The Website Development of a Teacher Tools Assistance System Integrated of Project Based Learning Model

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Abstract: The study, conducted in response to the shortcomings of the digital learning system in facilitating the Physics learning process with the project based learning model. So the purpose of this study is to develop a Teacher Tools Assistance System website as an answer to this problem. This study adopts the RnD method with the ADDIE model development framework focused on three stages, namely analysis, design, and development. The analysis stage examines the curriculum and learning environment. At the design stage, a prototype of the Teacher Tools Assistance System website is produced which is then tested at the development stage. The development stage is carried out with various tests, namely the Black-Box test, installation/launch, validation by media experts and material experts, and user responses involving 58 students of SMAN 3 Kota Jambi class XI. As a result, in the Black Box test, the website functionality achieved 100% on the teacher's page and 96% on the student's page. In the media expert validation, the score given was 4.44, which was categorized as very feasible. While the validation by material experts 1 and 2 rated it 4.50 and 4.47, categorizing it as very feasible category. In addition, the response from users gave a score of 4.20 in the category of worthy of the product. However, there are still shortcomings including the appearance of the website, website navigation that is not yet user friendly, and the emergence of bugs.

Keywords: Project Based Learning; Physics; Learning platform

Introduction

Digital technology has become an instrument that helps educators to teach in a more flexible way. However, in its implementation, this process requires thorough preparation (Putri et al., 2023; Listiyoningsih et al., 2022). The preparation includes including pedagogical training and technology usage for educators, having information-data infrastructure, institutional flows, and integrating practices to promote new innovations and training on digital technology in learning. The infrastructure cannot be prepared in a short time and requires expensive costs. (Wahyuningsih, 2021; Icela, 2022).

These time and cost constraints can be overcome by using various existing online learning system platforms such as e-learning, zoom, whatsapp, edmodo, and google classroom (Jabbar Alkubaisi, Al-Saifi, Al-Shidi, & Al-Shukaili, 2021). These learning platforms have advantages and disadvantages based on their use in the learning process. This is because each learning platform has unique characteristics in its use so that it is not uncommon for users, both teachers and students, to have difficulty using it (Foreman, 2017; Rachmi et al., 2024). Difficulty in using the platform can create new

problems for teachers and students in implementing it in the learning process using learning models that require students and teachers to be active, such as the project-based learning model (Sulistyorini & Anistyasari, 2020; Shpeizer, 2019).

The project based learning model requires many activities carried out by both teachers and students. These activities need to be monitored by the teacher himself using various relevant instruments(Flemming, 2000). However, some realities that emerge such as the results of Lee, Huh, & Reigeluth, (2015) research which revealed the inability of teachers to monitor and actively direct students in the learning process can lead to failure in achieving learning goals. Previous reviews or research reveal that this problem can be overcome by improving competencies for educators or integrating digital learning platforms that have been discussed previously. Integration of digital platforms can be an effective solution if the digital platform has specifications that match the characteristics of the project-based learning model (Dag & Durdu, 2017; Abuhmaid, 2020).

Various studies have been conducted for a long time by developing website-based learning platforms or using existing learning platforms. However, the results of these learning platforms need to be refined with additional more appropriate features. This is because the argument presented in the conclusion of Köse, (2010) research, which leads to the addition of features that focus on supervision and communication between users. So on this basis, further development is needed to ensure that digital learning platforms can be an effective solution.

