies. Problem-based learning is also an innovative, structured learning approach because in problem-based learning students focus on problems that have been identified and that involve their intellectual efforts [19]. Problem-based learning is a series of learning activities that are centered on the problem-solving process. This is because the problem is a starting point in learning so that learning activities are directed to solve the problems given [20].

Barrows and Tamblyn [21] stated that the main advantage of problem-based learning is that learning is self-determined and obtained through exploring or learning so that students become active participants in the learning process. Problem-based learning aims for students to acquire knowledge and form it in an integrated manner with the cases at hand to solve [22]. The purpose of problem-based learning is to give students the ability to find and correct problems, solve problems, discuss problems, analyze problem alternatives, and make the right decisions. Yerizon [23] found that problem-based learning can make students solve problems so that they can get the concept of the material independently.

Previous research found that the application of blended learning was able to positively influence learning outcomes [24]. In addition, Usman [25] found that the blended learning method was able to improve the quality and quality of learning and was able to increase the motivation, interest and learning outcomes of students. There was also a fairly high difference between conventional learning and blended-based learning and the application of blended learning could improve student learning outcomes as well as satisfaction and efficiency [26]. Likewise, research conducted by Prawoto and Pramulia [27] found that the application of

blended learning could stimulate and foster learning motivation for students and can improve learning outcomes because of the tendency of students to be more active, innovative, creative, and enthusiastic in independent learning.

Studies have repeatedly shown that students, regardless of age, are motivated and able to learn new technologically based tasks [28]. Moreover, students can significantly increase their abilities to work with new technology with proper training. Older students can optimize their results through extended practice. Younger students will adapt more quickly to technological issues and learn to master the technology at an advanced rate [28].

The new generation being so interrelated with technology, and it becomes nearly a must to use technology in classes. Dudeney and Hockly [29] refer to today’s kids as digital natives who grow up using technology and the parents as digital immigrants who have come late to the world of technology. Scaffolding is widely considered an essential component of effective instruction; therefore, the scaffolding strategy has been widely employed to include several tools such as multimedia and hypermedia software to provide learners with supports [30]. Most studies applying scaffolding theory provided static scaffolds in their learning contexts without considering students’ changes during the learning process. However, learning styles may be influenced by students’ experiences, so they are not unchanged traits that can be measured through explicit questionnaires once and ignored until the end of the implementation.

Individual differences among students have significant effects on their learning outcomes [31]. Previous studies examined these effects and indicated that providing the same learning materials and delivering the same instructional conditions to all students may lead to a reduction in learning performance without considering their different background characteristics, prior knowledge, experiences, and learning aptitudes [32]. For ensuring effective learning for all students, adapting teaching strategies and content to meet individual student needs has long been regarded as a central and persistent issue in education.

The term adaptive learning refers to a method of online instruction that involves providing personalized learning experiences resulting from a data-driven approach to curriculum design. This method builds on customized learning paths derived from algorithms, course analytics, assessment data, and feedback from students and can be used both to provide remediation and to help learners achieve mastery of content [33]. Therefore, Adaptive Learning Method is the solution for rural students as Adaptive Learning Method adapt to learning style, students’ needs, students’ available learning tool-tech, and authentic content.

This article presents the report of a study conducted with the focus of identifying the effectiveness of a problem-based learning as implemented in a blended system, combining offline and online learning system.

Methods

This quasi-experimental research was aimed to explore the effectiveness of a problem-based learning presented in a blended system. Students' responses toward the implementation of the program was also explored. Respondents were 160 students taking Marketing Management course of Accounting Department of the State Polytechnic of Malang-Indonesia; samples were selected through purposive random sampling. Respondents were equally divided into control and experiment groups with 80 students in each group. The data were collected through a pre-test, a post-test, and a questionnaire.

At the beginning of the study, both the control and experiment groups were asked to have pre-test. Then, the control group went through the learning of Marketing Management course using conventional strategy, the teaching strategy previously implemented in the class. The class did not apply problem-based learning, and the class was held face-to-face. The experiment group went through the learning implementing problem-based learning that was presented in a blended learning system, a combination of face-to-face and online class. After the treatments, both groups did the post-test. Then, questionnaire was also distributed to the experiment group. The questionnaire was aimed to identify students' responses on the implementation of the problem-based learning as presented in a blended learning system.

