Tarbawi: Jurnal Ilmu Pendidikan
p-ISSN:1858-1080|e-ISSN: 2615-6547
Vol. 18, No. 1, June 2022, 1-11

The Development of Website-Based Worksheets on Flat 3D Shapes Topic

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Abstract. *The development of website-based worksheets represents an innovation to enhance the quality of education during the Covid-19 pandemic. The aim of this study is to outline the process of creating and assessing the feasibility of website-based worksheets on the topic of flat 3D shapes. The ADDIE model, consisting of five phases: analysis, design, development, implementation, and evaluation, was used in this research. The instruments utilized included media and content validation questionnaires, teacher and student response questionnaires, and tests. The findings indicate that the website-based worksheets on flat 3D shapes fulfilled the criteria for validity, practicality, and effectiveness. The average validity index of the website-based worksheets was in the valid category, while the average of teacher and student responses to the worksheets was in the practical category. Furthermore, based on the average student learning outcomes, the website-based worksheets were found to be effective. As such, these worksheets can be adapted for use with other materials by adjusting the design and content to suit the needs and characteristics of students, leading to more effective and efficient learning.*

Keywords*: ADDIE model, Flat 3D Shapes, Website-Based Worksheets*

INTRODUCTION

In this modern era, the rapid development of technology and information has had a significant impact on education, both positive and negative, thereby driving the evolution of learning and the improvement of students' understanding abilities. Education in the 21st century is no longer just about boosting cognitive skills, but also focuses on developing a range of competencies such as communication, collaboration, and critical thinking. Moreover, students require easy-to-use learning resources and media that help them grasp concepts more effectively (Rachmawati et al., 2020; Hulwani et al., 2021). This has been confirmed by research which shows that learning outcomes can be enhanced through a variety of components, including teaching materials (Wiguna et al., 2022). However, in reality, these materials are often not utilized to their full potential.

Many levels of education in Indonesia still teach mathematics in a traditional, rote manner, with an emphasis on computational procedures rather than conceptual understanding (Yuni et al., 2021). The presentation of mathematical concepts and theories is not effective without the use of appropriate materials, media, and learning resources. Appropriate teaching materials can foster a conducive learning environment that can stimulate students' minds and enhance their learning experience (Koparan, 2017). Moreover, these materials are critical components in facilitating students' learning and can simplify the teaching process for teachers, transforming their role from instructor to facilitator. By using the right teaching materials, teachers can streamline their time and make the learning process more effective and engaging.

Teaching resources can support student-led learning and serve as a tool for evaluating the skills they have acquired. These resources can take the form of written or unwritten materials, such as textbooks, modules, handouts, worksheets, models, audio materials, and other interactive teaching aids (Lawe & Dopo, 2019; Murod et al., 2021). These materials are organized and utilized in the learning process, outlining the competencies that students are expected to master.

The 21st century learning landscape requires the integration of technology into education (Purnawati et al., 2020; Permanasari, 2016; Daggol, 2017; Chania et al., 2020; Aulia et al., 2022; Septia et al., 2021). The rapid advancements in technology in the field of education pose a challenge for teachers to incorporate technology into their teaching methods. In response to the demands and expectations of 21st century learning and the 2013 curriculum, teachers must develop digital-based teaching materials that are easily accessible, anywhere and anytime (Ramadhani & Fitri, 2020; Ikhlas, 2021). The aim is to extend the learning process beyond the classroom and make it accessible at all times. The outbreak of the Covid-19 pandemic has forced the shift from traditional face-to-face learning to online learning, causing a major disruption in the education industry, especially in Indonesia (Santoso, 2020). To make online learning effective, instructors must deliver their material in an innovative and engaging manner (Elisa et al., 2021).

According to various studies (Allsop & Jesse, 2015; Murati & Ceka, 2017), teachers understand the impact of technology on education and believe that incorporating technology in the classroom has a positive effect on the learning of mathematics (Hubers et al., 2020). However, some challenges such as technical difficulties, unreliable internet connection, limited access to electricity, budget constraints, curriculum limitations, and shortage of human resources hinder the integration of technology in the learning process. Moreover, teachers don't always maximize the use of technology in teaching and find it difficult to combine subject matter and technology (Purnawati et al., 2020).

