

## DEVELOPMENT OF WEBSITE-BASED LEARNING MEDIA ON MEDIA ELEMENTS AND TELECOMMUNICATION NETWORKS AT SMK NEGERI 1 PAINAN

Ferju Prihamdani<sup>1</sup>, Thomson Mary<sup>2</sup>, Rini Novita<sup>3</sup>

Pendidikan Informatika  
Universitas PGRI Sumatera Barat  
ferjuprihamdani@gmail.com<sup>1</sup>, thomsonmary1980@gmail.com<sup>2</sup>, rininovita165@gmail.com<sup>3</sup>

### Abstract

This study aims to develop a website-based learning media for the Basic Computer and Telecommunication Network Engineering subject, particularly the Media and Telecommunication Networks topic for Grade X TJKT students at SMK Negeri 1 Painan. The research was motivated by limited practical facilities and the lack of interactive learning media, which resulted in low student learning outcomes. This study employed the SDLC iterative model consisting of requirements analysis, design, development, testing, and implementation. Data were collected through expert validation sheets and practicality questionnaires for teachers and students. The developed media integrates visual materials, instructional videos, and interactive quizzes to support independent learning. Validation results indicate that the media achieved a software quality evaluation score of 88.19%, while practicality scores reached 95.48% from teachers and 86.75% from students, categorized as highly practical. These findings demonstrate that the proposed web-based learning media is feasible and effective in supporting the teaching and learning process in vocational education, particularly in improving students' understanding of abstract networking concepts.

Keywords: Learning Media, Website, TJKT, Interactive, SDLC Iterative

### Abstrak

Penelitian ini bertujuan untuk mengembangkan media pembelajaran berbasis website pada mata pelajaran Dasar-Dasar Teknik Komputer dan Jaringan, khususnya materi Media dan Jaringan Telekomunikasi untuk siswa kelas X TJKT di SMK Negeri 1 Painan. Penelitian ini dilatarbelakangi oleh keterbatasan fasilitas praktik dan kurangnya media pembelajaran interaktif yang berdampak pada rendahnya hasil belajar siswa. Penelitian ini menggunakan model iteratif SDLC yang terdiri dari analisis kebutuhan, perancangan, pengembangan, pengujian, dan implementasi. Data dikumpulkan melalui lembar validasi ahli serta angket kepraktisan untuk guru dan siswa. Media yang dikembangkan mengintegrasikan materi visual, video pembelajaran, dan kuis interaktif untuk mendukung pembelajaran mandiri. Hasil validasi menunjukkan bahwa media memperoleh skor validitas beta testing sebesar 88,19%, sedangkan skor kepraktisan mencapai 95,48% dari guru dan 86,75% dari siswa, yang dikategorikan sangat praktis. Temuan ini menunjukkan bahwa media pembelajaran berbasis web yang diusulkan layak dan efektif dalam mendukung proses pembelajaran di pendidikan vokasi, khususnya dalam meningkatkan pemahaman siswa terhadap konsep jaringan yang bersifat abstrak.

Kata kunci: media pembelajaran, website, TJKT, interaktif, SDLC iterative

### INTRODUCTION

The rapid advancement of Information and Communication Technology (ICT) has significantly transformed educational practices, particularly in vocational education (Sari, 2020). The integration of digital technology enables learning to become more interactive, flexible, and student-centered. In

vocational high schools, especially in the Computer and Telecommunication Network Engineering (TJKT) program, mastery of technology-based competencies is essential to prepare students for the demands of the digital industry (Rijal, 2020).

Basic Computer and Network Engineering is a foundational subject that plays a crucial role in helping students understand computer network

systems. However, its implementation in many vocational schools still faces several challenges. Limited practical facilities and the dominance of conventional learning media often hinder students from fully grasping abstract networking concepts. Learning media such as PowerPoint presentations and tutorial videos tend to function as one-way information delivery tools and have not optimally facilitated active student exploration (Rijal, 2020).

Empirical data from SMK Negeri 1 Painan indicate that student learning outcomes remain relatively low, with 65% of students failing to achieve the Minimum Learning Mastery Criteria (KKTP). This condition highlights the urgent need for more interactive and technology-enhanced learning media. The issue becomes increasingly relevant under the Merdeka Curriculum, which emphasizes deep learning, differentiation, and the effective integration of digital technology in instructional processes (Sari, 2020).

