

Problem-Based Learning (PBL) during Online Teaching [†]

Muhd Khudri Johari ^{1,*}  and Nur Zaimah Jamil ²

¹ Academy of Language Studies, Universiti Teknologi MARA Melaka, Alor Gajah Campus, Alor Gajah 78000, Malaysia

² Faculty of Modern Languages and Communication, Universiti Putra Malaysia, Serdang 43400, Malaysia

* Correspondence: muhdkhudri@uitm.edu.my

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Abstract: The purpose of this study is to examine how problem-based learning (PBL) is adapted in an online teaching medium using Microsoft Teams and then utilized in Aviation English classrooms at a Malaysian aviation-based technical institution with the purpose of testing for any discernible effect. Using Microsoft Teams, lecturers guided final-year Aircraft Maintenance undergraduates into self-directed study and peer instruction for five consecutive weeks. A study was performed to determine the influence of online PBL instruction on learners' exam results. The paired sign test was used to analyze the non-normal data in SPSS—the mixed results showed that additional studies should be carried out for additional areas of study/curricula when pursuing PBL-Institute prestige in order to enhance the online PBL implementation processes and choose the most appropriate online PBL framework for each area of study.

Keywords: problem-based learning; Aviation English; paired sign test

1. Introduction

With several effective implementations and designs, online problem-based learning (PBL) has been customized in a variety of ways to accommodate a wide range of subjects, curricula, and programs. Developed as a result of the medical school curriculum [1], it is frequently used as an educational strategy [2] and a method of evaluation for students [3] at various levels—areas of study covered include engineering education [4].

The primary aim of this study was to determine the efficacy of online PBL in Aircraft Maintenance courses as a starting point for achieving PBL-Institute certification within several years. In some ways, this project may also be viewed as trial research with the aim of attempting to fully introduce online PBL at the university level. Online PBL was used to teach one of three Aviation English disciplines available in the Bachelor of Aircraft Engineering Technology degrees for this project; both Mechanical and Avionics students were chosen randomly. However, the number of Mechanical students examined was much greater than the total population of Avionics students, as just one Avionics group was offered the chance to be the chosen group during that term (final-year students).

2. Literature Review

Diverse Aviation English courses are presently taught at a variety of levels in higher education, ranging from certifications and A-level courses up to postgraduate programs. Certain educators continue to favor traditional instructional practices (e.g., huge lectures and public visualization, as well as experiential activities) as their approach; this is most likely due to personal opinions and perspectives [5]. Despite this, an increasing number of academics are developing and experimenting with different methods of approaching these courses with their students—notably online PBL [6].

The researchers chose to adapt an online PBL simulation as intervention procedures, and they not only tested for statistical importance but also used a pre–post-test experimental



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method [7]. Several noticeable variations were the overall number of students and their individual disciplines, the measuring instruments used, and the substance of the Aviation English topic. Researchers began by guiding the Experimental group students on interactive learning and peer instruction during the first week of sessions before the post-test. The second week marked the beginning of a totally learner-centered atmosphere in class; students were educated briefly on online PBL immediately following the set introduction, and they were required to answer the issues presented within 60 min. However, during the third and fourth weeks, students received their in-class tasks immediately following a predetermined induction, and researchers guided both sessions.

3. Methods

This sample was restricted to all (89) final-year Bachelor of Aircraft Engineering Technology students registered at Universiti Kuala Lumpur—Malaysian Institute of Aviation Technology (UniKL MIAT) and specializing in either a Mechanical or Avionics major. The course materials from the chapter “Writing an Aircraft Maintenance Report” were taught online via Microsoft Teams and tested over the five consecutive weeks. Participants were randomly assigned to one control group and three experimental groups from four classes (three Mechanical classes and one Avionics class). Both the pre- and post-test questions were open-ended and mirrored the complexities of real-world scenarios. Each exam required students to respond to all ten open-ended questions within 60 min. Two marks were awarded for completing all justifications and elaborations with the right answer to each question. Following consultation with the university’s corresponding program coordinators and subject matter experts regarding the scoring systems, it was accepted that three proficiency levels would be used, particularly for the analysis of test scores (out of 20) in this investigation—‘Low’ (0–14), ‘Moderate’ (15–17), and ‘High’ (18–20).

4. Results

The overall subject proficiency level for all classes was *moderate* (mean = 17.629). Table 1 shows the percentages for each level.

Table 1. Percentages for each proficiency level.

Low (0–14 Marks)	Moderate (15–17 Marks)	High (18–20 Marks)
3.47%	75.28%	21.35%
(3 out of 89 students)	(67 out of 89 students)	(19 out of 89 students)

Table 2 shows the normality of distribution for both groups’ pre-test scores below.

Table 2. Normality of distribution for both groups’ pre-test scores.

Group	Normality of Distribution
Experimental groups	The skewness value was -1.498 , while the Kurtosis value was 5.245 . Although the skewness value was still within the range between -2 and $+2$, the Kurtosis value was significantly outside the similar range. Even the Shapiro–Wilk’s value (0.00) was lower than alpha. Hence, the data were considered to be non-normal.
Control groups	The skewness value was -2.29 , while the Kurtosis value was 4.783 . Both values were outside the range between -1 and $+1$. In addition, the Shapiro–Wilk’s values (0.00 for Mechanical 1; 0.012 for Mechanical 2; and 0.032 for Avionics) were also lower than 0.05 . Hence, the data were considered to be non-normal as well.