Method

This research was conducted on the basis of RnD (Research and Development) which aims to produce a prototype in the form of a website that is implemented in facilitating the physics learning process only for the project based learning model on the material of uniformly accelerated linear motion in grade XI phase F. In the development process, the researcher used the ADDIE model (Analysis, Design, Development, implementation and Evaluation). The development process using the ADDIE model is carried out based on procedural steps. According to M.Rusdi, (2018), The ADDIE model is conceptually shown in Figure 1.
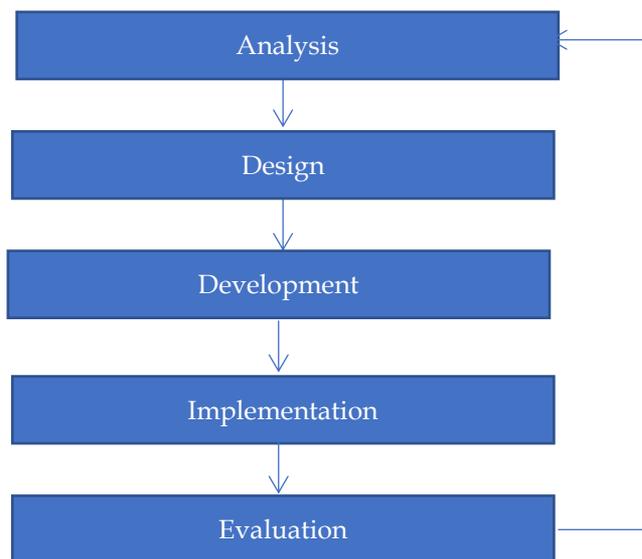

Figure 1 ADDIE model scheme

Development is not fully carried out until the evaluation stage, but rather development is carried out until the development stage. So that the development stages are summarized into only three stages, namely analysis, design, and development, which are shown in Figure 2.
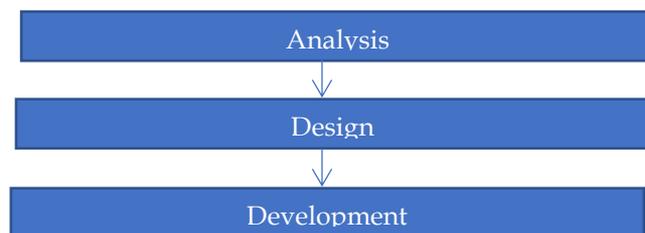

Figure 2. ADDIE model used

The purpose of using only three steps is to see the initial feasibility of the prototype before further research is carried out. The development process was carried out in stages, the first of which was to conduct a needs analysis by conducting observations using the interview method on four high school Physics teachers to identify the curriculum used, learning design, and interaction between teachers and students when the project-based learning model was used in Physics learning. In the second stage, the process of creating a development design was carried out. The creation of a development design was carried out in stages, starting from determining a development team consisting of researchers, media experts, and material experts, determining the resources used, creating a development schedule, creating a storyboard, determining development specifications and building a prototype.

After the second stage, it is continued with the third stage, namely the development stage. The development

stage is carried out with a series of tests. The tests carried out start from the Black-Box test which is carried out to test the functionality of the website, the installation/launch test which is carried out to test the website on different browser environments and devices, the validity test by media experts and material experts which is carried out to determine the feasibility of the website, and the respondents' responses. Through this test, data is obtained using instruments adapted from various studies, including media expert instruments adapted from Lukitaningrum, (2016) and material expert instruments adapted from Kustandi & Sutjipto, (2011). Meanwhile, the instruments used to obtain respondent responses were adapted from research by Pratama & Buditjahjanto, (2016).

Respondents who acted as samples were 58 students of class XI phase F at SMAN 3 Kota Jambi. The sampling technique was carried out using the cluster sampling technique. The cluster sampling technique is the determination of the number of samples by taking samples from a population randomly without looking at the size of the population. This aims to avoid taking a lot of time and heavy costs (W.Creswell & Creswell, 2018). The data analysis technique uses a Likert scale.

The Likert scale is a scale that provides interpretation of the data obtained. The scale used consists of 5, including strongly agree, agree, neutral, disagree, and strongly disagree. Details can be seen in table 1.