Previous studies have demonstrated that web-based learning media can improve student engagement and learning outcomes. (Pertiwi & Irfan, 2021) reported that web-based learning developed using the Instructional Development Institute (IDI) model significantly improved student mastery, with more than 86% of learners achieving the expected competency level. Similarly, (Rijal, 2020) found that web platforms integrating learning materials, videos, and online assessments enhanced students' learning flexibility and independence. In addition, the increasing internet penetration in Indonesia, reaching 77.02% of the population, further supports the feasibility of implementing web-based learning environments (Rahayu & Sri, 2023).

Despite these promising findings, most previous studies primarily focused on content delivery and basic interactivity. Limited research has integrated rich visual simulations, such as 3D visualization, specifically designed for telecommunication network materials in vocational education contexts. Furthermore, prior works have rarely addressed the specific learning constraints faced by TJKT students in schools with limited laboratory facilities.

Therefore, a clear research gap exists in developing web-based learning media that not only provides structured content and online assessment but also incorporates interactive visual features to concretize abstract networking concepts. This study aims to develop and evaluate an interactive web-based learning media for telecommunication media and network topics in the TJKT program at SMK Negeri 1 Painan. The main contribution of this

study lies in the integration of quizzes, multimedia learning resources, and 3D visualizations within a context-specific web platform to enhance student engagement and learning outcomes in vocational education.

## METHODS

### Research Design

This study employed a Research and Development (R&D) approach using the System Development Life Cycle (SDLC) iterative model, which includes requirements analysis, design, development, testing, and implementation (Hasanah, 2020).

### Subject

The subjects of this study consisted of one subject teacher, 21 Grade X TJKT students of SMK Negeri 1 Painan, and two expert validators (media expert and material expert).

## RESEARCH METHODS

This research was conducted at SMK Negeri 1 Painan. The type of research used in this study was Research and Development (R&D), which aimed to produce website-based learning media and test its validity and practicality (Pertiwi & Irfan, 2021). The development model used was the iterative Software Development Life Cycle (SDLC) model, which consists of four stages: requirements, design and development, testing, and implementation (Samudra & Maharani, 2023).

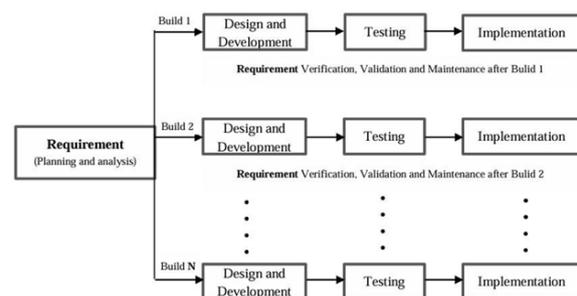


Figure 1. Iterative SDLC Model

### Requirement (Planning and analysis)

This stage is the earliest stage in system development. At this stage, system requirements are planned and analyzed.

### Planning

The planning stage aims to identify user needs for web-based learning media. The results of

the identification show that the website must have key features such as interactive material (in the form of text, video, and animation) to facilitate student understanding, practice questions as a means of reinforcing material, and interactive quizzes for direct learning evaluation.

### Needs Analysis

The learning system currently implemented at SMK Negeri 1 Painan still relies on conventional methods, such as the use of PowerPoint, video tutorials, and Google Classroom.

The system to be developed involves three main types of users, namely administrators, teachers, and students, each of whom has different access rights. Administrators play a role in managing user accounts, both teachers and students, as well as monitoring system activities through a dashboard.

The main processes in this new system are divided into three categories: learning, evaluation, and collaboration. In the learning process, teachers upload multimedia-based materials that students can access at any time. Students learn independently using interactive features such as quizzes and 3D images. In the evaluation stage, students complete assignments and quizzes online, and the system provides automatic assessments. These assessment results can be viewed immediately by both students and teachers on their respective dashboards.

The work procedures in the system are tailored to the roles of each user. Admins log in, then manage user accounts (add, edit, or delete), and monitor system activity through the dashboard. Teachers log in, upload materials and assignments, monitor student results, and provide feedback through forums or grade notes. Meanwhile, students log in to access materials, complete assignments, view grades, and take quizzes.

