Indonesian Journal of Business Analytics (IJBA)
Vol.3, No.4, 2023: 1323-1336

Development of Project Based Learning-Based Interactive E-Modules on Industry Standard Front-End Web Development Skills for Vocational High School Students

Bambang Sujatmiko[1]*, Dava Daviar Saputra[2]
Universitas Negeri Surabaya
Corresponding Author: Bambang Sujatmiko bambangsujatmiko@unesa.ac.id

A R T I C L E I N F O

Keywords: E-Module, Platform, Codenesa, Front End Web Development, Learning Media

Received : 11, June
Revised : 16, July
Accepted: 22, August

A B S T R A C T

Codenesa is an electronic module based in which there are interactive features for students to be able to practice the syntaxes explained in this platform. The research has the purpose to create and develop the Codenesa platform which to help support and create senior high vocational students to have a real portfolio as a professional to debut in the digital industry. The flow of the creation and development of Codenesa is through problem finding, data collection, production, and development of the Codenesa platform itself, the validation stage from expert lecturers covering the material and product aspects of Codenesa as a platform. The results of the expert lecturer validation stage show a value of 86.66% while the value of student responses when using the Codenesa platform as a learning medium shows a result of 93.13%. in addition, the increase in results is no less important when the pretest and posttest show significant results. This can be seen from the average pretest of students with a score of 50 and getting an average post-test score of 81.94. It can be concluded that using the Codenesa platform can increase the average value by 31.94% compared to students who study without using Codenesa who can only increase the average value by 13.66%.

DOI: https://doi.org/10.55927/ijba.v3i4.5296
ISSN-E: 2808-0718
https://journal.yp3a.org/index.php/ijba

INTRODUCTION

As global technology develops rapidly, now the whole world has been forced to follow the flow of technological developments, whether it's a developed country or a developing country like Indonesia. For developed countries such as America, Germany, Russia, and even China, there have been many races to launch many technological breakthroughs that are useful for many people and for the country. Developed countries have made technology a must for their citizens to study, especially for the millennial generation who are currently pursuing primary, secondary, and tertiary education (Chowdhury et al., 2021).

According to the Ministry of Communication and Information of the Republic of Indonesia, Indonesia needs nine million digital talent in the period 2015-2030 or it can be said that Indonesia needs 600,000 digital talent per year (Raya et al., 2021). Thus, the ability of the younger generation who are literate about technology is needed. It is not only the generation that can use technology that is needed, but the generation that can create and develop this technology that is most needed at this time. With the increasing demand for competent workers in this field, and with the increasing demand for a digitally literate generation, it is hoped that Vocational High School (SMK) students will have greater opportunities because they have been provided with practical and theoretical aspects at school. However, this still needs to be supported by appropriate learning methods along with industry-standard materials so that the provision provided by schools or teachers to students is maximized. For now, the school uses a curriculum based on the Ministry of Education and Culture of the Republic of Indonesia which still uses basic material and belongs to the category of old material so it is not relevant to current developments in industrial technology. Research with large funds is needed to realize this goal and the research time is rather long, but with the development of existing technology now researchers want to take advantage of this opportunity with simple steps in this research, namely by developing a learning media in the form of interactive e-modules with a Front End Web development curriculum in accordance with the current industry so that students can find out the best aspects and practical ways needed in today's digital industry. Based on this, this study raised a title "Development of PjBL-Based Interactive E-Modules on Industry Standard Front End Web Development Skills for Vocational High School Students".

THEORETICAL REVIEW

Development

Development is a process carried out to develop and validate a new product. And the product here is not just a textbook, instructional film, and computer software but can be a method and a program (Divayana et al., 2018).

E-ModuleInteractive

E-module interactive is a student learning media that contains material in the form of text, visuals, and audio which can increase students' interest in

active learning. Interactive e-modules are part of the Distance Learning (PJJ) media which can be accessed via the internet and contains material with visual, audio, and graphic elements that make it easier for students to study independently without being limited by space and time. The interactive electronic modules (e-modules) are modules in digital form that consist of elements of text, images or contain both accompanied by interactive features to stimulate students to actively solve problems during the learning process (B Sujatmiko et al., 2021).