Table 1 Likert scale for validation and user response

Description	Score
Strongly Agree	5
Agree	4
Neutral	3
Disagree	2
Strongly disagree	1

Data interpretation is done by finding the average score obtained on each instrument. So it is necessary to determine the interval scale to obtain the criteria value which is the standard for assessing the product's eligibility. The interval scale can be obtained by using equation 1.

$$ir = \frac{s_{maks} - s_{min}}{n} \tag{1}$$

Description

s_{maks} = Maximum score

s_{min} = Minimum score

n = a lot of data

Because the Likert scale that is set has 5 classes, the number of classes is 5. Then the interval scale is obtained with the following calculation: $ir = \frac{s_{max} - s_{min}}{n}$

$$ir = \frac{5-1}{5} = 0,8$$

By obtaining an interval scale, the score classification is a form of data interpretation in the validation of media experts, material experts, and user responses presented in table 2.

Table 2 Data interpretation for validation and user response

Score interval	Category
1.00 – 1.80	Highly infeasible
1.81 – 2.60	Infeasible
2.61 – 3.40	Moderate feasible
3.41 – 4.20	Feasibel
4.21 – 5.00	Highly feasible

Result and Discussion

The results obtained in the development process are a prototype of the Teacher Tools Assistance System (T-TAS) website that can only be used on uniformly accelerated linear motion material. The development process is carried out through several stages, including:

Need Analysis

The results of the needs analysis were obtained through an interview method with 4 high school physics teachers in Jambi City. The results of the interview included curriculum analysis and learning environment analysis. Based on the results of the two analyses, two things were obtained, including:

Curriculum Analysis

Based on the interview results obtained from interviews with four high school Physics teachers in Jambi City, the teachers have implemented the independent curriculum and have started implementing the project-based learning model in Physics learning, including Physics teachers at SMAN 3 Jambi City and SMAN 5 Jambi City. In addition, according to the teacher's statement, the competency to be achieved is that students not only understand Physics theory and material but can implement it in real life. Therefore, the researcher used ATP from internet sources because the learning objectives achieved were in accordance with the teacher's statement. The learning objectives used were to analyze physical quantities in constant and uniformly

changing linear motion and to describe the concept of uniformly changing linear motion through graphs.

Learning environment analysis

The results of the interview showed that teachers involved several technology platforms that were applied in learning. Teachers used the Google Drive platform which was used to store assignments, the Whatsapp and Zoom platforms which were used to communicate with students. The use of many platforms made the learning process inefficient. In addition to making the learning process inefficient, students and teachers often experienced miscommunication in the learning process, including being late in collecting assignments, and providing documentation reports to teachers. In conclusion, the learning environment became ineffective due to the use of irrelevant learning platforms and miscommunication between teachers and students.

Design

Based on the results of the needs analysis, it is necessary to provide an integrated learning platform for the project-based learning model in the material of regular linear motion in the form of a website. The platform must be designed to support the student communication process during the learning process, collect assignments and documentation of student work, and manage learning. Realizing the platform requires going through several stages, including the following:

Determine the Development Team

The development team consists of two Physics education lecturers who are experts in the field of media and materials and researchers. The two lecturers play a role in providing direction and providing validation in the field of media and materials. While researchers play a role in building product prototypes.

Determined Resources Used

The resources that need to be provided to support the development process include the following:

Tabel 3. Support the development process

Programming Language :	PHP and JavaScript
Website server :	Apache
Database Management system	MYSQL
Minimum laptop device spesifications :	
Operation system :	Windows atau LINUX
RAM :	4 Gigabyte
Text editor :	Visual studi code
Framework :	Bootstrap
Markup language :	HTML dan CSS
Application design :	Nicepage
Human resources :	Web developer
Web Socket :	Pusher
Hosting server :	Jagoan hosting

Prepare a Development Schedule

The development schedule is used as a guide in controlling the progress of product development to be on time. Development is planned to run for 9 months which can be seen in table 3. But in reality in the field, the development time is running slower than planned. The development time can be seen in table 4.