### System Requirements Analysis

The system must provide user management features with role-based authentication (admin, teacher, student). In addition, the system needs to support various formats of learning materials such as text, video, and animation. Evaluation is carried out through interactive quizzes that are automatically assessed by the system. Finally, a dashboard must be available to display real-time learning outcome reports for teachers and students.

In terms of hardware, a server with sufficient capacity is needed to handle many users

simultaneously, as well as user devices such as PCs, laptops, or smartphones with a stable internet connection. For software, the system is built using Laravel. From a security perspective, sensitive data such as passwords and grades must be encrypted, and the system needs to be protected from attacks such as SQL injection and CSRF (Ery Hartati, 2022).

### Design and Development

This diagram shows the flow of interaction between users and the system according to the functions and roles of each actor in the system usage process.

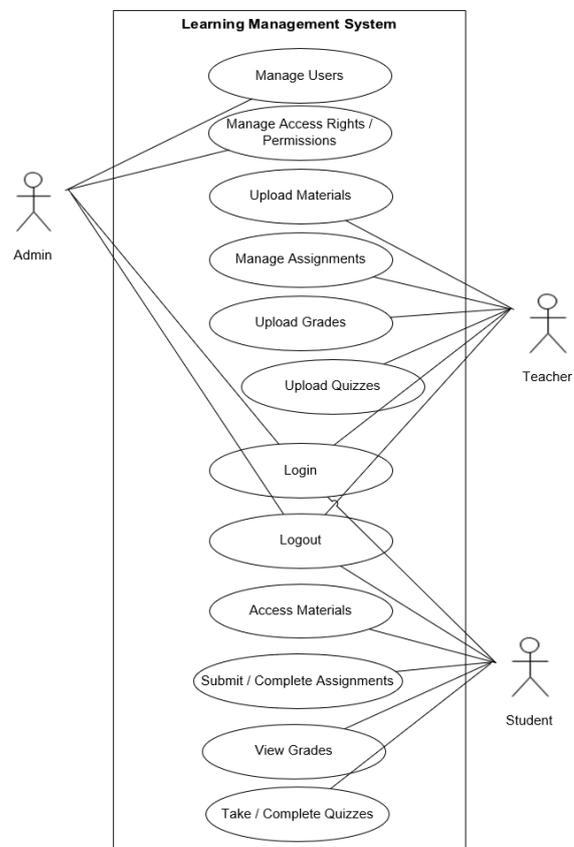


Figure 2. Use Case Diagram

The use case diagram in Figure 2 illustrates the interaction between three main actors, namely administrator, teacher, and student, with the web-based learning system. Each actor has different access rights and system functions.

### Testing

System testing is carried out to ensure that the built system runs well and as expected. The main focus of this evaluation includes user-friendliness and the effectiveness of the system in

achieving the objectives set at the beginning of the design. If errors are found, either in the early or final stages of development, then comprehensive repairs or adjustments to the system are necessary (Karisma Putri & Hasanah, 2021).

The system testing process consists of two types, alpha testing and beta testing, each of which plays an important role in assessing the quality and readiness of the system before it is fully implemented.

### Alpha Testing

The alpha testing stage aims to validate the system using whitebox and blackbox methods. Whitebox testing checks the program's logic flow and internal code structure, while blackbox testing evaluates the system's functions from the user's perspective. In addition, validation is carried out by system experts to assess technical aspects and interface appearance.

### White-Box Testing

White-box testing was conducted by directly examining the internal structure of the program code, including its logical flow and control structure, in order to detect potential errors or weaknesses in the application implementation (Rafli et al., 2024). This technique allows developers to verify whether the program logic operates as intended at the code level.

According to (Sie et al., 2022), white-box testing encompasses several analytical procedures. In this study, the testing process involved: (1) identifying the program logic flow using flowcharts and determining the basis path as the reference for testing; (2) calculating program complexity using the Cyclomatic Complexity method to measure the number of independent execution paths; and (3) constructing test cases based on the identified logical paths to ensure that all possible execution flows function correctly.

Table 1. Cyclomatic Complexity

N	Module /Page	Edge (e)	Node (n)	C = e - n + 2	Independent Paths	Complexity Level
1	Login Page	4	4	2	2 paths	Low

2	Add User Page	12	11	3	3 paths	Moderate
3	Material Page (Teacher)	8	8	2	2 paths	Low
4	Assignment Page	9	9	2	2 paths	Low
5	Score Page	6	6	2	2 paths	Low
6	Quiz Page	8	8	2	2 paths	Low

Based on the cyclomatic complexity analysis, most modules have a complexity value of 2, which indicates low complexity and simple control flow. The Add User module has a complexity value of 3, categorized as moderate but still within manageable testing limits. These results indicate that the developed system has good logical structure and is relatively easy to test and maintain.