Project Based Learning

Project-based learning refers to an instructional-inquiry method that involves students in forming their knowledge experience by completing a real project to develop. Project-based learning is a learning method that emphasizes students solving a complex problem by investigating and understanding new learning through inquiry. In a general sense, this learning model is called a teaching method that uses real problems in a project on a student learning system with the aim of facilitating students in processing a given theoretical understanding to be implemented in the project (Bambang Sujatmiko et al., 2020).

Front-End Web Development

Reporting to the official page of Front End Web Masters (https://frontendmasters.com), Front end web development, which is often referred to as client-side development, is the ability to create a web page or website in the form of an application using HTML (Hypertext Markup Language), CSS (Cascading Style Sheet), and Javascript where users can see and interact directly with the page. As the name suggests, front-end web development emphasizes the appearance and interaction of a site's pages, in contrast to back-end web development, which is focused on the logic and data processing algorithms for a site to function to meet user needs (Lawhon, 1976)(Indriyanti, 2020).

METHODOLOGY

The method used in this research is the Research and Development method. The research and development methods are processes or methods that serve to gain validation and develop a product (Wibawa et al., 2019):

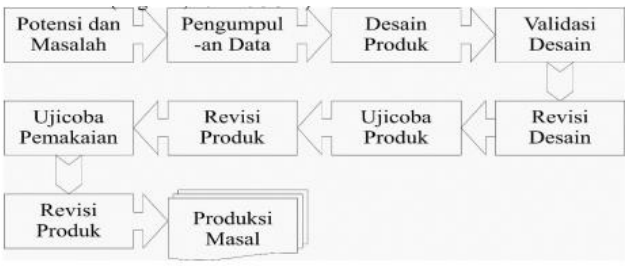

Figure 1. Research and Development Chart

Due to the limited time and funds of the researcher, the researcher did not carry out all the sequences contained in the chart above. The researcher simplifies the steps above into four steps which do not reduce the essence of the ten steps.

The following are four steps derived from the ten steps described(Sugiyono, 2017)(Wibawa et al., 2020):

1. **Research and data collection stage**
   a. Conduct analysis and observation of existing e-module learning media through current national and international scientific journals as well as relevant previous research journals.
   b. Conduct an analysis of the 2013 curriculum used by schools and the learning path used today to become a front-end web developer from the official W3School and MDN Docs (Mozilla Developer) website pages.
   c. Analyzing data on the need for digital talent in Indonesia through the official page of the Republic of Indonesia Kominfo and data on the most social media users according to GlobalWebIndex data on the official BBC news page.

2. **planning stage**
   a. Develop interactive e-module concepts that will be used as student learning media.
   b. Develop a curriculum or learning path that is in accordance with the current front-end web development industry, especially those used in the IT agency or software house industry.

3. **Product development stage**
   a. Making interactive e-modules in accordance with the existing concepts at the planning stage. E-modules are built using HTML, CSS, Javascript, Bootstrap Framework, and several other libraries.
   b. Creating a curriculum for e-modules that functions as a learning path for student learning in improving front-end web development skills.
   c. After the development stage is complete, the e-module will be deployed so that it can be accessed using the internet.

4. **Validation and trial phase**
   a. The validation stage of learning media and materials in this study was carried out by material experts and media experts.
   b. Phase 1 revision.
   c. The product trial was conducted in class X students of SMK Negeri 2 Surabaya by dividing it into two class groups, namely the control and experimental classes. The two groups carried out the pre-test and post-test processes.
   d. Final product improvement.

RESULTS

Software Development

The flow of using Codenesa is shown in the following diagram shown in Figure 1. Flow of Codenesa.

