the subject. The project-based learning approach was chosen by the researcher for this study because PjBL has its own goal of integrating information technology, and from their point of view, this suitable learning approach is implemented with the aid of online resources.

To be prepared to cope with students who are using IT and technology, teachers in the twenty-first century need to be physically fit, mentally sharp, creatively agile, idealistically resilient, and self-assured. In line with Arends (2004), teachers have a major duty in the teaching and learning process to make sure that the science they teach may be most effectively absorbed by the students. Additionally, students should have the freedom to investigate each subject using methods appropriate for the twenty-first century, particularly computer science courses. For example, students should be allowed to use technology to better understand programming language, project-based learning components, and creative problem-solving techniques.

Less programming understanding in computer science courses specific benefit from teacher-centered instruction since it inspires and motivates students to pay attention in class all the time. On a basis of a study by Huang and Fraser (2009), gender, ethnicity, student grade level, and interest in programming are the main factors influencing students' attitudes towards the coding environment, belief in writing coding, interest in coding exploration, and perception of the programming environment. To research and investigate students' programming performance and skill, a study was carried out (McCracken et al., 2001). According to the study, student's struggle with reading, writing, and creating simple computer code.

There have been many conversations and ideas regarding how to teach students programming, as studies have shown that doing so can be challenging for some students (Bonar & Soloway, 1983; Lahtinen, Ala-Mutka, & Järvinen, 2005; Coull & Duncan, 2011). Based on their study, students don't understand programming as a set of problem-solving skills, but rather as a simple practical activity using computer. Based on (Bennedsen & Carpersen, 2008; Kazimoglu, Kiernan, Bacon, & Mackinnon, 2010; Liu, Cheng, & Huang, 2011). As a result, most students who study programming in computer science courses tend to acquire limited information and fail to develop problem-solving techniques based on the structure of previously taught material.

Literature Review

"Project-based learning (PjBL)" refers to a methodology that maintains a focus on student-centered learning, with students actively participating in group projects (Felder & Brent, 2016). The goal of project-based learning is to help students learn how to manage their own learning more responsibly (Malicky, Huang, & Lord, 2006). Aspects of self-management abilities will be developed via a project-based learning approach (Jusoff et al., 2010). Depending on Mannila et al. (2014), students find it difficult in the topics of algorithms and command codes because they can't describe the concepts of the algorithm and command code accurately. Problems with understanding concepts related to algorithms and command codes occur because of their lack of understanding of basic computer science concepts, such as binary code and base number conversion in computer systems. A study by Abdul Rahman, Ismail, and Mat Daud (2011) on evaluating students' understanding of algorithm concepts and command codes showed that students showed limited understanding of the topic of the algorithm and command code and misunderstanding about the algorithm and the command code. Several studies have been studied related to the problem of mastering programming among students when studying programming (Islam, Sheikh, Fatima, & Alvi, 2019). According to Yusuf and Noor (2023) researchers have begun using media tools to encourage students to explore programming challenges and to lessen the difficulty of programming. The combination of learning strategies is used to solve the problem. One of the strategies used is to integrate the PjBL teaching model into the teaching and learning process. Table 1 below shows the effect of integrating the PjBL learning model into teaching processes and programming upgrading over previous literature.

Table 1. Past studies on Project-based learning (PjBL) used in the field of study and findings in the study.