Research Findings and Discussion

Descriptive statistics of the initial ability (pre-test) and the ability after being given treatment (post-test) as well as the progress gained of both control and experiment groups is presented in Table 1. As seen in the Table 1, the pre-test scores of both groups were not far different; the control group's average score of pre-test was 69.6 while the experiment group's score was 71.7. However, the results of the post-tests of the experiment group (78.41) was higher than the control group's scores (72.33). The progress gained by the experiment group (6.71) was also higher than the that gained by the control group (2.72).

Correlational analysis was also done to correlate the data of both control and experiment groups. Table 2 presents the results of the statistical analysis of paired samples correlation, analysis the correlation between the control and experiments groups. As seen in Table 2, there was no significant correlation between the control group and experiment group. Moreover, the post-test results of the control group were negatively correlated to the scores of the experiment group. the same was also true with the progress gained by the two groups; the progress scores of the control group were negatively correlated that of the experiment group.

Furthermore, to find out the significant differences in the values of post-test and progress gained by both groups, a statistical testing using the paired t-test (paired-sample t-test) was done. The significant levels accepted was decided to be below 0.05.

As presented in Table 3, it can be seen that the paired t-test results for the difference between the pre-test scores of the

control group and experiment group shows a t-value of -1.833 which was significant at 0.071. this means that there was no significant difference between the scores of the control group and that of the experiment group. this may mean that both groups started the class with equal knowledge and skills of marketing management course.

Statistical analysis result of the post-tests of both control and experiment groups show a t-value of -4.943 with the significant level of 0.000. This shows that there was significant difference in the results of post-test, with the experiment group attained higher scores than the control group did. Furthermore, progress attained by both control and experiment groups were also statistically calculated. Results of the analysis show t-value of -3.872, conveying that there was a significant difference in the progress attained by the two groups with the significant level of 0.000. This underlines the fact that the experiment group significantly gained higher progress than the control group did.

Table 1. Descriptive statistics of control and experiment groups for the pre-test, post-test, and progress gained

Mean			N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test of Control Group	69.6000	80	7.16638	.80123
	Pre-test of Experiment Group	71.7000	80	7.46197	.83427
Pair 2	Post-test of Control Group	72.3250	80	7.05274	.78852
	Post-test of Experiment Group	78.4125	80	7.53506	.84244
Pair 3	Progress Gained by Control Group	2.7250	80	5.82655	.65143
	Progress Gained by Experiment Group	6.7125	80	6.63553	.74187

Table 2. The results of t test for the comparison of outcomes for control and experiment groups
Paired Samples Correlations

		N	Correlation	Sign.
Pair 1	Pre-test control & experiment groups	80	.020	.864
Pair 2	Post-test control & experiment groups	80	-.139	.218
Pair 3	Progress gained by control & experiment groups	80	-.089	.435

Table 3. The results of t test for the comparison of outcomes for control and experiment groups

Paired Differences						t	df	Sig. (2-tailed)	
Mean		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	Pre-test cont- Pre-test exp	-2.10000	10.24460	1.14538	-4.37982	17982	-1.833	79	.071
Pair 2	Post-test cont- Post-test exp	-6.08750	11.01460	1.23147	-8.53868	-3.63632	-4.943	79	.000
Pair 3	Progress cont- Progress exp	-3.98750	9.20992	1.02970	-6.03707	-1.93793	-3.872	79	.000

The hypothesis tested in this study was whether progress attained by the experiment group learning the materials through problem-based presented in blended learning was significantly higher than the progress gained by the control group who learned the materials through conventional method. With the above-stated data, it can be concluded that the H_0 was rejected and the working hypothesis was accepted.

Thus, it can be concluded that in general, the achievement scores of marketing management of students who learned through problem-based learning presented in a blended system were higher than that of the control group with conventional learning strategies. The results of this study support previous related research (for example Collis & Moonen [35]; Osguthorpe & Graham [36]; Twigg [37]; Young [38]) which claimed that a class with the application of blended learning was more effective than a class that applied a face-to-face approach only. This was also in accordance with Thorne's idea [39] that blended learning was better than conventional learning because blended learning integrates innovation and technological advances using online learning and media.