Table 4. Development schedule plan

Development stages	Months								
	1	2	3	4	5	6	7	8	9
Analysis	█	█							
Design			█	█	█	█	█		
Development								█	█

Table 5. Field development timeline

Development stages	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
Analysis	█	█										
Design			█	█	█	█	█	█	█			
Development										█	█	█

Create a Storyboard

Storyboard provides a conceptual design that provides a user interface (UI) design that will be used by the user. The user interface (UI) design contains several features including student/teacher login features, student/teacher registration, student/teacher dashboard, student/teacher project menu, discussion forum, student and teacher library menu, student and teacher project timeline menu, teacher and student presentation menu and reflection menu. These features are designed on two displays, namely the display on the desktop screen and smartphone.

Determine Product Spesifications

Product specifications are determined through the results of the needs analysis that has been carried out. The product specifications that have been determined include the following:

i. The product is a website that integrates the project based learning model.
ii. The product operates by controlling the learning process in stages following the syntax of the project based learning model.
iii. The product can be accessed through at least three types of browsers, namely Google Chrome, Microsoft edge, and Mozilla firefox.
iv. The product uses two programming languages, namely PHP and JavaScript.
v. Data storage is done using a database management system by MYSQL.

Build a Prototype

The prototype was built starting from creating a user interface (UI) display. The display was made uniform for teacher and student users, which was done so that the prototype development could be done easily. In addition to building a user interface (UI) display, it is necessary to build an appropriate database design. The database that was built was designed using a relational model. The relational model is used to facilitate data management and facilitate building business logic. Business logic is built using the PHP and JavaScript programming languages. The Teacher Tools Assistance System (T-TAS) business logic works based on the project-based learning model. This aims to ensure that teachers do not need to study the learning model first.

Development Stage

The development stage is a stage that consists of a series of tests consisting of Black-Box tests, Installation/Launch tests, media and material expert validation, and user response tests.

Black-Box testing

Black-Box testing is a functional test on each website feature. The functional test of the website is carried out in 3 stages with the results before and after the repair can be seen in Figure 3.
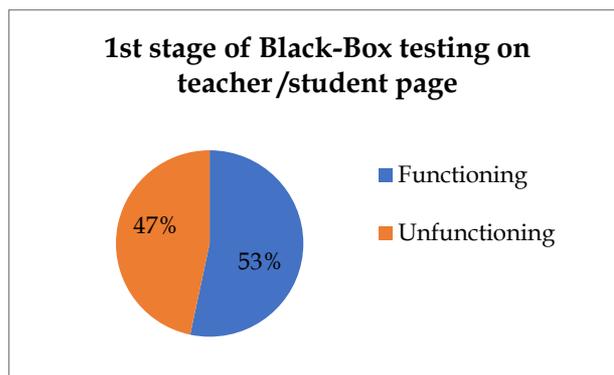

Figure 2. The result of 1st stage Black-Box testing on teacher page and student page

Black-Box test stage 1 on the teacher's page showed that 53% of the website's functionality was running well. While the other 47% could not function properly. While on the student page also gave the same percentage. In the second stage of the Black-Box test, many website functionalities were able to run well after improvements were made. The results are presented in Figure 4 and Figure 5.
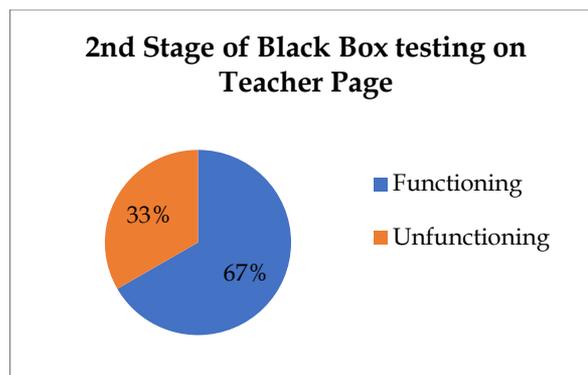

