

Proceedings of International Conference on Education, Technology, and Innovation

Homepage: <http://proceedings.upi.edu/index.php/ICETI/index>



Project Base Learning Assisted by Codepen Web Media on Understanding Concepts and Practical Abilities of Software Engineering Students on Web Programming Materials

Sintia Risna Warman^{1*}, Pratama Benny Herlandy¹, Rahmad Al-Rian¹, Edi Ismanto¹, Vitriani¹

¹ Department of Informatics Education, Universitas Muhammadiyah Riau, Pekanbaru, Indonesia

*Correspondence author email: sintiarisnawarman18@gmail.com

ABSTRACT

Understanding the concept and practical ability of web programming is important for RPL Vocational School students. Students who have a good understanding of concepts will be able to understand programming logic and be able to solve problems related to web programming. As well as being able to write web programming code correctly and efficiently. One way to improve students' understanding of concepts and practical abilities of web programming is to use (PjBL) assisted by Codepen web media. Web Codepen is an online platform that provides facilities for writing, sharing, and editing programming code, while PjBL is a Learning Model that uses projects or activities as the core of learning. The main problem in this study is that students find it difficult to understand basic concepts such as HTML, CSS, JS. This study aims to determine the impact (PjBL) assisted by web codepen media on the understanding of concepts and practical abilities of RPL students in Web Programming Materials. This research is a quasy experiment research with a the-non equivalent Group Design design with data collection carried out Essay Pretest Postes and project tests. The results of the study showed a significant increase in students' understanding of concepts and practical abilities after the application of this method. The increase in the average learning outcomes of students from 73.63 to 82.74 and practical ability from 77.89 to 87.30 indicates that PjBL assisted by Codepen web media is effective in improving students' understanding of concepts and practical abilities in learning web programming.

Keyword: *PjBL, Web Codepen, Concept Understanding, Practical Skills, Web Programming*

1. Introduction

In the 4.0 era like now, technology is developing very rapidly in various aspects of the world, technology has become an important tool to assist in various tasks, including household tasks, business, social services, government and education, including the most popular currently is computer technology. . According to (Budiman, 2017) The advantages and benefits of using computer technology are increasing the speed and accuracy of work.

Apart from advances in computer technology, internet technology is also experiencing rapid development. The internet, which is a wireless network, allows computer users to connect with other users anywhere and at any time. Even today, the term "Cyberspace" is used to characterize how widespread use of the internet has spread throughout the World. Based on research [1] explains that the Internet is a global (worldwide) collection of thousands of computer networks and millions of personal computers that are managed freely.

Meanwhile, a website is a collection of site pages summarized in a domain or subdomain on the world wide web (www). Usually a website consists of documents written in HTML (Hyper Text Markup Language) format. [2]

(Melinda & Zainil, 2020) Project Based Learning (PjBL) is an innovative learning model that uses projects/activities as a learning medium, so that it can involve students actively in the learning process and problem solving activities, and students can work in groups and produce a valuable product. Meanwhile, [3] explains that PjBL is a learning model that involves all students in the learning process and gives students more time to solve a problem individually or in groups according to the theory, concept or information obtained by students.

Web programming is one of the subjects taught at Vocational High Schools (SMK), especially in the field of Software Engineering (RPL). This subject studies the basics of web-based programming, starting from the basic concepts of formatting with HTML (Hypertext Markup Language), introduction to programming languages (PHP), to problem solving in web-based programming languages.

Web programming has become an important aspect of education, especially in Vocational High Schools (SMK) majoring in Software Engineering (RPL). [4] in his research explained that there are still factors that cause students to be less interested in learning coding and there are still students who feel they are in the wrong major and do not know that the RPL major is closely related to the world of coding and ultimately causes their lack of interest in learning web programming.

1.1. Library Review

1.1.1. Project Base Learning

PjBL is a learning model that involves students in working on tasks based on complex problems from learning material and connected to the surrounding context. [5] PjBL is a learning model that uses real world problems as a context for students to learn critical thinking and problem solving skills as well as to gain essential knowledge and concepts from the subject matter [6]

Project Base Learning (PjBL) is a learning method that emphasizes solving real problems and developing practical skills through projects that are relevant to everyday life. By using PjBL, students can learn actively and have the opportunity to be directly involved in the learning process.