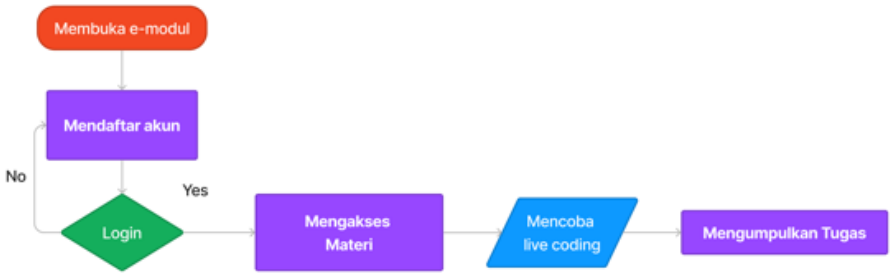

Figure 1. Codenesa flow

Figure 1. The Codenesa flow begins when opening e-module access. Starting from the stage of registering an account. After the user has registered, the user account has been stored in the Codenesa database. After saving, the user can log in according to the e-mail and password that the user registered in the account registration process. When logged in the user's learning progress is automatically stored in the Codenesa database so that data will be displayed on the student dashboard page in the form of the number of modules that have been studied. In some modules, the user does some code input which can be done on the live coding page. After the entire series has been carried out, the final step of the user's task is to do the final assignment that has been provided and can be submitted through the Codenesa platform.

Platforms Codenesa e-modules are built using HTML, CSS, Javascript, PHP, Bootstrap CSS, and JQuery. Writing code on the platform is based on the latest web-based platform writing standards. The processing steps are from planning, designing, manufacturing, testing locally, and the last is deployment (deployment). The following is a display of the Codenesa platform interface this platform is already responsive and can be accessed via various devices ranging from desktop to mobile as shown in Figure 1. Codenesa Desktop

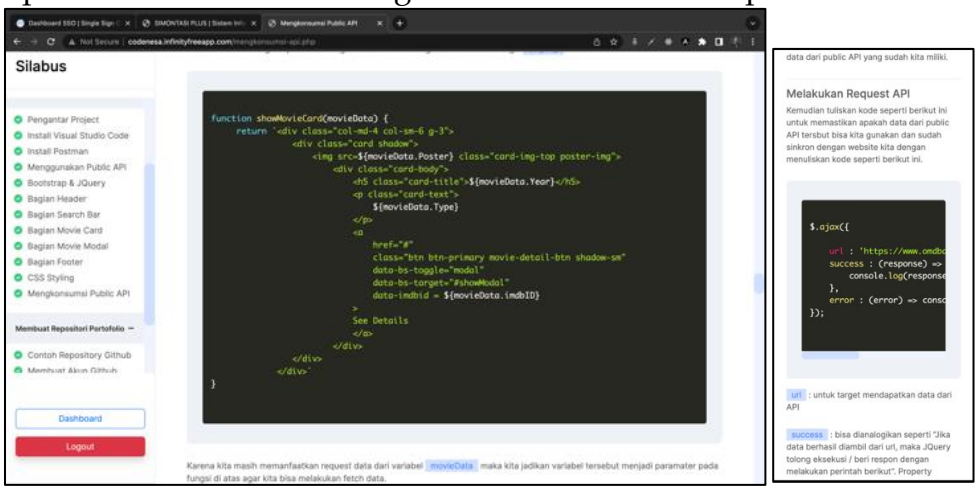

Figure 2. Codenesa in desktop and mobile responsive.

Besides being accessible via desktop and mobile, Codenesa can be accessed via mobile devices so that the e-module platform is responsive as shown in Figure 2. Codenesa is responsive. Codenesa materials are designed by adapting the developer environment, namely the standard code editor used by developers today. Aplikasi tersebut berjalan secara online seperti aplikasi media sosial lainnya(Prasetyo et al., 2014).

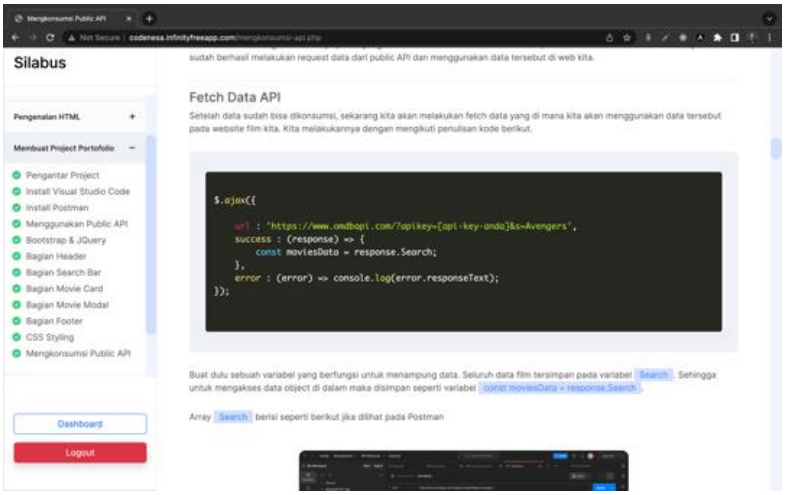

Figure 3. Material*Codenesa*

As shown in Figure 3. The Codenesa material contains a track record of the modules that have been studied. If the module has been studied, it will be marked with a green tick. So that students have to study sequentially and cannot continue to the next page.

