

Adopting Authentic Problem-based Learning (APBL) to Enhance Self-efficacy of Learning and Perceived Digital Literacy Skills of University Students

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Abstract: Problem-based learning (PBL) has emerged as an innovative education and it is increasingly gaining its prominence in the institutes of higher learning worldwide. PBL Educators believed in using problems to stimulate learning. This paper aimed to compare students' learning self-efficacy (LSE) and perceived Digital Literacy (DL) skills between groups of students attempting a class project in the Physics course using Authentic Problem-based Learning (APBL) approach (experimental group, E (R)) and traditional lecture approach (control group, C (R)). This study utilized two groups, Random Selection, Pretest and Posttest design by setting up an experimental group and a control group for the experiment. 39 students undertaking Physics course in FALL 2016 semester in the American Degree Transfer Program at Taylor's University in Malaysia participated in this study. The study investigated whether there existed difference in the LSE mean score and perceived DL skills of the university students after attempting a class project under APBL approach and traditional lecture approach and if a correlation existed between perceived DL skills and LSE mean score. The independent variable of this study was the teaching and learning approach while the dependent variables were the mean LSE mean score and perceived digital literacy skills in a self-reporting and numerically measurable LSE questionnaire adapted from Klobas. A paired-sample t-test showed that the mean LSE score of experimental group students was increased while there was no significant difference for control group students after attempting the class project. Independent sample t-test indicate that there was no significant difference in the LSE mean score in the pretest while there was a significant difference in the of LSE mean score in the posttest between the experimental and control group. Independent sample t-test conducted for perceived digital literacy skills showed that there was a significant difference in the perceived DL skills between the experimental and control group after attempting the class project. Pearson's moment correlation showed that there was a positive correlation among LSE mean score, perceived DL skills and perceived gain in DL after students attempted the class project.

Key words: *Digital literacy skills, Authentic Problem-based learning, traditional lecture, learning self-efficacy, Experimental design, Higher education*

INTRODUCTION

An educational shift from teaching to learning approach has been observed since the past decades whereby outcome-based education (OBE) is being emphasized around the world. Malaysia began to implement OBE in 2004 [1]. OBE is also introduced and piloted in disciplines of sciences and technology, social sciences and humanities in many universities in Malaysia as parallel with the Ministry of Higher Education reform policy and Malaysian Quality Assurance of higher education since 2010. As a result, various student centred learning (SCL) approaches and instruction strategies have been encouraged and practised in the universities and institutes of higher learning in Malaysia. These SCL approach includes Problem-based

/ Project-based learning (PBL), flip classroom, cooperative learning, guided discovery learning, role-play, etc.

Among these SCL strategies, PBL is believed to be more beneficial to both teachers and students as it engages and empowers students in the content, and opens a broad variety of techniques beyond the standard lecture to encourage faculty to stay fresh and current in their field, and involved in their students' progress [2]. As a result, PBL has emerged as one of the most popular approach of learning and is gaining its prominence in most of the universities [3]. In Malaysia, following the successful implementation of PBL in the Medical and Dental Faculties of University Malaya, many institutes of higher education have been observed to adopt PBL

approach [4]. A growing number of medical and non-medical schools began to introduce PBL since 1990s [5]. PBL is a curriculum development and instructional system that simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem solvers confronted with an ill-structured problem that mirrors real-world problems [6]. PBL environment is a constructivist learning environments designed in such a way as to stimulate a situation for the students to gain or acquire content knowledge through the philosophy of “learning how to learn the material” for its [7]. In PBL environment, learning is triggered by a carefully selected and well-designed problem that demands from the learner acquisition of critical knowledge, problem-solving proficiency, self-directed learning strategies and team participation skills. Students in PBL environment must possess high level of communication skills, ability to identify and define problems, seeking and evaluating information and use it effectively. These skills are embraced under the broad term of digital literacy skills to raise students’ learning self-efficacy which will enhance their learning experience.