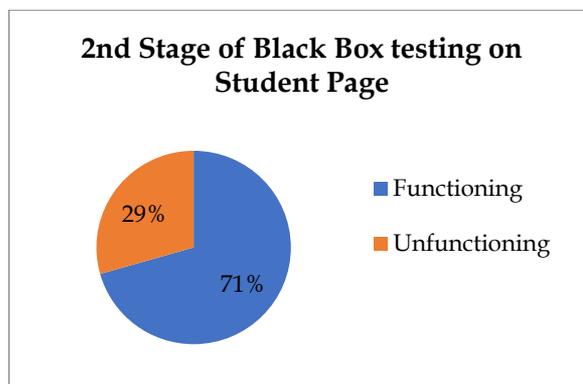**Figure 3.** 2nd stage of Black-Box testing on teacher page

Figure 4. 2nd stage of Black-Box testing on student page

Based on the graph in Figure 4, there has been an increase in functionality on the website. The functionality of the website that has been running well is 67% on the teacher page while on the student page 71% of the website functionality has been running well. The test results still show that the website is required to make improvements again.

In the third stage of the Black-Box test, almost all features can function properly. The teacher page has shown that the website functionality has run well by 100%. While on the student page, 94% of the website functionality has run well. The results of the third test are shown in Figure 6 and Figure 7.
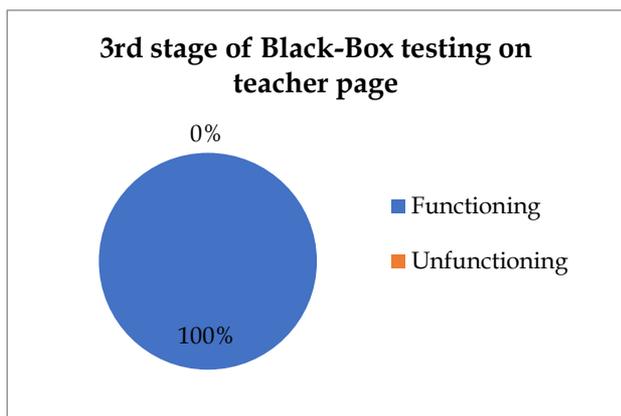

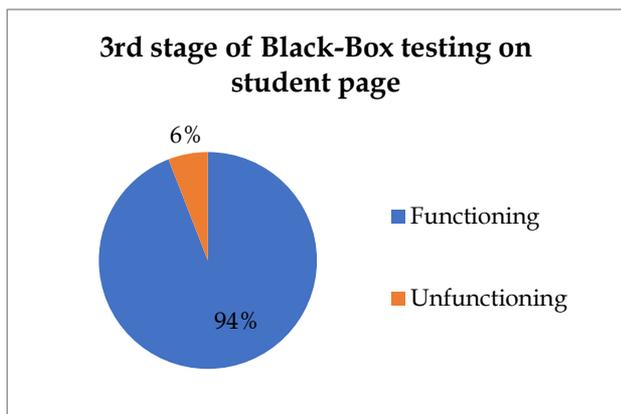**Figure 5**. The result of 3rd stage of Black-Box testing on teacher page

Figure 6. The result of 3rd stage of Black-Box testing on student page

Media Expert Validation

Media expert validation in this development aims to determine the level of media feasibility in three aspects, namely usability, functionality, and visual communication. The validation results are shown in table 5.

Table 6. The results compilation of expert media in three stages

Aspect	Validate 1	Validate 2	Validate 3
Usability	3.14	3.43	4.29
Functionality	3.29	4.24	4.82
Communication and visual	3.60	3.70	4.20
Average	3.34	3.79	4.44
Category	Moderately feasible	Feasible	Highly feasible

Based on table 5, the usability aspect got a score of 3.14 with moderately feasible category. The functionality aspect was given a score of 3.29 with moderately feasible category and the communication and visual aspects were given a score of 3.60 with feasible category. Overall, the website aspect was at a score of 3.34 with a moderately feasible category. These results indicate that several improvements are needed, including ease of accessing the website, the speed of the website in operating, and there is a display that is still not neat and the use of language that uses foreign terms.