Learning steps Project based learning explained by [7] in his research, namely:

- 1) Ask questions at the start

Learning begins by asking challenging questions and can lead students into the learning material that will be discussed in the project. Teachers can ask contextual questions followed by in-depth investigations. Then students are given assignments in controlled activities.

2) Planning a project

Learning continues by preparing a project plan that will be carried out by students with teacher guidance. In planning this project, activities will be determined that will be carried out by students from the beginning to the end of learning, such as determining rules, choosing activities to be carried out to answer important questions, dividing tasks and responsibilities between group members, choosing tools and materials.

3) Determine the activity schedule

Students must prepare a schedule of activities for project implementation based on the plans that have been made. This stage of preparing the schedule will be carried out by the students themselves and the teacher only as a companion. So that students can understand that carrying out a project requires good and systematic scheduling so that planning can be carried out well. The teacher's role is to direct students, this can be done by providing examples of schedules that have been carried out before. Then students will arrange a schedule of activities outside of class hours so that students can get enough time to be creative, explore and gain wider inspiration. If the schedule has been arranged, students can convey the results through presentations as a form of responsibility.

4) Supervise the project implementation process

In the process of running a project, students will independently carry out the planned project with monitoring from the teacher. This is done to control students' work and guide the project activities.

5) Assessment If the project has been implemented, the teacher will then carry out an assessment to assess the achievement of the expected competencies. In this case the teacher must carry out the assessment authentically.

6) Project evaluation

This project evaluation activity is the end of the learning. In this activity, students together with the teacher reflect while carrying out the project.

1.1.2. Internet Technology

The internet is a connection between various types of computers and networks in the world with different operating systems and applications where this connection utilizes advances in communication media (telephone and satellite) which use standard protocols in communicating. [8]The Internet is a group of computers or server which are connected to each other through various media (cable, radio, satellite, etc.). These computers are located in all parts of the world, making it possible to form an information network global.

1.1.3. Website Technology

Website technology is a way to make it easier to convey information in online learning, by utilizing a framework in platform design. [9] A website is an interconnected web page that contains a collection of information in the form of text, images, animation, audio and video that can be accessed via an internet connection created for individuals, organizations and companies. [10]

Thus, the website referred to in this research means an information page that is available online and can be accessed throughout the world as long as it is connected to the internet network

1.1.4. Codepen Web Application

A web application is an application that runs using the web *browser* where creating a web application consists of using several programming languages in the form of *Hypertext Markup Language* (HTML), *Cascading Style Sheet* (CSS), *Hypertext Preprocessor* (PHP), Javascript, dll. [11].

[12] Codepen is *platform online* to edit and create interfaces that have been developed in HTML, CSS, and JavaScript, and to test those codes. *Platform* This allows users to share and connect with the codes they have created. Whereas [13] says that Codepen functions as a code editor *online* and open source learning environments. As well as Codepen displays HTML, CSS and JavaScript code snippets created by users.

Based on the Expert Opinion explained above, it can be concluded that Codepen is a web-based application that allows users to *experiment* using HTML, CSS, and Javascript. As well as Codepen as a code editor *online* and a learning environment that is easily accessible to anyone and anywhere. To access Codepen Web, users need an internet connection via <http://codepen.io>. Through this application, users can directly observe the changes they make to the structure of the programming code being studied. Additionally, they can also share their work with other users to learn from. In Codepen, there is a lot of code that has been created by other users that can be learned for free.

1.1.5. Students' understanding of concepts

[14] Explaining Understanding The concept of material is the basis for someone to solve problems. Meanwhile, in other research [15] understanding can be interpreted as mastering something with the mind. Understanding comes from the word understand which means "to understand correctly". Putting them in relation to each other correctly and using them appropriately in the situation.

1.1.6. Student Practical Ability

[16] Explaining practical methods is intended to educate by providing educational material using tools or objects, while demonstrating, with the hope that students will become clear and clear and at the same time be able to practice the material in question.