Authors	Study Purpose	Findings
Abdul Rahman et al. (2011)	To explore the role of PjBL concepts and variables that significantly relate to meta cognitive, self-regulation and motivation among students of Mechanical Engineering at the Bharu City Polytechnic of the Ministry of Higher Education.	1) PjBL has helped shape the face of the students' competition in solving problems related to their projects. 2) PjBL produces products, develops projects, manuals/use manuals and comprehensive content
Çelik, Ertaş, and İlhan (2018)	To help K–12 educators create technology-based apps by utilising visual programming and project-based learning	The study's findings demonstrate how K–12 educators use a variety of programming ideas when implementing encoding in these assignments. A significant portion of students gave this K–12 teacher application project positive feedback.
Islam et al. (2019)	To find out how project-based learning affects vocational high school students' performance and to find out what they think about AutoCAD programming issues	The study's findings demonstrate that project-based learning raises students' proficiency in AutoCAD programming. Additionally, students said that they were able to learn significant material through the use of a project-based learning application that was both flexible enough for the teaching process and increased their interest in the subject matter.
Lu Zhang and Yan Ma (2023)	Many academics have investigated project-based learning in light of the 21st-century educational reform for skills. Nevertheless, there is still debate over whether project-based learning can actually enhance students' learning outcomes.	The study's findings demonstrated that, in contrast to the conventional teaching paradigm, project-based learning greatly enhanced students' learning outcomes and had a favourable impact on their ability to think critically, develop positive emotional attitudes, and attain academic goals.
Devi Hidayati et al., (2023)	To find out if ESP students' overall learning outcomes are improved by employing PjBL. A single group pre-test and post-test experimental design was used in this study, and the participants	The results showed positive relationships between the participants' academic achievement and their high mean scores on the learning outcomes subscales that were examined. These findings

	included 40 samples that were specifically chosen.	could contribute to the expanding corpus of research on the subject of how to integrate various techniques and approaches to teach and learn ESP across disciplines.

Project Based Learning (PjBL)

Project-based learning (PjBL) is a cutting-edge method of instruction (Blumenfeld et al., 1991). This is one of the pedagogies of blended learning that addresses contextual learning elements in real-world situations and issues. It provides relevant learning resources, guidance, and modules to be studied, with the goal of assisting students in acquiring the knowledge and skills necessary to solve problems. According to Smith (2017), educators serve as learning facilitators by assisting students in developing problem-solving skills, monitoring the learning process to keep students on course, encouraging continuous improvement in students' learning, and guiding students towards a solution that satisfies Polman development (2000) objectives. The main focus of this project-based learning is active learning, in which students work in small groups to discuss issues and assess solutions to problems that teachers present during the teaching and learning session.

Project-based learning (PjBL) is also a type of instruction that is distinct from traditional learning techniques (Sayuti et al., 2020). While the PjBL module is more oriented on student learning and problem-solving by the group of student's conventional education is more focused on content. Project-based learning uses a variety of modelling techniques. BIE Gold Standard PBL, 2007 (The Buck Institutional Education), Merrill model, 2013, (First Principles of Instruction Model), and PBL Gold Standard 2020 are three examples of PjBL models. The PBL Gold Standard model was chosen by the researchers because it includes all the components, Table 2 describes the details of 7 elements in PBL Gold Standard model together with students' activity.

Table 2. Seven elements of Project-based learning (PjBL) by PBL Gold Standard (2020) model with student's activity

Elements	Description	Implementation in this study for students' learning
1) Significant content	A PjBL project is always built around a significant issue, question, or problem that needs to be solved.	• Students start earning a project by watching a learning video shared by teacher in Google Classroom • Students watch video about "how to create Python code for the beginners."
2) Need to know	Inquiry, research, and application are all part of the extensive and demanding research process that PjBL project participants go through.	•The students explain what they watched in the learning video shared by the teacher in the Google Classroom forum room