Through this approach, the internal consistency and structural quality of the developed system can be systematically evaluated.

Table 2. White-box Testing

N	Aspect Tested	Description	Expected Result	Result (Valid)
1	Condition Path (if/else)	Examination of all logical branches.	All condition paths are tested and produce the correct output.	√
2	Condition Path (if/else)	Examination of all logical branches.	All condition paths are tested and produce the correct output.	√

3	Input Validation	Testing all possible input possibilities.	The system provides an appropriate response for all inputs.	√
4	Function/Method Output	Checking the results of each function/method.	All functions return output according to specifications.	√
5	Error Handling	Testing handling of invalid inputs/errors.	Errors are handled properly without crashing.	√
6	Extreme Paths	Checking for empty, large, or unusual inputs.	The system remains stable and the output is consistent.	√
7	Module Integration	Checking interactions between modules.	Data between modules is well-integrated.	√
8	Application Performance	Testing under heavy load.	The system remains responsive and stable.	√

### Black-Box Testing

Black-box testing was applied to validate the functional performance of the system by examining the relationship between input and output without analyzing the internal code structure. This method aims to ensure that the software operates in accordance with the predefined functional specifications (Kartiko, 2020).

In this study, black-box testing focused on verifying major system functions, including user interaction, navigation, content access, and quiz operations. The testing results were used to confirm that each feature of the web-based learning media performed correctly from the end-user perspective.

Table 3. Black box testing

Page	Description	Expected Result	Result (Valid)
Landing Page	Displays initial information and navigation buttons.	The landing page appears with functioning text and buttons.	√
Login Page	Form for users to log in to the system.	Login is successful when email and password are valid.	√
Admin Dashboard	Main page for admins to manage users and data.	Admin can access and manage user data.	√
Teacher Dashboard	Main page for teachers to manage materials and assignments.	Teachers can upload materials and manage assignments.	√
Student Dashboard	Main page for students to access materials and assignments.	Students can view materials, assignments, and grades.	√
Upload Material Page (Teacher)	Form for teachers to upload learning materials.	Materials are successfully uploaded and stored in the system.	√

Materi al List Page (Student)	Displays the list of available materials for students.	Materials can be viewed and read by students.	√
Logout Page	Feature to log out from the system account.	After logging out, the user is redirected to the login page.	√

### Beta Testing

Beta testing aims to test the practicality of the learning media that has been created. Beta testing is carried out by involving potential end users of the website (Sahi, 2020). At this stage, users are asked to try out the website and provide direct feedback or input to the development team for evaluation and system improvement (Susanto et al., 2020).

This beta testing was conducted with the involvement of experts to assess the suitability of the system. The main focus of this stage was to review the quality of the developed website, the extent to which it was able to meet user expectations, and to evaluate the feasibility of the system based on predetermined assessment criteria (Masripah & Ramayanti, 2020).

Beta evaluation of the system is carried out using a questionnaire instrument based on the ISO/IEC 9126 standard, which is designed to measure software quality systematically and objectively. The evaluation refers to six main characteristics in the ISO/IEC 9126 standard, namely: functionality, reliability, usability, efficiency, maintainability, and portability (Jamil et al., 2021). The assessment was carried out by two lecturers from the Informatics Education Study Program, PGRI University of West Sumatra, who acted as expert validators.

Beta testing also included end-user participation to assess the system's suitability for functional and non-functional requirements. The main objectives were to evaluate the quality of the developed software, the extent to which the system was able to meet user expectations, and to assess its suitability based on predetermined criteria (Hidayatillah et al., 2022).

Beta testing aims to assess the practicality of the learning media developed, involving teachers and students as the main users in the context of field implementation (Aditya & Purwiantono,

2020). This evaluation is intended to determine the extent to which the media can be effectively applied in the learning process and to obtain direct feedback from teachers as facilitators and students as end users.