1.1.7. Software engineering

The Software Engineering major is a major that discusses all aspects of software production, starting from the initial stages of requirements capturing (analyzing user needs), specification (determining the specifications of user needs), design, coding, testing to system maintenance after use. [17]. The materials studied in the Software Engineering Department (RPL) usually include programming languages, web design, knowledge related to ITE Law and IPR, but it depends on the school and the curriculum for each year. [18]

2. Methods

This study uses a quasi-experimental method, which involves experiments in which the placement of experimental units into experimental and control groups is not done randomly (nonrandom assignment) [19]. This method was chosen because it allows hypothesis testing or evaluation of the effect of an independent variable on the dependent variable by considering the limitations of control over the existing variables. The research design used is The non-equivalent group design, where the experimental and control groups are not selected randomly. Both groups were given a pretest to assess the initial conditions, then given different treatments, namely the experimental group used project-based learning (PjBL) with the help of Codepen web media, while the control group used conventional learning. After that, both groups were re-measured with a posttest to evaluate learning outcomes.

This research uses a quantitative approach which aims to test the relationship between hypothesized variables. The independent variable in this research is method *project based learning* (PjBL) using the Codepen online platform, the dependent variables are students' understanding of concepts and practical skills. The research sample included the experimental class (XI RPL 1) and control class (XI RPL 2) at SMK Muhammadiyah 2 Pekanbaru located on Jalan K.H. Ahmad Dehlan number 90, copy. Malay, Sukajadi District, Pekanbaru City, Riau Province

Data collection was carried out using tests and non-tests. This test was carried out twice, namely a pretest before treatment and a posttest after treatment to measure students' conceptual understanding and practical skills. The design used is The non-equivalent group design, observation of student performance during learning and documentation related to research activities. The research tools used are written tests to measure understanding of concepts and practical tests to evaluate students' abilities in using HTML, CSS, and JavaScript.

To ensure the validity and reliability of the instrument, validity testing was carried out using SPSS software and using all adjusted correlation criteria, reliability was measured using Cronbach's alpha coefficient. The collected data is analyzed to provide general information about the research results, and inferential statistical tests are used to test the hypothesis. The normality test was carried out using the Shapiro-Wilk test, while the homogeneity test was carried out to ensure that the variables came from the same population. The hypothesis was tested using the t-test to determine whether there were significant differences in students' conceptual understanding and practical skills between classes *experiment* and control class.

3. Results and Discussion

3.1. Results

This research uses several analytical methods. The first step is descriptive analysis. The second step is hypothesis testing which includes normality testing, homogeneity testing, and T test. Each research result is described as follows.

3.1.1. Results of Descriptive Statistical Analysis of Students' Concept Understanding

This research was conducted at SMK Muhammadiyah 2 Pekanbaru with two classes that received different treatment. The experimental class implementing (PjBL) with the help of CodePen web media had 27 students, and the control class using conventional learning methods also had 27 students. This research was conducted in 4 sessions, each session 3 class hours, with a focus on teaching web development concepts such as HTML, CSS and JavaScript.

In experimental classes, students learn through a project-based approach that includes creating simple websites and applications. Each unit is designed to deepen students' theoretical understanding and practical skills through real-world topics. Evaluation is carried out through pre-test and post-test to measure increases in student understanding

In the control class, students received explanations and exercises without using PjBL or the codepen io platform. Although the material is taught in the same way, this approach focuses more on direct instruction and practice without involvement in real-time based projects. For more clarity, you can see the descriptive research results in table 1 below:

Table 1: Descriptive of Student Concept Understanding

Descriptive Statistics					
	Number of Samples	Range	Minimum	maximum	Mean
Pretest Experiment	27	28	60	88	73.63
Posttest Experiment	27	31	69	100	82.74
Pretest Control	27	22	55	77	68.37
Posttest Control	27	26	60	86	73.19
Valid N	27				

In Table 1 above, it can be seen that the results of the pretest and posttest in the experimental class showed that the average value of student learning outcomes increased, namely the average pretest value was 73.63 while the average posttest value was 82.74 with a difference of 9.11.