3)	Driving question	Students must apply critical thinking skills to the central issue, challenge, or question while producing a product of the highest calibre. A compelling project is also more likely to boost involvement and motivation	• Students explore activities by identifying and designing problem-solving steps for questions given by the teacher and the end of the lesson. Throughout the learning process, students can expound on and investigate a well-designed topic, problem, or challenge.
4)	Voice and Choice by Students	With project-based learning, students have the freedom to choose what they produce and how they convey their ideas. Students have a strong sense of ownership as a result of their innate autonomy, which motivates them to work more and care more about the assignment they have been given.	• Students discuss with colleagues in the Google Classroom forum room and share ideas and answers about the questions given by teacher in the Google Classroom forum room.
5)	21st Century Skills	A genuine project relates to pertinent concerns, interests, and problems in the students' life while addressing 21st century abilities in a real-world setting.	• Students create projects by referring to references such as the website from the internet, video from YouTube and form 3 computer science textbooks using 21st century skills.
6)	Innovation	PjBL promotes students to provide, accept, and apply feedback to their final output in order to edit and improve it. Collaboration chances are created through the critique and editing process that might not otherwise exist.	• Students implement the project with innovation ideas and collaboration with colleagues.
7)	Reflection	Structured time for reflection is part of a well-designed project. Students have the opportunity to change their projects as needed and learn from the experience when reflection time is allotted to them.	• Completing project • Send the project to teacher through Google Classroom forum room.

By applying PjBL in the classroom, students' management skills also will be developed (Malicky et al., 2016), among the aspects of self-management skills developed by students through PjBL are problem-solving skills, time management skills, critical thinking skills and communications skills.

Methodology

In this study, thirty form three (F3) students (n = 30) from one school in Penang were involved in a pre-test and post-test group. For the four weeks that the programming topic was taught, in addition to the two weeks for the pre and post-tests, all available learning tools were used, including computers, online textbooks, and project materials. The teaching and learning process was performed through Google Classroom. This research study was implemented over the course of six weeks. Students must use Python programming to create a simple grading system. The system needs input, process, and output. For instance, key in the marks is an input; calculate the marks into grade is a process; and print out the finale grade is an output. Students must write a Python code that describes the grading system. They will use the seven PjBL elements as they develop the system to finished their project. The application of six weeks of project-based learning is detailed in Table 3.

Table 3. Implementation of 6 weeks-of Project-based learning (PjBL) in the classroom

Methodology	**Weeks**	**Students Activities (Google Meet, Google Classroom, YouTube and Python programming application software)**
Pre-Test Introduction	– Week 1	-Pre-test of Python programming -Teacher uses Google Meet to meet students online to explain about the project about create a simple grading system using Python programming code as their project.
Project Development	-Week 2 to – Week 4	-Google Classroom is used to students while sharing coding tutorial videos and webpages resources with them. -In a group, students must create a simple system using Python programming code and need to present it at the end of the course. -Students look for information, discuss about it, and work on the assigned project with their colleagues. The task must be completed in three weeks.

		-Students began to develop a strategy after conducting research and consulting with their colleagues. -Students use the Python programming code to create the system. -Students used Python coding application software to test run their coding.
Discussion	- Week 5	-After finished create the system, students need to present about the system in groups. -After the students' presentations, student will upload the system in Google Classroom for teacher to check and reflects the best projects and reward the students group.
Post-Test	- Week 6	-Post-Test Python programming

Online Learning Using Google Classroom

One popular tool for integrated learning using the project-based learning (PjBL) model is Google Classroom. Google created this free online learning platform to create an online medium of learning through teacher and student. One of Google Classroom's primary features is its ability to interact with other Google products, such as Google Meet and YouTube. Teacher have created classes in this Google Classroom that are taught similarly to the primary class interface and the connected application within Google Classroom are depicted in Figure 1.