Research shows that students who have been taught through PBL possess several positive attributes, such as better ability at integrating knowledge and addressing problems, ability in interpreting and evaluating more objectively than those who have been taught in traditional approach [8]. PBL learners are self-regulating and retain ownership of their learning [8], as well as, exhibiting increased achievement and retention levels [9-10]. Dochy, Segers, Bossche, and Gijbels [11] argued that PBL learners have better retention of declarative knowledge, although they remembered fewer facts, as well as greater knowledge application, both immediate and long lasting, which is a skill sought after in the workforce [12]. PBL innovatively fosters teamwork, self-organization, information searching skills, as well as comprehension of knowledge [13]. Savery [14] describes problem-based learning as “focused, experiential learning organized around the investigation and resolution of messy, real-world problems”.

For adult learners such as university or college students, Authentic Problem-based Learning (APBL) is viewed as an appropriate approach to create learning. APBL is purported to empower learners by encouraging them to take a deep approach to their own learning and to become more confident and self-directed in their learning. It incorporates uncertainty which provokes real learning. Students develop knowledge, skills and attitude in various stages of problem solving process in an APBL approach. This study adopts this definition as a framework, conceptualizing the authentic problem-

based learning model as a student-centred learning approach rooted in an authentic problem.

Previous research also shows that information literacy skills training improves students’ academic self-efficacy in a problem-based learning environment [15]. Past research documented that self-efficacy has strong and positive influence on students’ motivation and achievement and there is a strong relationship between information literacy and academic self-efficacy [16]. Self-efficacy is the confidence in one’s ability to behave in such a way as to produce a desirable outcome [17]. Bandura [18] further speculated that it is “the belief in one’s capabilities to organize and execute courses of action required to produce given attainments”. In academic context, learning self-efficacy (LSE) is the “self-evaluation of one’s ability and chances for success in the academic environment” [19]. Researchers have found that LSE is a strong predictor of academic performance in college students with positive correlations ranging from $r = .49$ to $r = .71$ [19-21]. As students’ academic expectations and self-efficacy increases, they are more likely to “show higher performance”. In PBL research community, however, there is limited research carried out to examine the effect of Problem-based learning on students’ learning self-efficacy and digital literacy skills as well as the relationship between learning self-efficacy and Digital Literacy skills in PBL classroom. Given the evidence that LSE is closely linked to academic achievement and learning experience, it warrants a research to study the impact of APBL on LSE and perceived digital literacy skills of university students.

The Problem

The central role of university students in PBL environment is to learn how to learn and prepare themselves in future profession. PBL educators have emphasized on the development of knowledge and skills, improving their ability at integrating knowledge and addressing problems, ability in interpreting and evaluating more objectively. However, PBL educators have omitted the development of LSE and digital literacy skills of the students which relates to their confidence in accomplishment of the learning tasks or class project. This omission will limit students’ ability to participate in team work to successfully foster deep learning. Without proper guidance in information seeking during the different phases in PBL activities and to resolve uncertainty in the PBL process, university students lack confidence during their learning process. This phenomenon will affect their success and survival in PBL environment. PBL research community has recognised the importance of information literacy to the successful implementation of PBL [22], but little research has been conducted to study the model of PBL which will lead to raise level of learning self-efficacy

and digital literacy skill which will eventually affect the learning experience of the university students in the PBL environment.

The Objective of the Study

The objective of this study is to determine the effect of APBL (treatment) on university students’ LSE and perceived digital literacy skills in Physics course, by comparing mean scores of students’ LSE and perceived digital literacy across the treatment and control groups. The study also investigates the relationship between the students LSE and perceived digital literacy after they perform the class project. The research questions related to this objective are:

RQ1: Does Authentic problem-based learning (APBL) have impact on learning self-efficacy of university students in performing a class project in Physics course?

RQ2: Is students’ perceived information seeking skills differ between experimental group and control group after performing a class project in Physics course?

RQ3: Are there correlation among students’ LSE, perceived information seeking skills and perceived gain in digital literacy skills.

These research questions guided the formulation of the null hypotheses of this study:

H₀₁: Authentic problem-based learning had no statistically significant impact on students’ learning self-efficacy in performing a class project.

H_{01a} : There was no statistically significant difference between the pretest and posttest mean score in students’ learning self-efficacy for students in experimental group while performing the class project.