Table 2: Descriptive Student Practical Ability

Descriptive Statistics					
	Number of Samples	Range	Minimum	Maximum	Mean
Pretest Experiment	27	30	60	90	75.44
Posttest Experiment	27	28	72	100	87.30
Pretest Control	27	30	55	85	73.44
Posttest Control	27	31	60	91	77.89
Valid N	27				

From Table 2 above, it can be seen that based on the results of the pretest and posttest in the experimental class, it was found that the average value of students' practical abilities had increased significantly, namely the average value *pretest* is 75.44 while the average value *posttest* is 87.30 with a difference of 11.86. compared to the control class with a difference of 4.45.

3.1.2. Hypothesis Testing

a. Normality Test

The Normality Test is carried out to determine whether the data is normally distributed or not. The normality test taken from this research is Safiro-Wilk with SPSS. The normality test calculation is presented briefly with the test criteria being that if the 2-tailed Asymp sig value is > 0.05 , the data is normally distributed. Can be seen in table 3 below:

Table 3: Concept Understanding Normality Test

	Class	Shapiro-Wilk		
		Statistics	Df	Say.
Concept Understanding	Pretest Experiment	.929	27	.064
	Experimenta / Posttest	.902	27	.015
Control Posttest	Pretest Control	.956	27	304
	Posttest Control	.973	27	685

In table 3 above, it can be seen that the significance value in the Shapiro Wilk type test for calculating the N-Gain Score on the experimental class pretest learning results is 0.64 or sig. $0.064 > 0.05$. So it can be concluded that the research data is normally distributed. For the experimental class posttest it is 0.15 or sig. $0.115 > 0.05$ it can be concluded that the research data is normally distributed.

Table 4: Practical Ability Normality Test

	Class	Shapiro-Wilk		
		Statistic	Df	Say.
Practice Ability	Experimental Pretest	918	27	.035
	Posttest experiments	968	27	.556
	Pretest Control	943	27	.141
	Posttest Control	.961	27	.390

Based on table 4 above, it can be seen that the significance value in the Shapiro-Wilk type test for calculating the N-Gain Score on the practical ability of experimental class students is 0.35 or sig. $0.35 > 0.05$. So it can be concluded that the research data is normally distributed. For the control class it is 0.141 or sig. $0,141 > 0.05$ it can be concluded that the research data is normally distributed.

b. Homogeneity Test

This test is carried out to determine whether the data is homogeneous or not. It can be seen in table 5 below

Table 5: Concept Understanding Homogeneity Test

NO	R _{count} (based on mean)	Say.	Criteria	Is
1	0,666	0,05	Homogeneous	$r_{count} > r_{table}$

Based on table 5 above, it can be seen that the significance value of r_{count} Based on Mean of 0.666. This indicates that the Sig value. Based on Mean > 0.05 so it can be concluded that the data research results show a homogeneous or equal relationship between the independent variable and the dependent variable.

Table 6: Practice Ability Homogeneity Test

NO	R _{count} (based on mean)	Say.	Criteria	Is
1	0,187	0,05	Homogeneous	$r_{count} > r_{table}$

Based on the table above, it can be seen that the significance value of r calculated on Based on Mean is 0.187. This indicates that the Sig value. Based on Mean > 0.05 so it can be concluded that the data research results show a homogeneous or equal relationship between the independent variable and the dependent variable.

c. Uji T

This test was carried out to test whether there were significant differences in students' conceptual understanding and practical abilities after implementing the Project Base Learning (PjBL) learning model assisted by Codepen web media in class XI RPL at SMK Muhammadiyah 2 Pekanbaru. Can be seen in the table below:

Table 7: Concept Understanding T Test

No	Sig. (2-tailed)	T _{count}	T _{table}	Is	Category
1	0,000	4,686	1,674	$T_{count} > T_{table}$	H ₁ accepted

Based on the T test results presented in the table, the t_{count} value is 4.686 and t_{table} is 1.674 with a significance level of 0.05. Because the value of t_{count} is greater than t_{table} ($t_{count} > t_{table}$), then H_0 is rejected and H_1 is accepted. This shows that there is a significant difference in understanding concepts between students who use Project Base Learning (PjBL) assisted by Codepen web media and students who use conventional learning.