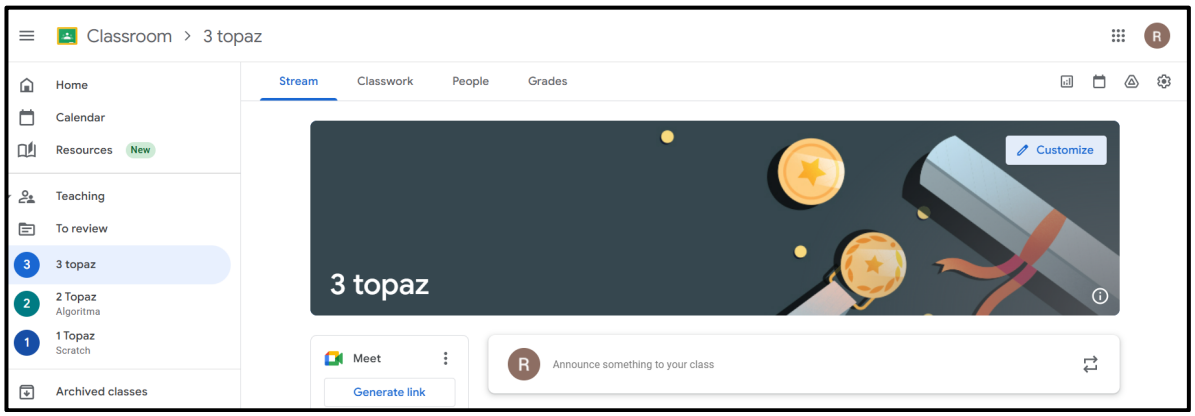


Figure 1. Google Classroom image

After designing a classroom in Google Classroom, the researcher provided some tasks that students need to do before a face-to-face class was run as a student's initial provision. Students will be given a YouTube link, to further enhance their understanding of the titles they need to learn. In addition, to watching videos from YouTube, students are also requested to have a discussion based on guided questions provided by researchers in the comment room. This is based on improvement suggestions suggested by the expert. It will be guided and supervised by a teacher who only acts as a facilitator in Google Classroom. Student watch a video uploaded in Google Classroom before start doing their project are shown in Figure 2.

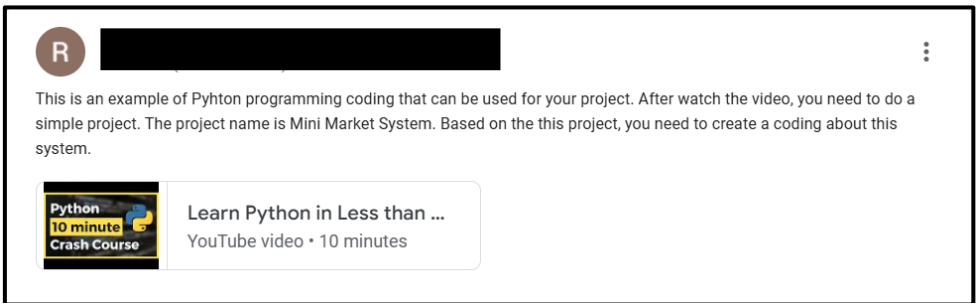


Figure 2. Instructions given by teacher to the students to watch the video

Every student in a group is asked to develop a simple system by using Python code, upload it to the Google Classroom, and turn it in to the teacher as soon as in-person class begins. This assignment is based on the notes and videos that are provided to them in Google Classroom. The work that students turn it in to their teacher during the project-based learning approach happened in the Google Classroom is displayed in Figure 3 below, which is based on the assignment guidelines they obtained via video uploaded at Google Classroom. The student project example was shown in Figure 4.