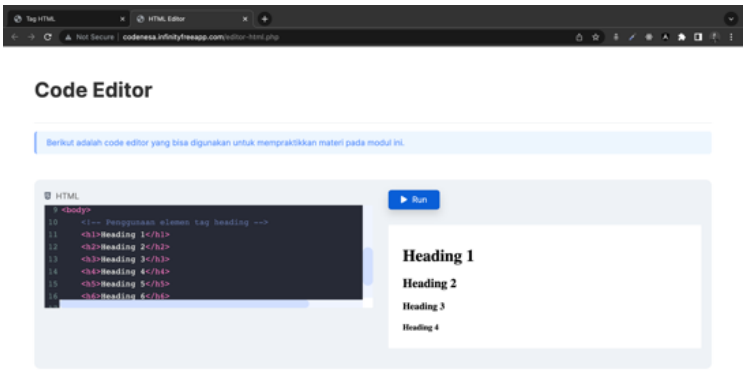

Figure 4. *Codenesa Live Coding*

This study emphasizes the interactive aspects contained in the platform, so psychomotor features are mandatory features. In some modules, the material is given a live coding feature like Figure 4 where students can learn while trying live coding without having to leave the Codenesa platform so that students feel comfortable learning while practicing what has been explained in the module. The live coding interactive feature is also responsive so that when accessed via mobile the display is still neat according to the width of each device that the user is using.

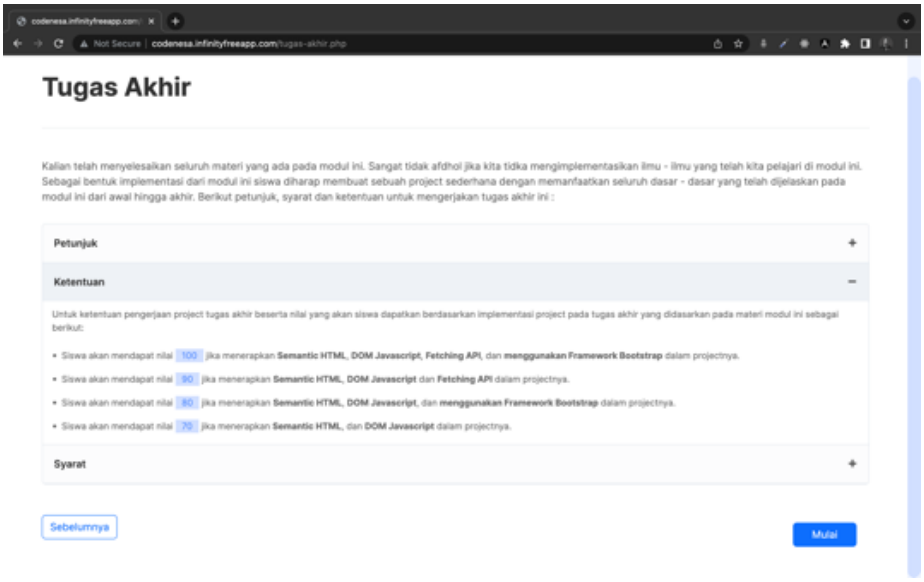

Figure 5.*Submission Codenesa*

The part that is no less important is the final assignment collection page or what is called a submission as shown in Figure 5. This page contains instructions for work and what conditions students must fulfill in order to get maximum results or grades according to their understanding after studying the modules in Codenesa. And the availability of assignment collection links for the teacher to review regarding student final project work.

Research Implementation

The research was carried out at SMK Negeri 2 Surabaya with the Software Engineering (RPL) class X study program in web programming subjects. The research was conducted for five days.

