Development of Web-Based Interactive Worksheets

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Abstract. Worksheets play an important role in supporting students' material understanding and skill development, however, conventional worksheets often have limitations in terms of collaboration, automatic evaluation, and immediate feedback. This research aims to develop a Web-based Interactive Worksheet through the 4D Model (Define, Design, Develop, Disseminate). The developed application has interactive features that allow students to understand the assessment criteria before doing the task and get an estimated value after completing it, the color marking feature can also make it easier to monitor individual contributions in collaboration and an effective assessment system, the results of the application trial in a large group showed an average score of 4.60 with a good category. The application of this research is expected to continue to be developed based on user feedback and adopted more widely in the context of education.

Keywords: Worksheets, Interactive, Web-based.

1 Introduction

Worksheets are one of the learning tools that play an important role in helping students understand the material in depth. The use of worksheets can support the development of cognitive skills, such as critical thinking, problem solving, and analysis, as well as strengthen understanding and mastery of new skills.[1]. In addition, worksheets also serve as a formative assessment tool, allowing lecturers to assess students' level of understanding and provide constructive feedback. Worksheets can improve students' organizational and time management skills, while facilitating collaboration between students.[2]. However, worksheets in the form of printed or static documents are often ineffective in attracting student interest. Conventional worksheets have limitations, especially in terms of collaboration, automatic evaluation, and providing immediate feedback. To overcome these challenges, innovation is needed through the development of worksheet applications that can accommodate modern learning needs.[3], increases interaction, and provides faster and more accurate feedback.

The development of this application is expected to provide a more interactive solution [4], adaptive, and flexible [5] for students, allowing accessibility anytime and anywhere. The app is designed to support effective collaboration [6], provides faster evaluation [7], and provide

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constructive feedback [8]. With the immediate feedback feature, students can quickly identify errors and concepts that have not been well understood. Faster evaluation also benefits lecturers, saving them time in the assessment process, allowing them to focus more on other aspects of teaching. The app supports greater collaboration and discussion and allows lecturers to monitor student activity, provide additional feedback, and provide more targeted guidance. In addition, the worksheet application allows for more structured material management. All worksheets and student work can be stored in one digital platform, allowing easy access to previous materials, evaluation of learning progress, and preparation for exams. With structured management, students do not have to worry about losing important notes or assignments, which often happens in manual systems. Overall, the development of worksheet applications not only provides practical solutions to improve learning efficiency, but also provides long-term benefits in improving the quality of student understanding, encouraging more effective self-learning, and creating an educational ecosystem that is more adaptive to technological developments.

2 Method

This study adopted the 4D development model (Define, Design, Develop, Disseminate) to design and develop a worksheet application aimed at university students. This model provides a systematic framework consisting of four main stages. In the first stage, Define, front-end analysis, learner analysis, task analysis, concept analysis, and instructional goal specification are conducted. This stage aims to understand user needs and clearly define the purpose of the application. The second stage, Design, involved drafting worksheets and assessments, media selection, format selection, as well as the initial design of the app. At this stage, the design of the app is defined and prepared for further development. The third stage, Develop, includes evaluation by experts, development testing, and validation testing. This process ensures the app meets the set quality standards and functions according to the expected objectives. Finally, in the fourth stage, Disseminate, the app is disseminated for use by the target audience, ensuring that the app can be accessed and utilized effectively. Through this systematic approach, the research aims to produce an effective and adaptive worksheet application for university students.

3 Result

The results of this study regarding the development of worksheets are described in detail as follows:

3.1 Define

This stage began with a front-end analysis, which identified that the current use of worksheets was done manually. In this system, lecturers provide worksheet files to students who then complete the task according to the format provided. This method is quite effective in providing students with a clear overview of the assignment. However, the main drawback of this method is the time it takes for the lecturer to grade the assignment, which results in students not receiving immediate feedback. In addition, lecturers have to manually recap the

grades, increasing the possibility of data input errors. Experience has also shown that there is a backlog of assignments to be checked, as well as a need for improvement in the quality of students' assignments and their engagement in group work. Furthermore, analysis of the students showed that they understood the task format and had good experience in using the learning application. However, some students still showed low collaboration skills, as seen from their low level of engagement in peer assessment. An analysis was also conducted on the assignments in the current curriculum, which include various types of assignments in accordance with KKNI (Indonesian National Qualification Framework), such as routine assignments, critical book reports, critical journal reviews, mini-research, projects, and idea engineering. Student assignments are also adjusted to the Outcome-Based Education (OBE) curriculum, so that the form of assignments is more contextual and relevant to educational needs. Based on this analysis, the developed application aims to increase the effectiveness of assignment assessment by lecturers, provide quick and accurate feedback to students, and improve supervision and collaboration in group assignments. The app will also be equipped with clear grading criteria, provide an overview of assignment quality expectations, and reinforce contextual assignment forms that are relevant to the existing curriculum.

3.2 Design

The design stage begins with determining the form of worksheets to be used, namely individual and group worksheets. Both types of worksheets are equipped with clear assessment criteria and can be observed by students, so that they can understand the expectations and standards expected. The medium chosen for the worksheet development was a web-based application. This choice is based on its ability to support the features expected in the previous stage. Web-based applications offer easy accessibility for students through various devices such as smartphones, tablets, and laptops, and allow integration with existing learning technologies in educational institutions. The interface design of the app was created with a focus on clarity of navigation, logical layout, and reduction of the user's cognitive load. This ensures that students can use the app easily and efficiently. In addition, the application is equipped with a structured user access system, including login, registration, and role-based access rights features. These features are designed to be accessed through various web browsers, supporting user needs in a flexible and secure manner.