H_{01b}: There was no statistically significant difference between the pretest and posttest mean score in students’ learning self-efficacy for students in control group while performing the class project.

H_{01c}: There was no statistically significant difference in the pretest mean score in students’ learning self-efficacy between students in experimental group and students in control group before performing the class project.

H_{01d}: There was no statistically significant difference in the posttest mean score in students’ learning self-efficacy between students in experimental group and students in control group after completing the class project.

H₀₂ : There was no statistically significant difference in the perceived Digital Literacy skills between students in experimental group and control group after completing the class project.

H_{02a}: There was no statistically significant difference in the perceived information seeking skills between students in experimental group and control group after completing the class project.

H_{02b}: There was no statistically significant difference in the perceived gain in Digital Literacy skills between students in experimental group and control group after completing the class project.

H₀₃: There was no statistically significant correlation among students’ posttest LSE score, perceived information seeking skills and perceived gain in digital literacy skills after performing the class project.

METHODS

The Sample

A total of 39 undergraduate students who have registered in the Fall-2016 Physics course in American Degree Transfer Program at Taylor’s University participated in this study. These students studied in the same class prior to the experimental study.

Research Design

This study utilized Two groups, Random Selection, Pretest, Posttest design by setting up an experimental group and a control group for the experiment, as shown.

Group	Pre-test	Treatment	Post-test
Experimental group = E (R)	0	APBL	0
Control Group = C (R)	0		0

The experimental study was carried out at the 13th week of the semester. During the experimental study, all the 39 students were requested to flip a coin and to be randomly assigned into experimental and control group. During this random assignment process, those who obtained the obverse side of a coin were assigned to the experimental group E (R) while those who obtained the reverse side of the coin were assigned to the control group C (R). 20 students were assigned to experimental group and 19 students were assigned to Control group during the random assignment. The students in experimental group were given APBL treatment while performing the class project. The students in control group attended traditional lecture on the topic related to class project during the normal lecture schedule before

they performed the class project. Both groups started with the class project at the same time on the Saturdays of 13th week. All participants were pretested before they received the problem scenario of the class project and post-tested after they completed and presented their solution at the end of the day with 2 separate sets of questionnaire as described in the instruments.

Instruments

The independent variable of this study was the mode of instruction, namely traditional lecture approach (Control group) and APBL treatment (Experimental group) to prepare students in performing a class project. Students in experimental group underwent 3 sub-group meeting sessions and facilitated by lecturer during their class project. Students in control group went ahead with the class project as they have attended the traditional lecture with topic related to the class project. The dependent variable was the mean LSE scores on the self-reporting and numerically measurable questionnaire measured in 10-points Likert scale. The scale was administered in a pretest and posttest format for both experimental and control. The questionnaire was a series of 27 items developed by Klobas [23]. Additional items on perceived information seeking skills and perceived gain in digital literacy skills measured in 10-points Likert-scale, were also included in the posttest questionnaire. The instruments yielded reliability coefficients of 0.950 based on 27 items of LSE in the pretest questionnaire, and 0.911 based on 29 items of Post-test questionnaire. The perceived information seeking skills and perceived gain in DL skills were included in the posttest questionnaire. This indicates that the dependent measures were valid as the reliability coefficients obtained were higher than the recommended level of 0.70 [24].

Progression of class project

Both the control group and experimental group received the problem scenario after they have attempted the pretest LSE questionnaires. They formed small group of 4 to 5 persons to perform the class project. Students from the control group were allowed to kick off the class project at their own pace without intervention of lecturer until they finish and record their presentation. The full report and video presentation were submitted for evaluation via email at the end of the day, any time before mid-night (24:00) of the day.

Treatment: Authentic Problem-based Learning, APBL

The APBL approach in this study was adapted and combined from APBL model [25] and the Republic Polytechnic’s “one-day, One-Problem” approach to

PBL [26]. The approach was built around modified version of Wilson Problem-solving model [27]. This APBL model was conducted on Saturday from 8 am to 5 pm to avoid disruption of students’ time-table.