1. **Data Collection**
   a. **Validation lecturer score**

Table 1. Expert lecturer validation scores

No	Score
1	42
2	36
Amount	78

If it is assumed that each indicator gets a maximum value of 5, then the score obtained is as follows:

5 x 9 x 2 = 90

It can be explained that 5 is the maximum value, 9 is the number of questionnaire items, and 2 is the number of validation lecturers.

So if it is calculated using the formula described in the method section above the expert lecturer score is 86.66%. With these results, it is said that the Codenesa platform is feasible to be tested on students.

b. Student response score

Table2. Student response score

No	Amount
1-36	365

If it is assumed that each indicator gets a maximum value of 5, then the score obtained is as follows:

1 x 11 x 36 = 392

It can be explained that 1 is the maximum value, 11 is the number of questionnaire items, and 36 is the number of students.

So if it is calculated using the formula described in the method section above the expert lecturer score is 93.13%. With this score on the Codenesa platform trial, it is included in the very good or very feasible category to be used as an intermediary for student learning.

c. Pretest and Posttest experimental and control classes

The scores of the experimental class and the control class are shown in Tables 5 and 6, which show that the experimental class has higher scores than the control class 81.94 and 66.67.

Table 3. Compilation of experimental class scores

Mark	Pretest	Posttest
Min Value	30	75
Max value	70	90
Means	50	81.94

Table 4. Compilation of control class values

Mark	Pretest	Posttest
Min Value	30	50
Max value	75	75
Means	53.06	66,67

2. Data Testing

After collecting the data, the data obtained is as described above, there are differences in data from the experimental and control classes. To prove the validity of student learning outcomes, further tests are needed on data from student learning outcomes by following the following steps in the analytical procedure.

a. Create descriptive statistics

After collecting existing data to facilitate the testing step, the first thing to do is to turn the collected data into descriptive statistics and the following table of descriptive statistics in this study, as in Table 7.

Table 2. Descriptive statistics of student grades

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pretes Eksperimen	36	30	70	50.00	10.142
Posttes Eksperimen	36	75	90	81.94	5.248
Pretes Kontrol	36	30	75	53.06	12.264
Posttes Kontrol	36	50	75	66.67	6.969
Valid N (listwise)	36				

b. Perform data normality test

The data has been made into descriptive statistics for the next step is to test the normality of the data. To find out about the distribution or distribution in the normal category or not by comparing the pretest and post-test values that have been obtained in the study to meet the requirements of the Independent T-Test where the data must be normally distributed and homogeneous as shown in table 8.

Table 3. Data normality test

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Kelas	Statistic	df	Sig.	Statistic	df	Sig.
Hasil Belajar Siswa	Pretes Eksperimen	.133	36	.105	.955	36	.148
	Posttes Eksperimen	.192	36	.002	.873	36	<.001
	Pretes Kontrol	.113	36	.200*	.954	36	.144
	Posttes Kontrol	.184	36	.003	.894	36	.002

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

From the results above, in this study, the data are classified as not normally distributed. Data is categorized as normal if the Kolmogorov-Smirnov and Shapiro-Wilk significance values are > 0.05. The research data is not normally distributed because there are extreme values resulting in a skewed distribution of data which is commonly called Skewness. Therefore, the next step is to do a nonparametric test.

c. Performing the Mann-Whitney nonparametric test

The following is an explanation of the Mann-Whitney Nonparametric Test from this study. The Mann-Whitney test, only takes posttest scores from two class groups as the final score results in Table 9.

Table 4. The Mann-Whitney test

Test Statistics[a]

	Hasil Belajar
Mann-Whitney U	36.000
Wilcoxon W	702.000
Z	-6.982
Asymp. Sig. (2-tailed)	<.001

a. Grouping Variable: Kelas

It can be observed from the results above, for the Mann-Whitney nonparametric test the significance value is <0.001.

d. Performing the Lavender homogeneity test

The distribution of data is categorized as not normal as previously described so carry out a homogeneity test using the Lavene Test. The Fisher F test is used if the data is normally distributed, so in this study, the results from the Lavene Homogeneity Test show significant results as follows.

Table 5. Homogeneity test

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Hasil Belajar	Based on Mean	1.572	1	70	.214
	Based on Median	1.551	1	70	.217
	Based on Median and with adjusted df	1.551	1	66.645	.217
	Based on trimmed mean	1.565	1	70	.215

3. Results of Data Analysis

The results of the normality and homogeneity tests have been described above so that the hypothesis test was taken based on the significance value of the Mann-Whitney test which showed significant results in student learning between the experimental group class and the control group class. The following is an explanation of the results of the hypothesis test.