The results of this study are also in line with research conducted by Dziuban et al. [40] who found that blended learning has the potential to improve learning outcomes. This situation is partly because blended learning combines several aspects such as web-based instruction, video streaming, synchronous and asynchronous communication, and face-to-face learning [41, 42]. Furthermore, Osman [43] found that students have higher level of interest and motivation when participating in a blended learning classes. Hence, the implementation of blended learning has its advantages and ought to be further enhanced for its ability to draw students' interest and motivation in their learning.

Further data were gathered regarding students' responses to the implementation of problem-based learning as presented in a blended system. Respondents' responses to the distributed questionnaire are as presented in Table 4.

Table 4. Students' responses toward the implementation of problem-based learning presented in blended system

No	Statements	Responses (Scale 1-5)
1	I feel more motivated to learn materials presented in problem-based learning than those presented in lectures only	3.81

2	I would feel more easily bored when the learning materials are presented in lectures only.	3.74
3	I can comprehend and understand the materials better when presented in problem-based learning	4.08
4	Problem-based learning can improve my ability to think critically and creatively	4.11
5	I feel more motivated to learn from the real cases as found in real business.	3.88
6	The learning materials delivered using problem-based learning and presented in blended system are challenging and interesting.	3.99
7	I believe that the implementation of blended learning system would improve my achievement scores higher than the offline face-to-face learning system.	3.88
8	I can easily access the learning materials provided online (via mobile phone or computer) as implemented in blended learning system.	3.90
	Average all	3.92

As seen in the Table 4, from all the 8 questions, students voiced positive responses regarding the implementation of problem-based learning presented in a blended system. Within the range from 1 to 5, students stated that they felt motivated to learn materials offered in a problem-based learning. The responses value was 3.81. Problem-based learning presented in a blended system also made students felt less bored. Students could better comprehend and understand the materials which were presented in a problem-based learning. This strategy also made students think more critically and creatively. This is consistent with study by Butan [44] that learning using the problem-based learning method can encourage active learning and students can learn the content of the lesson through solving cases that mimic real-life situations. Besides that, Gorleku et. al. [45] found that problem-based learning method can provide motivation to students and most importantly, what students learn is better preserved, because students themselves determine what is important for their own studies, and seek information themselves. Problem-based learning also provides benefits for students and for their education because problem-based learning can improve their learning abilities. Therefore, the problem-based learning model is very suitable for education and has a significant impact on student understanding, information retention, and skills development.

Learning materials as found in real business made students more motivated to learn more. Furthermore, students found the learning materials more interesting and challenging (in a positive way) when presented through blended learning

system than through face-to-face lectures only. Students also stated that they could easily access the materials through computer or mobile phone. Finally, students believed that the implementation of problem-based learning as presented in a blended system would improve their learning achievement better than the materials presented in a conventional learning method and face-to-face lectures.

The implementation of the learning strategy in the current study impacted on the improved motivation and interest to further learn the materials. These affective factors have been known as very influential in the effective attainment of learning objectives. The results of this study are supported by Lakonawa et al. [46] who prove that motivation will encourage and guide students to be more encouraged to learn so that with high motivation, students will be able to maintain their enthusiasm for learning.

The effectiveness of the strategy of putting problem-based learning into a blended learning system as proven in the current study can be upgraded its implementation into the implementation of adaptive learning. Upgrading the strategy into adaptive learning method can be done by individualizing the problem-based learning materials and putting them into a computerized system. Following the pillars of adaptive learning as stated by Educause [34], therefore, enriching the learning materials need to be done, providing enforcement materials to accommodate fast learners and remedial materials to facilitate slow learners. Thus, adaptive learning which is believed to be potentially effective in the coming years can be realized.

Conclusions

Based on the results of the analysis and testing of research hypotheses, this study can be concluded that there is a significant difference in the learning outcomes of Marketing Management between groups of students who learn materials presented in a problem-based learning presented in a blended system and groups of students using conventional learning strategies. The effectiveness of the strategy in improving students' learning achievement may also be influenced by students' improved affective factors such as improved interest to learn, increased motivation to study. The effectiveness of problem-based learning as presented in a blended learning system supports the potential implementation of adaptive learning in the future by embedding individualized learning method into the strategy.

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