Table 8: Practical ability T test

No	Sig. (2-tailed)	T_{count}	T_{table}	Is	Category
1	0,000	4.692	1674	$T_{count} > T_{table}$	H_1 accepted

From the table above it can be seen that t_{count} is 4.692 and t_{table} is 1.674 with a significance level of 0.05. Just like in the analysis of concept understanding, t_{count} is greater than t_{table} ($t_{count} > t_{table}$), so H_0 is rejected and H_1 is accepted. These results indicate that there is a significant difference in practical abilities between students who use Project Base Learning (PjBL) assisted by Codepen web media and students who use conventional learning practices.

3.2. Discussion

Based on the research results that have been presented, it can be concluded that the application of Project Based Learning (PjBL) assisted by Codepen web media significantly increases students' conceptual understanding and practical abilities compared to conventional learning. This result can be seen from the comparison of pretest and posttest results in the two groups (experimental and control) which shows greater improvement in the experimental group who used PjBL assisted by Codepen.

In the aspect of understanding concepts, the implementation of PjBL assisted by Codepen web media increased the average score from 73.56 on the pretest to 82.74 on the posttest, with an increase of 12.4%. This increase shows that the project-based PjBL method allows students to better understand the concepts taught through direct experience and real application in the projects they work on. This is in line with research conducted by Anggriani et al. (2019) which states that project-based learning contributes significantly to students' learning outcomes and science process skills.

On the other hand, students who took part in conventional learning also showed an increase in understanding concepts, but the increase was not as big as that of the experimental group. The control group's posttest results showed an increase from 68.37 on the pretest to 73.19 on the posttest, with an increase of 7.049%. This shows that although conventional learning is able to increase understanding of concepts, this method is less effective than PjBL. Research [20] supports these findings by stating that conventional learning tends to produce shallow understanding because the focus is more on mechanical procedures rather than deep understanding.

In the aspect of practical ability, the difference between the experimental and control groups was also significant. The experimental group that used PjBL assisted by Codepen had an average score of 87.30, higher

than the control group which had an average score of 77.89. The higher increase in students' practical abilities in the experimental group shows that PjBL allows students to not only understand concepts but also apply them practically, which ultimately improves their skills. These findings are consistent with research [21] as well [22] who said that PjBL can significantly improve students' creative thinking and practical abilities.

Overall, the results of this research indicate that PjBL assisted by Codepen web media is more effective than conventional learning, both in increasing students' conceptual understanding and practical abilities. The PjBL method provides students with the opportunity to learn actively, think critically, and apply the knowledge gained in real contexts, which ultimately results in deeper understanding and better skills. The use of Codepen web media in the learning process also plays an important role in providing a more interactive and interesting learning experience, allowing students to interact directly with learning material digitally and in real-time. This makes PjBL assisted by Codepen web media a very relevant approach in the context of modern education which is increasingly oriented towards technology and practical skills.

4. Conclusion

The conclusion of this research is that there is an increase in students' understanding of concepts and practical abilities through application *project base learning* (PjBL) assisted by codepen web media for class XI RPL students at SMK Muhammadiyah 2 Pekanbaru for the 2023/2024 academic year. As for the results of this research, the increase can be explained as follows:

1. Average student learning outcomes before implementation *project base learning* (PjBL) assisted by Codepen web media is 73.63 and after implementation *project base learning* (PjBL) assisted by Codepen web media increased to 82.74. There was an increase with a difference of 12.4.
2. Average practical ability of students when applied *project base learning* (PjBL) with the help of codepen web media is 87.30 while in class *control* who applied conventional learning was 77.89. There was a difference with a difference of 9.41.
3. Differences were found *significant* between conceptual understanding and practical abilities of students who use the PjBL method assisted by Codepen web media compared to the control class that uses conventional learning.
4. The results of this research show that the implementation of PjBL assisted by Codepen web media has a real positive impact in increasing students' conceptual understanding and practical abilities. Therefore, this method can be recommended for wider application in other educational institutions, especially in learning that requires a strong understanding of concepts and practical skills such as in the field of Software Engineering (RPL).

Acknowledgement

My thanks go to Mr. Paiman Sanen S, Ag M, Pdi. Principal of SMK Muhammadiyah 2 Pekanbaru, who has given permission to conduct this research, and also to RPL 1 and RPL 2 students who have agreed to be research samples. I would also like to express my thanks to the Muhammadiyah University of Riau, especially the supervisor for their guidance and support during the research process.

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