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# The Effects of Technology-Integrated Project-Based Learning on Students' Acquisition of Programming Abilities in Computer Science Courses



**Abstract:** - For the best approaches to teach students programming abilities, researchers have held several talks and generated a huge number of recommendations. These recommendations have received a lot of attention because the majority of students that study programming tend to gain little information and fail to create problem-solving strategies using the programming principles they have learned. Pre-test and post-test are used to determine the efficacy of project-based learning (PBL) interventions. The purpose of this study is to look into how project-based learning in computer science classes affects students' acquisition of programming abilities

**Keywords:** Computer Science, Programming, Project-Based Learning,

## I. INTRODUCTION

There have been a lot of talks and thoughts about the best ways to teach programming to students because research [1, 2, 3] demonstrate that students have a variety of issues when learning computer programming. These studies contend that rather than viewing programming as a collection of specialized problem-solving skills, students view it as a purely technical activity [4]. Because of this, the vast majority of students that study programming tends to acquire limited knowledge and fail to develop problem-solving techniques employing the programming constructs they have acquired. Teacher-centered teaching and learning in programming subjects is less motivating and encouraging for students to stay focused in the classroom all the time. This is based on a [5] study that says young students' attitudes towards programming, confidence in programming writing, interest in programs, perception in programming and the utility of programming are heavily influenced by gender, ethnicity, student grade level and interest in computer science subjects. In their study analysis, students' grade level, ethnicity, gender, frequency of programming, experience in programming and interest in computer science influenced social values which in turn influenced interest in programs, programming perceptions and programming utilities. In addition, motivating students to learn programming topics in the classroom is a very challenging assignment for teachers according to [6] Allan Fowler, (2012). Moreover, students' mastery in problem-solving skills is somewhat lacking in the basic subjects of computer science, [7] (Savage & Piwek, 2019). Reference [8] shows that the main factor for students to fail and drop out in programming subjects is due to the lack of problem-solving skills among students. However, the problem of problem solving among students is not only based on the students but also on the selection of suitable teaching methods in the basic subjects of computer science by the teachers in the classroom.

## II. PURPOSE

### A. Review Stage

This study has chosen a project-based teaching method (PBL) and is expected to contribute in school education especially at the secondary school level where according to the study [9], teachers are still looking for suitable methods to improve students' knowledge and understanding in computer science courses. In this study, researchers used the Google Classroom platform to implement the project-based learning approach (PBL), which were selected because it can be connected with technological applications. The PBL educational approach gives teaching and learning projects top priority [10]. PBL is a teaching method that enables students to acquire

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advanced information and skills through teacher-assigned practical projects. [11]. This study incorporates technology applications for computer science courses to look into how project-based learning (PBL) affects the growth of programming abilities.

### **B. Evaluation**

Results from the pre-test and post-test for one group were used in the quantitative research study design of this investigation. Students will use project-based learning techniques to tackle programming difficulties and advance their programming achievement in this course. Project-based learning (PBL) approaches, namely, their effectiveness approaches, that have been implemented for students, is assessed using pre-test and post-test.

### **C. Output**

The results showed that 50% of students did better in the post-test compare to the pre-test. This implies that students now have a 50% greater comprehension of programming skills than they did before this. Students' performance and achievement in programming abilities have improved as a result of this project-based learning.

## III. METHODOLOGY

To respond to the inquiry posed by this study, which measures the students' programming proficiency, the researchers used pre-test and post-test. A set of test question papers is used for this study: pre-test and post-test. Before allowing the students to access the project-based learning environment, the pre-test was created to conduct an assessment. The post-test's objective is to evaluate students following their participation in a project-based learning setting. While post-test is designed to perform assessments after students apply a project-based learning environment. Researchers have chosen the scratch command code topic for this test. Therefore, the test conducted involved 30 students from form one students in this study. The pre-test and post-test given to the students are designed by researchers based on the syllabus in the computer science course from Ministry of Education Malaysia (MOE). The importance of this test is to assess the impact of project-based learning on programming skills by students. The "Scratch Command Code Achievement Test" was used for pre-test and post-test, and the results were determined by running a t-test on the data. The pre-test and post-test are divided into two parts, namely part A for objective question and part B for structural question. The questions provided in the given test is 20 questions. The implementation of scratch command code topic has lasted for 4 days in which all learning materials are used throughout the teaching and learning process via google classroom such as video and scratch application. Here is an arrangement that has been simplified to view this study procedure based on Fig.1.

Methodology	Days	Content
PBL	<b>1st Day</b>	Teacher explains about scratch command code topic via google classroom by using video and scratch website
Project 1	<b>2<sup>nd</sup> Day</b>	Teacher gives students project and give them two days to finish the project. The project can be related to any topics but must create a quiz using scratch application.
Discussion	<b>4<sup>th</sup> Day</b>	Students send their scratch

project through google classroom and teacher discuss with students about the project and give marks to them.