One of the main features of this application is the ability to work on worksheets interactively. Through this feature, students can clearly understand the expected grading criteria before starting to work on the worksheet. Upon completion of the assignment, students can also get an estimate of the grade they will earn, allowing them to evaluate their work in real time. This feature not only increases the transparency of assessment but also supports a more purposeful and informative learning process. Another feature in this application is a special color marking system on group assignments done by students. This feature is designed to illustrate the activeness and contribution of each group member in completing the task, making it easier to monitor and evaluate the involvement of each individual. Lecturers can directly assess assignments done by students in the application and without having to first download student assignment files and extract a list of student grades to be inputted in the final grade list.

3.3 Develop

This stage includes the testing and refinement process. Product trials are carried out to obtain feedback and evaluation from experts and students, so that improvements can be made before the product is ready for dissemination. the following are the results of the assessment from the experts

Table 1. Expert Trial Assessment

No	Aspects to be assessed	Expert Assessment Score			Average	Description
		1	2	3		
1	User Interface	4,27	4,45	4,36	4,36	Good
2	User Experience	4,45	4,36	4,55	4,45	Good
	Total	8,72	8,81	8,91		
	Average	4,360	4,405	4,455		

Overall, the app scored well in both aspects evaluated, with an average score of 4.36 for User Interface and 4.45 for User Experience, respectively. These results indicate that the app has been successfully designed with an attractive interface and provides a satisfactory user experience. However, in order to improve the overall quality of the app, it is important to look at feedback from students as users, this step will ensure that the app not only meets expert standards but also fits the needs and expectations of users. Next, a large group test was conducted and the following are the results

Table 2. Large Group Product Test Results

Aspect	Desription	Score	Mean
Functions and Features	Applications respond to commands and process data	624	4,66
	Application loads pages quickly	621	4,63
	Application performance is consistent	611	4,56
	Application to fulfill expected goals and needs	631	4,71
	Features that are offered minimize user needs	611	4,56
	Features in an integrated application that are really helpful	625	4,66
User Interface and Experience	Applications that respond to user interactions	610	4,55
	The ease of using the application	622	4,64
	The visual design of every page and feature	604	4,51
	The application provides intuitive support	623	4,65
	Readibility text in the application	617	4,60
	Visual design application that is comprehensive	626	4,67
	The application's response to the user's input	619	4,62
	Applications that are responsive and adjust to the size of the screen	610	4,55
	The elements of the application interface	620	4,63
	The application's design aligns with the user's context and goal	605	4,51

Effectiveness and Efficiency	The application provides users with feedback	628	4,69
	Applications function well in a variety of platforms	604	4,51
	Applications compatible with a variety of operating systems	627	4,68
	Applications help you increase your work productivity	623	4,65
	Applications facilitate or expedite your task completion	617	4,6
	Features of the application to help you achieve your goals	611	4,56
	An easy-to-use application to help you with your tasks	600	4,48
	The application does not crash or have any bugs	611	4,56
	Applications operate efficiently when using RAM and CPU	614	4,58
	Mean		4,60
	Category		Good

The score indicates that the app provides sufficient and relevant functions and features for a large group of users. The features in the app are effective and support user activities well, although there are still opportunities for further additions or improvements. In addition, the interface of the app is well designed, making user interaction easy. The intuitive design contributes to the effectiveness of the app, which not only fulfills the set objectives but also operates stably.

3.4 Dissemination

Dissemination of the results of the application development is carried out through specially designed training for students and lecturers, with the aim of ensuring that users can utilize the application effectively. The training includes a thorough explanation of the features and functions of the app, as well as how to integrate it in the learning process. After the training, users will be encouraged to implement the app in their learning activities.

4 Discussion

Previous research shows that improving students' collaboration skills can be done through worksheet applications. [9][10], In this study, the special color marking of group tasks in the worksheet is an effective feature in visualizing individual contributions in the collaborative process, with this feature, both lecturers and students can easily see the activeness and contribution of each group member, The use of technology in the form of e-worksheets also contributes to the utilization of digital tools that are increasingly important in the modern educational context. The integration of these technologies not only improves learning efficiency but also prepares students for relevant skills in the professional world, therefore, web-based e-worksheet applications play a crucial role in advancing the quality of education by offering more adaptive and integrated solutions. The use of web-based worksheets improves the quality of self-learning, more systematic assessment, increased access to information through the internet, learning autonomy and technology utilization.[11][12], Overall, web-based e-worksheet applications play an important role in advancing the quality of education, they not only meet current educational needs but also prepare students for future

challenges and demands. The integration of innovative features in e-worksheets has the potential to improve learning outcomes, enhance collaboration skills, and facilitate a more efficient and effective learning process.

5 Conclusion

This study successfully developed a web-based interactive worksheet application using the 4D development method (Define, Design, Develop, Disseminate). The results of the application trial in the large group showed an average score of 4.60 which was included in the good category. This score reflects that the application has met the expected standards. Future research is expected to identify areas that require improvement and expand the application to meet various user needs. In addition, it is hoped that this application can be adopted more widely and make a significant contribution to the efficiency and quality of web-based learning.

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