In the experimental group, the students were not taught with the topic related to the class project and they will treat the problem scenario as “real world” problem. This APBL mode will land them to the following “TIPS” [25] stages

Trigger their learning, students encountered high uncertainty level and curiosity when they received a problem beyond their existing knowledge to tackle with.

Inquire and information seeking behavior (ISB) occur to clarify and identify the problem by stating the problem statement (during 1st Meeting).

Propose ideas to manage the problem after seeking more information (ISB) to fill the knowledge gap (during 2nd Meeting)

Seek and acquire new knowledge (ISB) alongside with solving the problem (During 3rd meeting) to compile the acquired knowledge to solve the problem).

These stages took place in at least 3 meetings, where each meeting served as uncertainty resolution, as shown in modified version of Wilson’s Problem solving model.

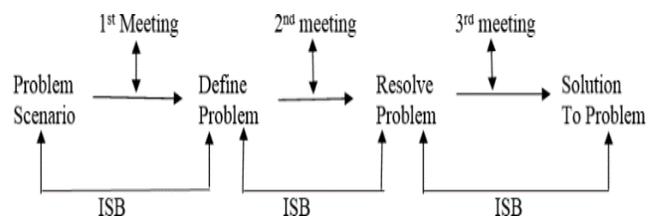


Figure 1. Modified version of Wilson’s Problem Solving model

In 1st meeting, students formed small group, they were presented with ill-structured “real world” problem to trigger learning due to curiosity. They began to craft and write problem statement, identify existing knowledge as well as knowledge gap to solve the problem. Individual member was assigned with specific task and proceeded with information seeking process (ISB). In the 2nd Meeting, information and newly acquired knowledge was gathered from all members in the group to make sense of the problem, the knowledge gap was narrowed and they proposed further ideas to manage the problem. Individual member continued to seek information (ISB)

along with problem solving process. In 3rd meeting, the knowledge gap was closed as much as possible by compiling all the information acquired and final solution was presented. Group members recorded their presentation of the proposed solution during this meeting. The full report and video presentation were submitted for evaluation via email at the end of the day, any time before mid-night (24:00) of the day.

RESULTS

The objective of this study was to determine the effect of APBL (treatment) on university students’ learning self-efficacy, perceived information seeking skills and perceived digital literacy skills in Physics course. This study also looked into the relationship between the students’ LSE perceived, information seeking skills and perceived digital literacy skills after they performed the class project. In order to examine whether these objectives were achieved, it was imperative to test all the null hypotheses and the associated subsidiary hypotheses.

Testing of Hypothesis H₀₁ and its subsidiary hypotheses

H₀₁: Authentic problem-based learning had no statistically significant impact on students’ learning self-efficacy in performing a class project.

H_{01a} : There was no statistically significant difference between the pretest and posttest mean score in students’ learning self-efficacy for students in experimental group while performing the class project.

H_{01b}: There was no statistically significant difference between the pretest and posttest mean score in students’ learning self-efficacy for students in control group while performing the class project.

H_{01c}: There was no statistically significant difference in the pretest mean score in students’ learning self-efficacy between students in experimental group and students in control group before performing the class project.

H_{01d}: There was no statistically significant difference in the posttest mean score in students’ learning self-efficacy between students in experimental group and students in control group after completing the class project.

Pair sample T-test was performed to test the two subsidiary Hypotheses H_{01a} and H_{01b} while Independent sample T-test was performed to test subsidiary hypotheses H_{01c} and H_{01d} . This T-tests enabled the researcher to decide on whether to reject or fail to reject null hypothesis H₀₁.

Table 1 shows the results of Paired sample T-test. The following results were reported based on the Paired sample t-test statistics:

- 1) H_{01a} was rejected in favor of H_{1a} :

There was a statistically significant difference in the pretest mean score (M=6.72, S.D = 1.01) and posttest mean score (M=7.98, S.D =1.10), t(19)= -5.07, P=0.00 in students’ learning self-efficacy for students in experimental group E (R) while performing the class project.

- 2) Failed to reject H_{01b}

There was no statistically significant difference in the pretest mean score (M=6.49, S.D = 1.37) and posttest mean score (M=6.98, S.D =1.16), t(18)= -1.43, P=0.17 in students’ learning self-efficacy for students in control group C (R) while performing the class project.