### Content Validity

Content validity is the extent to which an instrument, media, or learning material comprehensively covers the content or competencies that should be taught or measured in accordance with the curriculum or learning objectives (Adelina et al., 2022). Content validity testing was conducted by two lecturers from PGRI University of West Sumatra and one teacher from SMKN 1 Painan. This testing aimed to assess the validity level of the developed learning media.

### Implementation

The implementation stage is the phase of applying website-based learning media after the design, development, and testing processes have been completed, using the Laravel, MySQL, and Bootstrap frameworks (Dirgantara & Andrian, 2023).

The research subjects consisted of two expert validators who evaluated the validity of the content and appearance of the media, two lecturers and one teacher as content expert validators, one productive TJKT teacher who tested the practicality from the teacher's perspective, and 21 students from class X TJKT 1 who were selected using purposive sampling to test the practicality from the end-user's perspective.

In analyzing quantitative data, statistical analysis was used, which involved calculating the validity and practicality questionnaire scores using a Likert scale (1-4).

Table 4. Beta testing validation results

Symbol	Statement	Score
SS	Very Good	4
S	Good	3
KS	Fair	2
TS	Poor	1

Note:

- SS = Very Good
- S = Good
- KS = Fair
- TS = Poor

The results of the analysis are used as guidelines in revising website-based learning

media instruments or products. The formula used to calculate media validity is as follows:

$$\text{Validity Score} = \frac{\text{Total Obtained Score}}{\text{Maximum Score}} \times 100\%$$

Based on the percentage obtained, the assessment categories used to calculate the percentage can be seen in the following table:

Table 5. Validity Assessment Criteria

Answer Evaluation (%)	Weight
75 < V ≤ 100	Highly Valid
50 < V ≤ 75	Valid
25 < V ≤ 50	Less Valid
0 ≤ V ≤ 25	Invalid

Then, the criteria for the results of the practicality test are categorized in the following table:

Table 6. Practicality Assessment

Answer Assessment (%)	Weight
75 < P ≤ 100	Very Practical
50 < P ≤ 75	Practical
25 < P ≤ 50	Less Practical
0 ≤ P ≤ 25	Not Practical

## RESULTS AND DISCUSSION

### Research Results

Research results should be presented in the form of images, graphs, or tables accompanied by explanations. The website-based learning media developed in this study is called NetPedia, which is intended to support the learning of the subject Fundamentals of TJKT in the element "Media and Telecommunications Networks" in grade X of vocational high school. The development process was carried out through the Iterative SDLC stages, which consist of the requirements, design and development, testing, and implementation stages.

### Analysis and Planning Results (Requirements)

At this stage, the researchers conducted observations, interviews, and documentation collection to obtain preliminary information about

the learning conditions at SMK Negeri 1 Painan, particularly in the 10th grade TJKT class.

The results obtained included: 1) The observation results showed that the learning media used in schools were still conventional, such as PowerPoint and video tutorials, which were not very interactive, so that students had difficulty understanding abstract concepts such as network systems. 2) The results of interviews with teachers revealed that the available media were not able to facilitate students' learning needs optimally, especially in terms of flexibility and independent access to materials. 3) Documentation in the form of CP/TP and daily test scores showed that only 35% of students achieved the Learning Objective Achievement Criteria (KKTP), meaning that most students did not understand the material well. The user needs analysis identified that the media must be able to provide features such as multimedia-based material access, practice questions and quizzes, 3D images, and real-time student learning reports.

### Analysis and Planning Results (Requirements)

The interface design displays the main pages in the system, such as the main menu, material, assignments, scores, and quizzes.

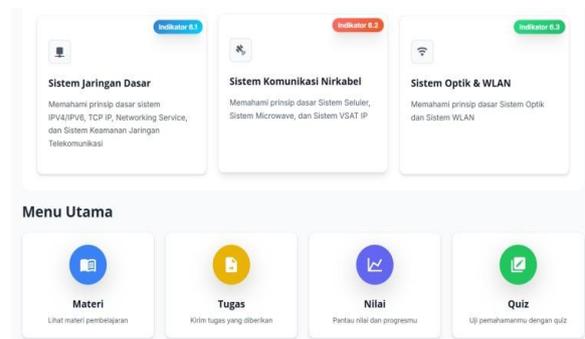


Figure 3. Main Menu

Figure 3 shows an application or learning website interface. The top section shows three "Indicators" (6.1, 6.2, and 6.3), each representing learning materials such as "Basic Network Systems," "Wireless Communication Systems," and "Optical & WLAN Systems," complete with brief descriptions of the materials. The bottom section is the "Main Menu" with four options: "Materials," "Assignments," "Grades," and "Quizzes," each with an icon and a brief description of its function.