**Fig. 1.** Project-based learning (PBL) days are being implemented in Google Classroom

IV. FINDINGS

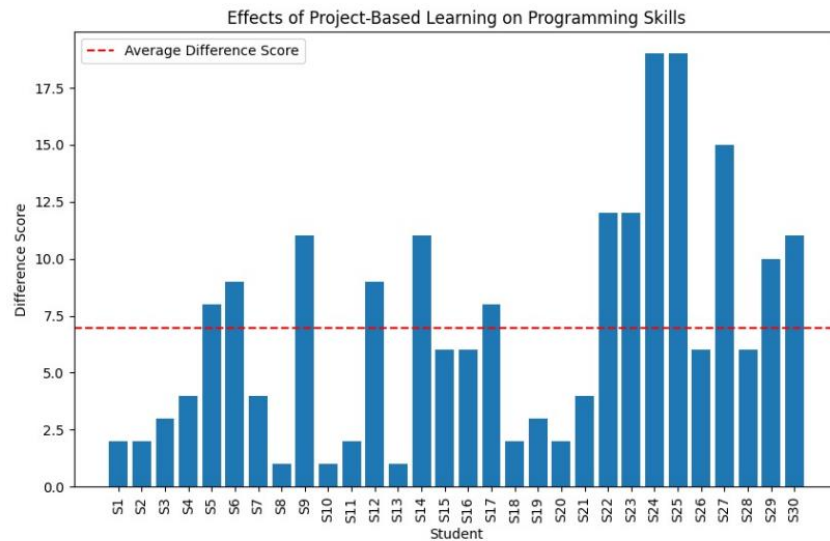
"Is there a significant difference between the experimental group in terms of achievement post-test?" is the first question for this study. The t-test were used to examine whether there is a statistically significant difference between the experimental group pre-test and post-test results. Figure 2 show the experimental group pre-test and post-test mean value.

Test	Mean	Standard Deviation Test	95 % Confidence Interval in Difference		df	Sig. (2-tailed)
			Low	High		
Pre-Test	22.733	6.731	-79.78	-74.7533	29	< .001
Post-Test	29.7	5.902	-72.504	-68.096	29	<.001

**Fig.2:** Pre-Test and Post-Test Scores in Scratch Command Code Topic

Based on the minimum and maximum scores of pre-test and post-test on student’s acquisition of programming skills from the figure above, the mean and standard deviation are also calculated for students. The results are displayed in Fig. 2. When Fig. 2 was reviewed, it was found that there was a statistically significant difference between the pre-test and post-test scores for the experimental group in favor of the post-test (p, 0.5). These results show that the Project-Based Learning approach had a favorable impact on students' accomplishment in programming abilities because between the experimental group's pre-test and post-test means, there was a significant difference.

Upon closer inspection of Fig. 2, it was discovered that there was a statistically significant difference between the experimental group's pre-test and post-test scores, favoring the post-test (p,05). These results indicate that the Project-Based Learning approach has a favorable impact on students' success because there was a significant difference between the experimental group's pre-test score mean and post-test score mean. The second sub-problem of the study was stated as “Do the students' programming skills significantly change as a result of the teaching approach used in accordance with the current program?”. By using SPSS software, it was determined whether there was a statistically significant difference between the experimental group's achievement score in the pre-test and post-test. The outcomes are shown in Fig. 3.



**Fig. 3:** Descriptive analysis of effect on project-based learning in student's programming skills

The graph above shows the number of students and the scores obtained by students for pre-test and post-test. Following the introduction of the project-based learning approach in this research, 17 students have difference score more than 5.0 marks in their post-test compare to their pre-test, only 8 students have difference score below 2.5 marks. The average difference score is 7.5

marks from pre-test to post-test. 13 students get more than 7.5 marks above the average score. The results of the tests showed that many students answered questions related to the scratch command code correctly after the PBL was implemented. There were a significant increase in scores by some students who answered questions about the scratch command code in post test. Project-based learning showed that it is one of the pedagogies that can give positive results on students' achievement in learning scratch command code on programming and increase students' skills, motivation and improve interaction between teachers and students.

## V. CONCLUSION

There is a widespread belief that learning is "a similar process in all persons and for all tasks, thus many people feel a common instructional approach should suffice" when it comes to the design of training (Clark 2000, p. 31). In addition to PBL, there are other effective strategies for assisting students in learning challenging and disorganized content. Despite being noticeably less effective than traditional instruction, PBL is still found to be useful in the training of skilled and talented practitioners learned during training sessions that take place in the classroom.

### Suggestions for Applying the Project-Based Learning Approach

- Students' success will rise if the project-based learning approach is widely used at school with well organized by teacher.
- Higher order thinking abilities are something that the updated computer science curriculum attempts to foster in students. For this reason, teachers that incorporate project-based learning into their scientific courses more regularly can aid their students in learning new information and excelling in their studies.
- As the project-based learning method is developed and implemented, teachers and students connecting with one another and sharing their experiences online will be beneficial for expanding the adoption of the approach.

### **Suggestions for Improving the Learning-Teaching Process**

- The availability of a teaching strategy that involves student acquisitions and the two most important features of project-based learning that students can employ to increase their achievement on their own learning. All students in a class should be taken into account if project-based learning is to be effective in the courses offered.
- The process will be facilitated by creating diverse working groups and project subjects that are applicable to daily life.
- Project-based learning will be more interesting if teacher design their assignments creatively in accordance with changes in today's technology in education.

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