Table 1: Paired-sample T-Test for Learning self-efficacy (LSE)

	E(R) n=20					C(R) n=19						
	Pre	s.d	Post	s.d	Sig.(2-tail)	t-val	Pre	s.d	Post	s.d	Sig.(2-tail)	t-val
LSE	6.72	1.02	7.98	1.1	0.00	-5.07	6.49	1.37	6.98	1.16	0.17	-1.43

Table 2 shows the results of independent sample T-test. The following results were reported based on the independent sample T-test statistics:

- 3) Failed to reject H_{01c}

H_{01c}: There was no statistically significant difference in the pretest mean score in students’ learning self-efficacy between students in experimental group (M=6.72, SD=1.02) and students in control group(M=6.49, SD=1.36); t(38)=0.605, p = 0.55.

- 4) H_{01d} was rejected in favor of H_{1d}

H_{1d}: There was a significant difference in the posttest LSE mean score between experimental group (M=7.98, SD=1.10) and Control group (M=6.99, SD=1.16); t(38)=2.73, p = 0.01.

There was a statistically significant difference in the posttest mean score in students’ learning self-efficacy between students in experimental group (M=7.98,

SD=1.10) and students in control group (M=6.99, SD=1.16); $t(38)=2.73$, $p = 0.01$, after completing the class project.

Combining the results from the paired sample T test and independent sample T-test, the null hypothesis H_{01} was rejected in favour of its alternative hypothesis, i.e. Authentic problem-based learning had statistically significant impact on students' learning self-efficacy in performing a class project.

Table 2: Independent sample T-test results of pretest LSE, Posttest LSE of students based on experimental and control group

Dependent variables	Group	n	Mean	S.d	t	p
Pretest LSE	E (R)	20	6.72	1.02	0.605	0.549
	C (R)	19	6.49	1.36		
Posttest LSE	E (R)	20	7.98	1.10	2.73	0.01
	C (R)	19	6.99	1.16		

Testing of Hypothesis H_{02}

H_{02} : There was no statistically significant difference in the perceived Digital Literacy skills between students in experimental group and control group after completing the class project.

H_{02a} : There was no statistically significant difference in the perceived information seeking skills between students in experimental group and control group after completing the class project.

H_{02b} : There was no statistically significant difference in the perceived gain in Digital Literacy skills between students in experimental group and control group after completing the class project.

An independent sample t-test was conducted to compare the perceived information seeking skills and perceived gain in digital literacy skills in posttest questionnaire. Table 3 shows the independent sample T-test statistics of perceived information seeking skills and perceived gain in digital Literacy skills of students based on experimental and control group.

H_{02a} was rejected in favor of H_{2a}

There was a statistically significant difference in the perceived information seeking skills between students in experimental group (M=8.15, SD=0.93) and control group (M=7.15, SD=1.50); $t(38)=2.49$, $p = 0.017$ after completing the class project.

H_{02b} was rejected in favor of H_{2b}

There was a statistically significant difference in the perceived gain in Digital Literacy skills between students in experimental group (M=8.15, SD=0.93) and control group (M=7.21, SD=1.44); $t(38)=2.43$, $p = 0.020$ after completing the class project.

As both subsidiaries were rejected in favor of its alternative sub-hypotheses, the null hypothesis H_{02} was rejected in favor of its alternative hypothesis, that is :

H_2 : There was a statistically significant difference in the perceived Digital Literacy skills between students in experimental group and control group after completing the class project.

Table 3 : Independent sample T-test results of perceived information seeking skills and perceived gain in digital Literacy skills of students based on experimental and control group

Dependent variables	Group	n	Mean	S.d	t	p
Perceived Information seeking skills	E (R)	20	8.15	0.93	2.49	0.017
	C (R)	19	7.15	1.50		
Perceived gain in DL skills	E (R)	20	8.15	0.93	2.43	0.020
	C (R)	19	7.21	1.44		

Testing of Null Hypothesis H_{03}

H_{03} : There was no statistically significant correlation among students' posttest LSE score, perceived information seeking skills and perceived gain in digital literacy skills after performing the class project.