Figure 4. Materials Page

Figure 4 displays the "Learning Outcomes" detailing the topics to be studied. There are three modules: the first one on "Basic Principles of TCP/IP" is already open, while the next two modules are locked and require completion of the previous quiz with a minimum score of 80 to be accessed.



Figure 7. Quiz Page

Figure 7 shows the "Interactive Quiz Collection" page, which invites users to hone their skills. It shows that there is 1 quiz available with unlimited learning opportunities ( $\infty$ ). At the bottom, some details of the quiz for the topic "TCP/IP" are visible.

### Testing Results

Testing was conducted to ensure that the developed media functions as designed and is suitable for user use.

### Beta Testing Validation Results

Beta testing validation aims to obtain input from experts regarding the feasibility of website-based learning media developed using the Laravel framework (Permatasari & Ekohariadi, 2023). The testing was conducted by two lecturers as validators, using an assessment questionnaire as an instrument. The following are the beta validation results, which can be seen in the following table:

Table 7. Beta testing validation results

No	Research Aspect	(%)	Category
1	Functionality	87	Very Good
2	Reliability	91.66	Very Good
3	Usability	87.5	Very Good
4	Efficiency	83.3	Very Good
5	Maintainability	91.66	Very Good
6	Portability	87.5	Very Good
	Average	88.19	Very Good

Table 7 proves that beta testing conducted by experts on website-based learning media in the Media and Telecommunications Network element for grade X TJKT at SMK Negeri 1 Painan showed very positive results. Based on the evaluation results, this media obtained an average percentage of 88.19%, which is categorized as "Very Good." This means that this media is considered very

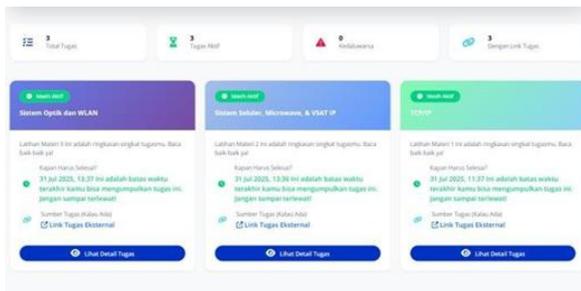


Figure 5. Assignment Page

Figure 5 displays a summary of the tasks that students must complete. Each task has a submission deadline.

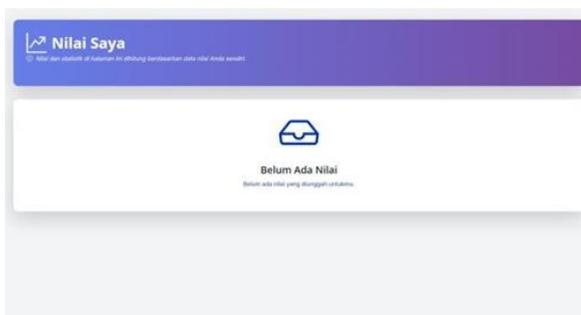


Figure 6. Grades Page

Figure 6 shows the "My Grades" page, which is used to view the user's grades and statistics. Currently, the page displays the message "No Grades Yet" because no grades have been uploaded for the user.

suitable and of high quality for use in the learning process.

### Teacher Practicality Validation Results

Practicality was conducted by teachers of the Fundamentals of Network and Computer Engineering subject for class X TJKT with the aim of determining whether website-based learning media could be used practically in learning. The research results can be seen in the following table:

Table 8. Results of Teacher Practicality Validation

No	Research Aspect	Validator		Average	Category
		V1	V2		
1	Attractiveness Appearance and presentation	93.75	87.5	90.62	Very Practical
2	Ease of use	91.66	100	96.83	Very Practical
3	Content quality	100	100	100	Very Practical
Average				95.48	Very Practical

Based on the results of the analysis and calculations evaluated by the teacher of the subject Fundamentals of Computer Networking and Telecommunications, an average of 95.48% was obtained, categorized as "Very Practical" and suitable for use as a website-based learning medium for the media and telecommunications network elements in the 10th grade TJKT class.