In the second validation, there was an increase in all aspects of the website after improvements were made. The usability aspect was given a score of 3.43, the functionality aspect was given a score of 4.24, and the communication and visual aspects were given a score of 3.70. Overall, the website aspects in this second validation were in the feasible category with several improvements. These improvements include the appearance on smartphone devices, functionality and communication, and visuals on the help feature.

In the validation by media experts in the third stage, all aspects of the website experienced improvements again. The usability aspect was given a score of 4.29, the functionality aspect was given a score of 4.82, and the communication and visual aspects were given a score of 4.20. The functionality aspect shows that the website's functionality is highly feasible to use. In this aspect, no more improvements are needed. The same thing is also given to the usability and communication and visual aspects. Overall revisions can be seen in table 7.

Table 7. Revisions based on media expert validation

Revisions	Result before revisons	Result after revisons
Add and complete the help menu		
Switch some unused features		
Fix the appearance of unresponsive components		

Improve the display on smartphone devices		
Add an assessment rubric		
Fixed a bug in uploading user profile data		
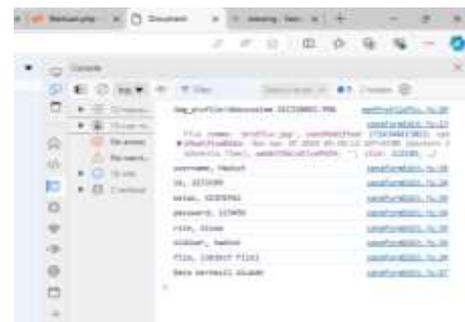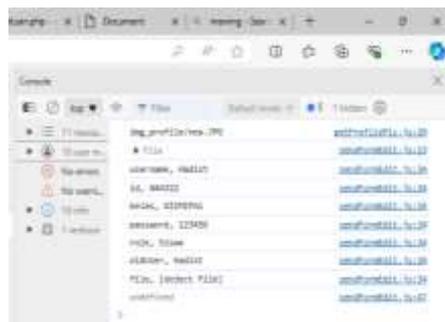
Material Expert Validation

The validation of material experts was carried out in three stages by material expert 1 and in two stages by material expert 2. The results of the validation by material expert 1 are presented in table 7.

Table 8. The result compilation of 1ˢᵗ expert material in three stages

Aspect	Validate 1	Validate 2	Validate 3
Learning design	2.83	3.83	4.67
Material	2.13	3.75	4.63
Communication and language	2.67	4.17	4.17
Average	2.54	3.92	4.50

Aspect	Validate 1	Validate 2	Validate 3
Category	Infeasible	Feasible	Highly feasible

Based on table 7 in validation 1, all aspects of the material are in the infeasible category. The learning design aspect was given a score of 2.83 due to learning objectives that were not in accordance with the school where the research was conducted. So it is necessary to replace the learning objectives according to the flow of learning objectives in the relevant high school.

In the material aspect, it was only given a score of 2.13 because the depth and breadth of the material were still minimal. Material experts provided comments by adding depth and breadth of the material. In addition, it is necessary to add sample questions to the material.

Meanwhile, in the language and communication aspect, it was given a score of 2.67 because there was a lot of ineffective use of language and the use of foreign terms.

In the second validation, improvements have occurred so that the score has increased significantly in all aspects of the material. In the learning design aspect, it was given a score of 3.83, the material aspect was 3.75, and the language and communication aspect was given a score of 4.17. So that overall the average score in the second validation was 3.92 with feasible category. In this validation, the material expert only provided improvements including improvements to several typos and ineffective words, the writing of the title on the cover, and the color of the letters used.