A Pearson product-moment correlation was computed to assess correlation among students' posttest LSE score, perceived information seeking skills and perceived gain in digital literacy skills after performing the class project as shown in Table 4. Results showed that the correlation 1) between students' posttest LSE score and perceived gain in digital literacy score was statistically significant ($r = 0.509$, $n = 39$, $p<0.01$, two-tailed), 2) between students' posttest LSE score and perceived information seeking skills was statistically significant ($r = 0.515$, $n = 39$, $p<0.01$, two-tailed), and 3) between students' perceived gain in digital literacy score and perceived information seeking skills was statistically significant ($r = 0.993$, $n = 39$, $p<0.01$, two-tailed).

Thus, null hypothesis H_{03} was rejected in favor of its alternative hypothesis. It indicated that there was a statistically significant, positively correlation among students' posttest LSE mean score, perceived information seeking skills and perceived gain in digital literacy skills after performing the class project.

Table 4: Pearson's Correlation coefficient among posttest LSE mean score

		Posttest LSE mean score	Perceived gain in DL Skills	Perceived information seeking skills
Posttest LSE mean score	Pearson's r Sig. (2-tailed) n	1	0.509** .001 39	0.515** 0.001 39
Perceived gain in DL Skills	Pearson's r Sig. (2-tailed) n	0.509** .001 39	1	0.993** 0.000 39
Perceived information seeking skills	Pearson's r Sig. (2-tailed) n	0.515** 0.001 39	0.993** 0.000 39	1

** Correlation is significant at 0.01 level (2-tailed)

DISCUSSION

Descriptive statistics showed that the posttest LSE mean score was higher as compared to the pretest LSE mean score for experimental group, while the posttest LSE mean score had not shown much difference as compared to the pretest LSE mean score for control group. Descriptive statistics also showed that there was not much difference in pretest LSE mean score between experimental group and control group. However, the posttest LSE mean score for experimental group was higher than control group.

Paired sample T test revealed that the posttest LSE mean score for experimental group were significantly higher than the pretest LSE mean score while there was no significant difference found in the control group.

Independent sample T-test revealed that the pretest mean score on learning self-efficacy were not significant difference between the experimental and control groups.

CONCLUSION

Results indicated that the two groups of students were similar in pre-existing learning self-efficacy before started the class project. Paired sample T test and Independent sample T-test conducted in this study had shown a significant difference in the posttest mean score of learning self-efficacy in experimental group. Results from the independent sample T-test also showed that the perceived information literacy skills and perceived gain in digital literacy skills for the experimental group was significant higher than the control group.

Results from Pearson's correlation showed that students' posttest LSE mean score, perceived information seeking skills, and perceived gain in digital literacy skills were statistically positively correlated. This results indicated that the learning activities and information seeking behavior embedded in the APBL approach and properly facilitated during the APBL process had successfully raised the learning self-

efficacy and digital literacy skills of the students in experimental group.

It can be concluded that Authentic Problem-based learning (APBL) approach has impacted learning self-efficacy and digital literacy skills of university students in their learning process while completing the class project.

Implication and further study

The key to PBL in higher education was to learn to gather information and use the acquired information efficiently and logically upon receiving an ill-structured problem. Students tend to overcome the information anxiety and performed better academically if they raised learning self-efficacy and become more confident in information seeking along with their learning process. By providing 3 stages of information seeking to reduce uncertainty by facilitator during the APBL approach, students felt competent and confident in themselves about their information seeking skills. They were more willingly to undertake information problem solving activities in class project, and they found themselves more easily transformed into self-regulated learners with higher learning self-efficacy. The APBL approach has significantly raised the learning self-efficacy and perceived digital literacy skills of the university students probably due to the fact that they felt more confident in their ability to get relevant and good information from internet sources, which was consistent with the findings from previous study.

Although this study found evidence that APBL raised the perceived information seeking skills and perceived gain in digital literacy skills, from the data collected it was not possible to quantify the amount of impact on information seeking skills and digital literacy skills offered by APBL. Further studies are therefore necessary to determine the impact of APBL on Digital literacy skills and learning performance of students.

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