### Student Practicality Validation Results

Testing the practicality of website-based learning media requires input from users, namely students, in the form of suggestions. Data was obtained after students used website-based learning media through student questionnaires. The following table shows the results of student practicality:

Table 9. Student Practicality Validation Results

No	Research Aspect	Percentage	Category
1	Appeal of appearance and presentation	91.36	Very Practical

2	Ease of use	84.2	Very Practical
3	Content quality	85.71	Very Practical
4	Time	85.7	Very Practical
Average		86.75	Very Practical

Based on the results of the percentage analysis assessed by students in class X TJKT 1 on media and telecommunications network elements, they obtained a score of 86.75% with the category "Very Practical" and are suitable for use as website-based learning media on media and telecommunications network elements.

### Content Validation Results

Content validation was conducted to assess the suitability of the content of the website-based learning media with the learning objectives and teaching materials. This process involved 2 lecturers and 1 subject teacher as validators. The assessment was carried out through a questionnaire containing indicators related to the Achievement of Learning Objectives and Curriculum Suitability.

Table 10. Content Validation Results

No	Research Aspect	Validator			Average	Category
		V1	V2	V3		
1	Achievement learning objectives	100	93.75	93.75	95.83	Highly Valid
2	Curriculum alignment	100	87.5	95.83	94.44	Highly Valid
Average					95.13	Highly Valid

Based on the results of the content analysis assessed by the validator, it was declared "Highly Valid" with a percentage of 95.13%, so the content validation results were declared suitable for use as a learning medium.

### Discussion

The website-based learning media that has been developed can assist students in the learning process. The software used in developing the

website-based learning media in this study is Visual Studio Code. The developed website is easy to use, thereby assisting in the learning process.

These findings are consistent with previous studies by (Pertiwi & Irfan, 2021), which reported that web-based learning media significantly improved student engagement. The high practicality scores in this study further confirm that integrating interactive multimedia and structured navigation can enhance usability in vocational learning environments.

### Beta Testing Validation

The average beta testing by experts on web-based learning media resulted in a rating of 88.19%, which is categorized as "Very Good". Therefore, it can be said that web-based learning media is suitable for use. Thus, this learning media can be used at SMK Negeri 1 Painan to assist in the learning process.

### Teacher Practicality Validation

Based on the results of the teacher practicality test on the website-based learning media, the questionnaire results in each aspect obtained an average of 95.48% in the "Very Practical" category. The data obtained shows that the learning media is very practical to use in the learning process.

### Student Practicality Validation

Based on the results of the practicality calculation of the website-based learning media conducted with a total of 21 students. The results of the student practicality questionnaire calculation obtained an average of 86.75% with the category "Very Practical" and suitable for use in learning.

### Content Validation

Based on the results of the feasibility test of website-based learning media content presented in the form of a questionnaire, the data obtained from the content validators was then analyzed using a Likert scale. The data obtained from the learning media content validators had an average of 95.13 % in the "Very Good" category and was deemed suitable for use as learning media.

## CONCLUSIONS AND SUGGESTIONS

### Conclusion

This study successfully developed a web-based learning media for telecommunication media and network materials in the TJKT program using the iterative SDLC model. The resulting system

provides interactive learning features, including structured materials, quizzes, and multimedia support to facilitate student learning.

The evaluation results demonstrate that the developed media is feasible and practical for implementation. Content expert validation yielded a score of 95.13%, indicating that the media is categorized as very good. The practicality test conducted by teachers obtained 95.48%, while student practicality testing reached 86.75%, both categorized as very practical. These findings confirm that the developed web-based learning media is appropriate, user-friendly, and effective in supporting the learning process.

Therefore, the proposed media can serve as an innovative learning alternative to enhance student engagement and understanding in Basic Computer and Network Engineering subjects, particularly in vocational education settings.

### Suggestion

For teachers, it is recommended to start integrating digital learning media like this into the teaching and learning process so that the delivery of technical material can be more easily understood by students.

For developers, it is recommended to develop additional features such as automatic evaluation and grade system integration to make the learning process more interactive and real-time.

For schools or educational institutions, it is recommended to provide support for the use of website-based media as part of a learning strategy in line with the implementation of the Merdeka Curriculum.

For further research, it is recommended that the scope of development be expanded to other materials in the TJKT subject, or applied to classes with different levels in order to assess the effectiveness of the media more comprehensively and sustainably.

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