In the third validation, all aspects of the material on the website were categorized as highly feasible. The learning design aspect was given a score of 4.67, the material aspect was given a score of 4.63, and the language and communication aspect was given a score of 4.17. In the third validation, all aspects had met the criteria of material expert 1 and did not provide recommendations for improvement. In the validation test, material expert 2 gave almost stagnant results at each stage. The results of material expert 2 at the two stages are shown in table 9.

Table 9. The result compilation of 2nd expert material validations

Aspect	Validate 1	Validate 2
Learning design	4.67	4.50
Material	3.88	4.40
Comunication and language	5.00	4.50
Average	4.52	4.47
Category	Highly feasible	Highly feasible

In the first validation, all aspects have reached the highly feasible category. The learning design aspect was given a score of 4.67, the material aspect was only given a score of 3.88, and the language and communication aspect was given a score of 5.00. It can be seen that the material aspect has a score that is not as high as the scores in other aspects because material expert 2 proposed to deepen the material and add sample questions in line with material expert 1.

The second validation gave almost the same results as the first validation. The learning design aspect was given a score of 4.50, the material aspect was given a score of 4.40, and the language and communication aspect was given a score of 4.50. Overall, all aspects of the material were highly feasible. However, there was a slight decrease in the feasibility of the learning design

aspect and the language and communication aspect. The cause of this decrease is not yet known because the material expert did not provide any information.

The user responses

The results of user responses from 58 students gave positive results. The results of the responses of the 58 students are presented in table 9.

Table 10. The results of 58 student user responses

Aspect	Score
Material	4.362
Language	3.996
Appearance	4.220
Benefit	4.224
Average	4.20
Category	Feasible

Based on table 10, the material aspect was scored 4.362, the language aspect was scored 3.996 which was lower compared to other aspects because the language contained on the website was less understood, the appearance aspect was scored 4.220, and the benefits aspect was scored 4.224. Overall, all aspects of the website are in the feasible category with a score of 4.20. These initial results show that conceptually the development of this system has succeeded in satisfying students after going through Black-Box testing, and a coherent validation process (Chatwattana, 2017). Although all aspects of the website are in the feasible category, respondents commented on the appearance of the website which was considered less attractive, the website navigation was not yet user friendly, and the emergence of bugs that disrupted website operations so that technical improvements needed to be made.

Conclusion

The development of the Teacher Tools Assistance System Website platform follows the ADDIE model which is carried out through several stages including the analysis stage which produces curriculum information, namely the curriculum used is the independent curriculum and learning design through the learning objective flow. In addition to curriculum analysis, an analysis of the learning environment is carried out which produces information, namely by implementing Physics learning using the project based learning model, there are often problems with communication with students and the use of inefficient learning platforms so that a platform is needed that can support better communication and learning management.

At the design stage, a prototype of the Teacher Tools Assistance System (T-TAS) website was produced with integrated specifications of the project based learning model, can operate on laptop/computer and smartphone devices and operate in different browser environments, user friendly, using PHP and JavaScript programming languages, and using MYSQL which handles the database. The prototype was validated by media experts with a score of 4.44 which was categorized as very feasible. Meanwhile, validation by material experts 1 and 2 gave scores of 4.50 and 4.47 respectively with a very feasible category. In addition, the response from users to the Teacher Tools Assistance System (T-TAS) website was given a score of 4.20 in the feasible category. However, there are still improvements that need to be made including the appearance of the website, website navigation which is not yet user friendly, and the emergence of bugs.

Author Contributions

The researcher Conceptualization, Wawan Kurniawan.; methodology, Febri Berthalita Pujaningsih.; software, Abdussalam Aswin Hadist; validation, Wawan Kurniawan., Febri Berthalita Pujaningsih. and Cicyn Riantoni.; formal analysis; investigation, Wawan Kurniawan. All authors have been read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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