Table 5. Hypothesis testing

Test	Significance Value
Standard of significance	0.05
Mann Whitney	< 0.001

So from these results, it proves that there were significant results in the experimental class which was treated in the form of using the Codenesa electronic module platform where students experienced an increase in learning outcomes of 31.94% compared to control class students who used conventional learning methods which only experienced an increase of 13.66%.

Data analysis techniques in this study used quantitative data analysis techniques. The results of this quantitative value are in the form of a score to determine the feasibility level of the platform that the researcher has developed to serve as a learning medium. The collection of scores was obtained from giving questionnaires to expert lecturers and questionnaires from student responses regarding the Codenesa electronic module platform.

Expert Lecturer Questionnaire Analysis

Scores are obtained using the Likert scale method in which a range of values is provided for each item of assessment indicator from one to five. And experts can give a tick(√) on each indicator item according to the value you want to give. The following details the range of values from one to five.

5 = Strongly Agree
4 = Agree
3 = Doubt – Doubt
2 = Disagree
1 = Strongly Disagree

To calculate the score that has been checked for each indicator item described above, it can be calculated using the formula below (Sugiyono, 2017).

$$\text{appropriateness (\%)} = \frac{\Sigma\text{Expert Lecturer Score}}{\text{Max Score}} \text{ x } 100\% \text{.....(1)}$$

Table 6. Achievement and Quality of Eligibility (Sugiyono, 2019)

No	Achievement Level	Qualification	Information
1	81 – 100%	Very good	Very decent, no revision needed
2	61 – 80%	Good	Decent, no revision is needed
3	41 – 60%	Pretty good	Not feasible, needs revision
4	21 – 40%	Not good	Not feasible, needs revision
5	<20%	Very Less Good	Very unfit, needs revision

Analysis of Student Response Questionnaires

The student response questionnaire uses the Guttman scale in which there are two values, namely a value of one and a value of zero. Following are the details of the student response questionnaire assessment.

1 = Yes,
0 = no

To calculate the score that has been filled in by students from the distribution of the questionnaire, it can be done with the following formula.

$$\text{appropriateness (\%)} = \frac{\Sigma\text{Expert Lecturer Score}}{\text{Max Score}} \text{ x } 100\% \text{ ..... (2)}$$

Table 7. Achievement and quality of feasibility

No	Achievement Level	Qualification	Information
1	81 – 100%	Very good	Very decent, no revision needed
2	61 – 80%	Good	Decent, no revision is needed
3	41 – 60%	Pretty good	Not feasible, needs revision
4	21 – 40%	Not good	Not feasible, needs revision
5	<20%	Very Less Good	Very unfit, needs revision

Analysis of student learning outcomes

Analysis of pretest and posttest data results that have been tested in two classes using the formula:

$$B = \frac{SB}{SM} \times 100 \quad \ldots\ldots\ldots\ldots\ldots (3)$$

Information :
B = Score of test results each - each student
SB = Total score obtained
SM = Total maximum score of students
100 = Constant

CONCLUSIONS AND RECOMMENDATIONS

Based on the exposure of the results of the above research in this study, the following conclusions can be drawn: (1) the validation assessment of two media expert lecturers gets a feasibility value of 86.66% where the feasibility value is included in the category of very feasible media developed in this study to be used as a learning medium in front end web development programming for SMK students as a provision of the industrial portfolio. (2) Apart from expert lecturers, the results of determining the feasibility of the learning media being developed in this study are also determined by the value of the responses of students who are the research sample by calculating using the Guttman Scale. The accumulated value yielded 93.13%. This value is included in the category of very worthy to be used as a learning medium in web programming subjects, especially in the front-end web development section. From statistical analysis, the data that has been collected in the form of student pretest and posttest scores was produced with the experimental class experiencing an increase in learning outcomes by 31.94%, while the control class experienced an increase in learning outcomes by 13.66%. The research has several recommendations and suggestions specifically for the improvement of researchers themselves, teachers, and other researchers who want to continue this research: (1) teachers who want to deliver learning materials that are practical in nature are expected to explore the latest developments regarding website developers who are currently loved. Not impressed to have to create learning media that is too complex, the most important thing is how to become a teacher who has reliable competence, which is what students need rather than just providing complex learning media, but the content is not the content needed by students. (2) To be able to stimulate active students and improve their competence in web programming lessons, it is expected to use the Project Based Learning (PjBL) method so that students can learn from the beginning reliable management of time, resources, and presentation skills as a provision for entering the digital industry.