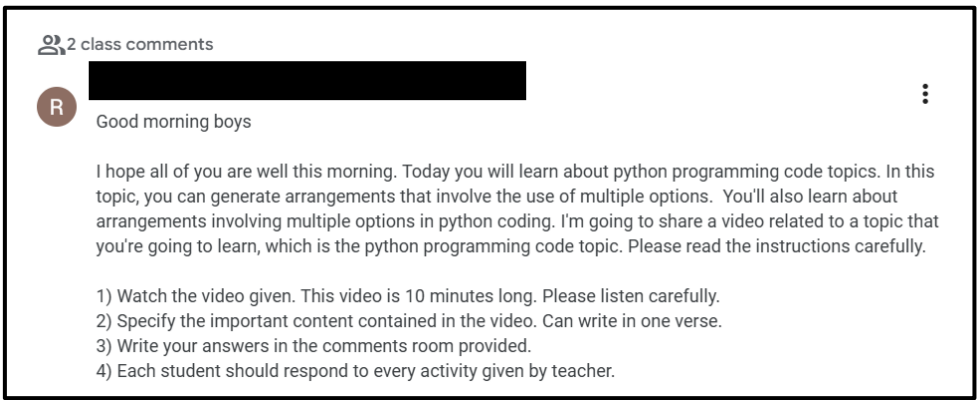
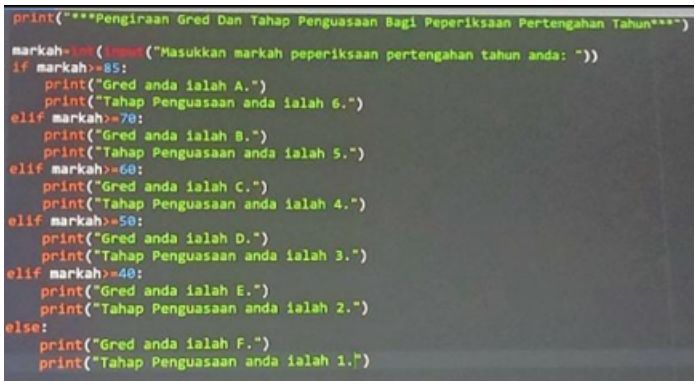


Figure 3. Students will follow PjBL guidelines through the learning process as explained by teacher



```
print("***Pengiraan Gred Dan Tahap Penguasaan Bagi Peperiksaan Pertengahan Tahun***")

markah=int(input("Masukkan markah peperiksaan pertengahan tahun anda: "))
if markah>=85:
    print("Gred anda ialah A.")
    print("Tahap Penguasaan anda ialah 6.")
elif markah>=70:
    print("Gred anda ialah B.")
    print("Tahap Penguasaan anda ialah 5.")
elif markah>=60:
    print("Gred anda ialah C.")
    print("Tahap Penguasaan anda ialah 4.")
elif markah>=50:
    print("Gred anda ialah D.")
    print("Tahap Penguasaan anda ialah 3.")
elif markah>=40:
    print("Gred anda ialah E.")
    print("Tahap Penguasaan anda ialah 2.")
else:
    print("Gred anda ialah F.")
    print("Tahap Penguasaan anda ialah 1.")
```

Figure 4. Example of students work after creating a system based on PjBL guidelines in Google Classroom

Finding and Data Analysis

The teacher administered pre and post-test on programming topics to thirty students (30) in total for this purpose. The tests were given out in the - week one (pre-test) and the- week five (post-test), both before and after the students used project-based learning for three weeks. The students are given twenty subjective questions. The student has forty minutes (40) to complete the test, both before and after the intervention. The test's objective questions are connected to the Python programming code that is presented. All of the PjBL competencies will be used by the students in the project intervention. The difference between each student's pre and post-test scores in the Phyton programming test is shown in table 4.

Table 4. Difference Score of Pre-test and Phyton programming Post-test for Each Students

Student	Pre-test	Post-test	Different Score
S1	45	50	+2
S2	95	100	+2
S3	55	63	+3
S4	70	80	+4
S5	80	100	+8
S6	50	73	+9
S7	68	78	+4
S8	58	60	+1
S9	50	78	+11
S10	65	68	+1
S11	45	50	+2
S12	40	63	+9
S13	70	73	+1
S14	50	78	+11
S15	70	85	+6
S16	80	95	+6
S17	45	65	+8
S18	95	100	+2
S19	48	55	+3
S20	70	75	+2
S21	45	55	+4
S22	23	53	+12
S23	38	68	+12
S24	45	93	+19
S25	38	85	+19
S26	60	75	+6

S27	45	83	+15
S28	55	70	+6
S29	60	85	+10
S30	50	78	+11
Mean	**57**	**74.5**	

S= Student

Based on these table 4 scores, the researcher created a graph chart, similar to Figure 5 below, which makes it easier to compare each student's pre- and post-test ratings.