5. Analysis

5.1. Null Hypothesis

Overall, the Control group ($M = 17.49$, $SD = 2.46$) scored slightly lower than the Experimental group ($M = 17.7$, $SD = 1.06$). The significant value was 0.644, which was more than alpha, based on the findings of the one-way ANOVA. As a result, we were unable to reject the null hypothesis 'There is no significant difference between the students' pre-test scores'. This is very reasonable given that no interventions were initiated at this point. Post-test results, on the other hand, were predicted to be altered following the initiation and implementation of the interventions.

5.2. Testing Mean Scores

Since the second hypothesis required evaluating the Experimental groups' pre- and post-test mean scores, they were all examined using the paired sample t -test. However, as previously stated, homogeneity tests revealed that the values from both the Experimental and Control groups were non-normal. As a result, the researchers chose a nonparametric test for this case—the paired sign test [8]. Prior to performing the analyses, the paired data (signs of different mean scores) were sorted as follows.

It was discovered that there were considerably more adverse differences (25 out of 45) between the values than there were favorable differences (14 out of 25) or ties (6 out of 25). The paired sign test revealed a Z -value of -1.601 , which was less than alpha and, hence, rejected the null hypothesis. It may be stated that the online PBL intervention had a considerable effect on the Experimental group pupils. The mean for the Experimental groups' post-test scores declined from 17.70 (pre-test) to 16.90. Although these mean scores indicated the Experimental group students' overall results, the researchers aimed to ensure that they demonstrated identical tendencies for all students enrolled in their specific courses.

5.3. Testing Individual Scores

To assess the efficiency of online PBL in these classrooms precisely, the disparities between each student's pre- and post-test results were thoroughly evaluated. If the online PBL intervention had a genuinely measurable impact, as previously determined, the results from these specific studies would correspond to the prior pattern.

The p -value for the paired sign test in Mechanical 1 was specified as "Exact Sig. (2-tailed)"; it was 0.00, which was less than 0.05. This result corroborated the prior finding—the researchers rejected the null hypothesis and established that the online PBL therapy had a statistically significant influence on students' test results. There were twenty negative changes as opposed to a few positive differences (3) and ties (2), which could only suggest that the intervention was eventually lowering the Aviation English competency of Mechanical 1 students. It may also be supported by the fact that their post-test mean scores (14.96) were much lower than their pre-test mean scores (17.52), indicating that they fell into the Moderate category rather than achieving the High category.

For the second Mechanical group, the paired sign test findings indicated that the p -value was "Exact Sig. (2-tailed)"; it was 0.023, which was less than 0.05. Additionally, this number indicated that the researchers rejected the null hypothesis and established that the online PBL intervention had a substantial influence on the students' test results. There were 18 positive differences compared to much fewer negative differences (6) and ties (4), indicating that the intervention was effective for the Aviation English competency of the Mechanical 2 students. Although the mean scores for their post-test did not appear to be substantial due to the little increase (from 17.93 to 18.25), they were noteworthy since they crossed the barrier and achieved the higher level of High rather than retaining their competency at the very same level.

The p -value for the Avionics class was specified as "Exact Sig. (2-tailed)"; it was 1.000, which was more than alpha. This number indicated that the researchers did not reject the null hypothesis and established that the online PBL intervention had no discernible

influence on the students' test results. There were five positive differences and ties as opposed to four negative differences, which could only mean that the researchers lacked compelling evidence at the 0.05 level to demonstrate a disparity in the Aviation English test scores of Avionics students following online PBL intervention compared to the prior Mechanical classes' findings—in addition, their mean scores did not change much either and remained in the Moderate range (17.57 increased to 17.64).

5.4. Effect on Post-Test Scores

The researchers failed to reject the hypothesis since the Z-value was -0.359 , and the Asymp. Sig. (two-tailed) value was considerably greater than alpha at 0.720. This established that, on average, online PBL has a positive influence on students' post-test results.

6. Conclusions and Recommendations

The researchers concluded that the trial produced conflicting findings—a good impact for Mechanical 2 students, an adverse influence for Mechanical 1 students, and no noticeable impact for Avionics students in terms of their Aviation English competency. Although there were comparable positive-effect results for one class in many other experiments [9,10], the researchers also reached adverse and non-significant-effect outcomes—which had been expected. The limits are unquestionably critical in identifying the most accurate and credible results within the purview of the institution. As a result, researchers will continue to explore with students from various disciplines, learning experiences, and areas of study in order to amass as much data and information prior to attaining the ideal PBL-Institute standard.

Several suggested online PBL conditions, such as low-to-moderate class sizes, student-centered techniques, and collaborative lessons, have already been established or outlined in UniKL MIAT. Additional technological disciplines [11–16] do not present a difficulty in terms of classroom sizes, since UniKL MIAT complies to the Civil Aviation Authority of Malaysia's (CAAM) regulation of allowing a limit of 28 participants in a group at any given time [17]. Non-technological disciplines [18–21], on the other hand, may set up a bigger student population in a classroom and would need a customized online PBL approach to accommodate the course content and teaching/learning methods.

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