FURTHER STUDY

Researchers still have limitations in conducting research Project Based Learning-Based Interactive E-Modules on Industry Standard Front-End Web Development Skills for Vocational High School Students researchers suggest conducting further research on this topic so that it can add reference or insight for readers.

REFERENCES

Chowdhury, G., Koya, K., & Bugaje, M. (2021). A recommendation-based reading list system prototype for learning and resource management. *Journal of Information Science*. https://doi.org/10.1177/01655515211006587

Divayana, D. G. H., Ariawan, I. P. W., Adiarta, A., Parmiti, D. P., Sanjaya, D. B., Kertih, I. W., & Wibawa, S. C. (2018). Design of Countenance Evaluation Model Based on ANEKA-Tri Hita Karana in Computer Learning for Vocational Students of Information Technology in Bali. *Journal of Physics: Conference Series*, *1108*(1). https://doi.org/10.1088/1742-6596/1108/1/012003

Indriyanti, A. D. (2020). Module for Developing Learning Media Applications for Wireless Networks in Project-Based Microtic Hotspot Materials for Microtic Setup (Configuration) Competency Improvement Module for Developing Learning Media Applications for Wireless Networks in Proj. *Journal of Physics: Conference Series*, *1569*. https://doi.org/10.1088/1742-6596/1569/2/022017

Lawhon, D. (1976). Instructional development for training teachers of exceptional children: A sourcebook. *Journal of School Psychology*, *14*(1), 75. https://doi.org/10.1016/0022-4405(76)90066-2

Prasetyo, D. G., Astra, I. K. B., Suwiwa, I. G., & Program. (2014). EFEKTIVITAS PEMBELAJARAN ONLINE DI PRODI PENJASKESREK FOK UNDIKSHA PADA MASA PANDEMI COVID-19 Davi. *Undiksha Repository*, *6*. https://repo.undiksha.ac.id/4791/2/1316011074- ABSTRAK.pdf

Raya, A. B., Andiani, R., Siregar, A. P., Prasada, I. Y., Indana, F., Simbolon, T. G. Y., Kinasih, A. T., & Nugroho, A. D. (2021). Challenges, open innovation, and engagement theory at craft smes: Evidence from Indonesian batik. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(2). https://doi.org/10.3390/joitmc7020121

Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D* (Issue 1,2). Alfabeta, CV.

Sugiyono. (2019). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, Kombinasi R & D dan Penelitian Tindakan* (3rd ed.). Alfabeta.

Sujatmiko, B, Wibawa, S. C., Dermawan, D. A., & Ongge, H. A. (2021). Computer Based Test (CBT) using Moodle-based High Order Thinking Skills in network design subjects. *IOP Conference Series: Materials Science and Engineering*, *1098*(5), 052112. https://doi.org/10.1088/1757-899x/1098/5/052112

Sujatmiko, Bambang, F, R., & Wibawa, S. (2020). Project-Based Learning as a Subnetting Material Completion in Network Design Studies Project-Based Learning as a Subnetting Material Completion in Network Design Studies. *Journal of Physics: Conference Series*, *1569*. https://doi.org/10.1088/1742-6596/1569/2/022018

Wibawa, S. C., Megasari, D. S., Mashudi, M., Sahlan, M., Kristanto, A., & Dewi, V. K. (2019). Camera DSLR animation media as learning tool base. *Journal of Physics: Conference Series*, *1402*(7). https://doi.org/10.1088/1742-6596/1402/7/077051

Wibawa, S. C., Sulistiyo, E., Martiningsih, N. G. A. G. E., Handoyo, E., & Johan, A. (2020). Moodle mobile development in enjoyable learning in computer system subjects. *IOP Conference Series: Materials Science and Engineering*, *830*(3). https://doi.org/10.1088/1757-899X/830/3/032017