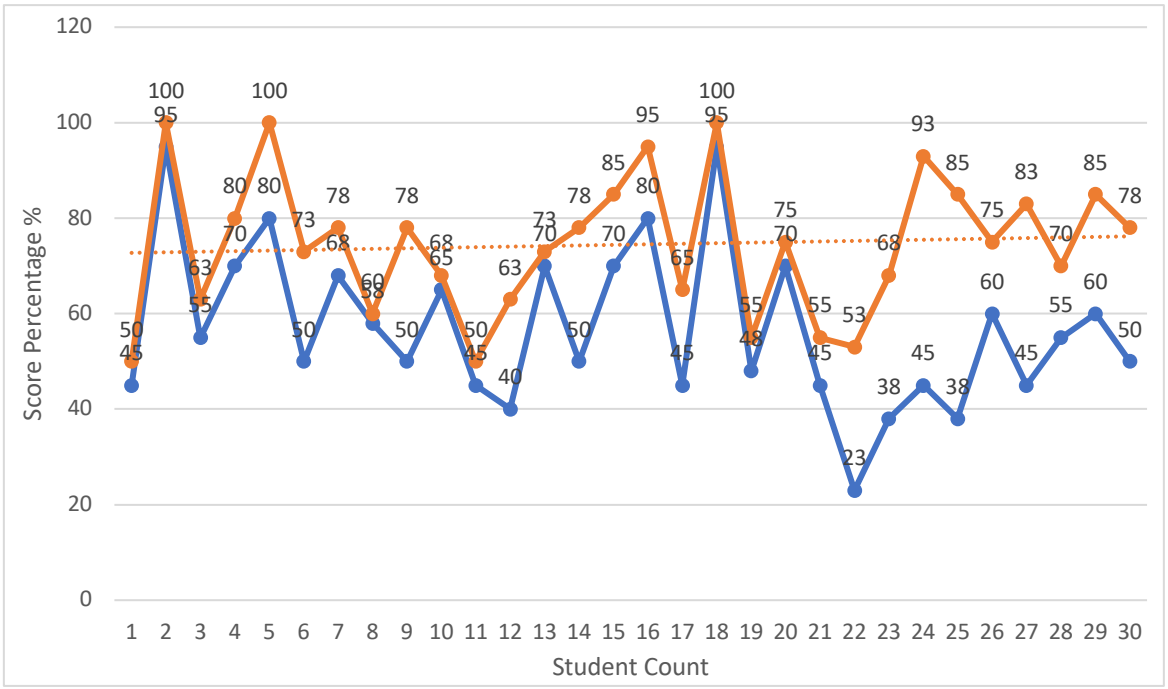


Figure 5. Difference Score of Pre-test and Post-test of Python programming test for Each Students

Discussions

Figure 5. illustrates the difference between the results of pre-test and student post test scores in percentage (%). This implies that there is a huge difference between a student's score before the test and after the test. The highest ranges were recorded for S2, S5 and S18 with 100% marks. It can be concluded that all students showed a positive improvement in post test scores in learning basic computer science subjects with a project-based learning environment. But, after treatment, S2, S5 and S18 managed to increase by 5% in the post test. learning method was used in this study, leaving 17 students with a post-test difference score greater than 25% marks increased from their pre-test. From the pre-test to the post-test, the average differential score is 40% marks. 13 students score more than average differential score that is more than 40% marks. Total difference mean score between pre-test and post-test is 17.5%. After the PjBL was implemented, the test results showed that many students properly responded to questions about the Python programming code and understand the programming code.

After making a descriptive analysis, the researchers have carried out an inferential analysis to see how far the difference is significance against mean value among pre- and post-test marks. Before determining a significant difference between the mean pre-test score and the mean post-test score, a normality test was performed to find out if the data obtained were normally or abnormally scattered. To test this data, the Shapiro-Wilk and Kolmogorov-Smirnov tests were used,

and the p-value was compared to the significant value. Figure 6 show the results of the normality test tested on the analysed data.

Test of Normality						
	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-Test	.158	30	.055	.948	30	.145
Post-Test	.080	30	.200	.961	30	.332

Figure 6. Results of Normality Test

Based on figure 6, the significance values are 0.145 and 0.332 are greater than the alpha values of 0.05. If the alpha value of the Shapiro-Wilk test is more than 0.05, then it can be concluded that the data are scattered normally. So, the null hypothesis that states the data is normally studded is accepted. Therefore, an analysis of paired sample t-test was carried out to determine whether the actual process or treatment had an effect on the selected population or whether there were two different groups from each other. The hypothesis for the paired sample t-test is as follows:

H0: There is no significant difference between the mean values for the Pre-test and the Python programming Post test.

H1: There is a significant difference between the mean values for the Pre-test and the Python programming Post test.

To determine the significant difference between the experimental group in terms of Python programming pre-test and post-test scores, a paired sample t test using SPSS has been used at confidence level 0.05. Figure 7 show the paired sample t test results for Python programming test scores during pre- and post-test.

Paired Samples Statistics				
	Mean	N	Std. Deviation	Std. Error Mean
Pre-Test	22.7333	30	6.73095	1.22890
Post-Test	29.7000	30	5.90237	1.07762

Figure 7. Pre-Test and Post-Test Mean Value in Python Programming Code

The mean and standard deviation are also computed for students based on the figure 7 above, which shows the minimum and maximum scores of the pre- and post-tests on the students' development of programming skills. Upon reviewing Fig. 7, it was discovered that the experimental group's pre- and post-test scores differed statistically significantly. The fact that there is a significant change in the means of the pre- and post-tests for the experimental group indicates that the project-based learning approach had a positive effect on students' acquisition of programming skills. Students felt a relationship with their teachers during that time and had a rise in motivation and the interaction between teachers and students was strengthened as a result of the project-related discussions through Google Classroom.

The test results revealed that once the project-based learning (PjBL) was introduced, many students properly responded to questions about the Python programming code. According to the outcomes of the PjBL implementation, certain students who responded to questions saw a considerable boost in their scores. This illustrates even more how students' attention has been drawn to and encouraged to study while working on projects as a result of the project-based learning design's integration with the 7 elements of the PBL Gold Standard model. Therefore, studies suggest that the advantages of project-based learning can help students be more creative and focused in the classroom, help them study

with peers, promote cooperation through problem-solving, and maintain their interest in the material (Zhang & Ma, 2023).

Students' fundamental literacies are effectively developed in the classroom through project-based learning (Hongxing, 2017), which also fosters the development of higher-order thinking skills (Weihong and Yinglong, 2019). The true benefit of project-based learning is found in its capacity to develop students' higher-order thinking abilities, including creative, problem-solving, and integrated application skills. This is achieved by having students work in small groups to explore real problems in order to gain a solid understanding of the fundamental ideas and concepts covered in the course, and by asking probing questions about the subject that are based on actual situations and the students' active participation in the investigation. Project-based learning is necessary in order to provide students with the 21st century skills and fundamental literacy where they will need for both in their future employment and personal lives.

Conclusion

When it comes to the design of classroom learning, it is generally believed that learning is "a similar process in all persons and for all tasks, thus many people feel a common instructional approach should suffice" (Clark, 2000). As a result, it is concluded that project-based learning approaches are more effective than traditional teaching strategies. The 7 elements of project-based learning (PjBL) are valid and appropriate for gauging students' attitudes towards programming, based on the results. The attitudes of the participants tended to be more positive. Finally, we discovered that programming experience is influenced by student attitude and learning strategy. The study's issue on the effects of technology-integrated project-based learning on students' acquisition of programming abilities in computer science courses were improved through project-based learning strategy.

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