To address these challenges, researchers are working towards developing innovative teaching technologies that align with the demands of 21st century learning and the 2013 curriculum (Hariyati & Rachmadyanti, 2022). One such example is the use of student worksheets that utilize technology, as they can support autonomous learning and be used to assess students' competencies (Riza et al., 2022). Website-based student worksheets, which are delivered electronically through a website using a Quiz Management System (QMS) application, offer several advantages, such as quick access to information, unlimited space, and the ability to combine various media forms (Febrina et al., 2020). Studies have shown that the use of math software can improve students' mathematical understanding abilities better than traditional learning methods (Septian & Monariska, 2021). This highlights the crucial role of learning media in enhancing students' skills (Maskur et al., 2020).

The development of website-based student worksheets has been the focus of research by several scholars. For instance, Khikmiyah (2021) found that using Liveworksheet for student worksheets allows students to work on their assignments online and directly submit them to their teacher. Liveworksheet is easy to access and use, and its teaching materials are available without any validity period. Additionally, Liveworksheet provides tutorials on how to use the platform, making it suitable for beginners who are creating teaching materials. Several studies have indicated that the use of Liveworksheets can enhance students' motivation to learn, improve their ability to comprehend concepts, and foster abstract thinking (Fitriani et al., 2021; Indriani et al., 2021; Suharsono & Handayani, 2021).

However, most of the previously developed student worksheets relied on Liveworksheets. In contrast, the current study developed website-based and geogebra-based student worksheets teaching materials that were integrated into a single website page, specifically for the topic of flat 3D shapes. This website is highly convenient as it allows students to access the materials from anywhere. Therefore, the objective of this study is to describe the process of creating and evaluating the viability of website-based worksheets for teaching flat 3D shapes.

METHOD

The purpose of this study is to develop website-based worksheets that can be used to teach the topic of Flat 3D Shapes. To accomplish this, the ADDIE model development research method (Branch, 2009) was utilized, as it is renowned for providing a clear and comprehensible process for product development (Rusdi, 2020). The ADDIE model offers a comprehensive and methodical approach to creating website-based worksheets. It ensures that all the aspects of development are taken into account and that the final product is evaluated for its effectiveness. By employing the ADDIE model, the probability of success in creating website-based worksheets is increased, and the final product is tailored to meet the needs of both students and teachers. The ADDIE model consists of five stages, which are analysis, design, development, implementation, and evaluation. The ADDIE development stages utilized in this study are illustrated in Figure 1.

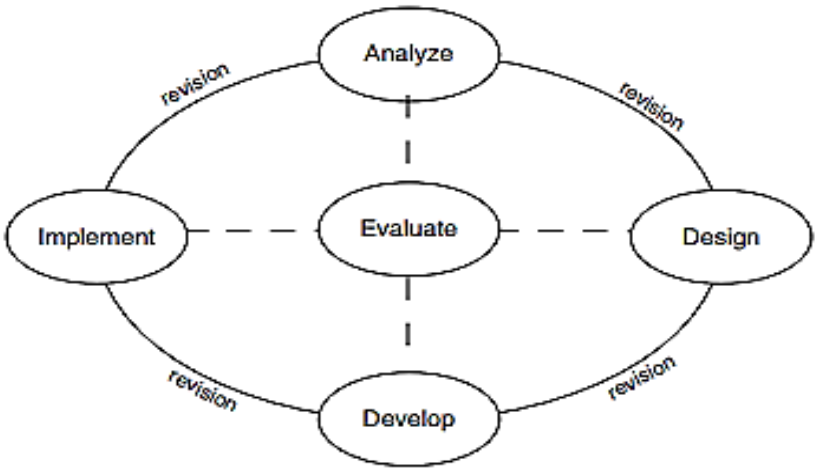

Figure 1. ADDIE Development Stages

In the analysis stage, the researcher conducted an assessment of the urgency, feasibility, and requirements for developing website-based worksheets to teach the topic of flat 3D shapes. The needs analysis involved evaluating student characteristics, background, and conditions, subject matter, and relevant sources to serve as a foundation for developing website-based worksheets. During the design stage, the researcher developed a plan for creating website-based worksheets, starting with a framework for building the website-based worksheets. This conceptual framework was used as a reference during the preparation of the website-based worksheets. In the development stage, the researcher created website-based worksheets based on the framework developed in the previous stage. In the implementation stage, the eligibility of the website-based worksheets that had been created was validated and tested. The trial was conducted with 18 students. In the final stage, the researcher analyzed the results of the trial to determine the

effectiveness of the website-based worksheets on students' understanding of building flat 3D shapes.

The researcher used a questionnaire and an interview to gather data from students about their perceptions and experiences with the website-based worksheets and how they impacted their understanding of the concept of building flat 3D shapes. Based on the evaluation results, the researcher can modify or improve the website-based worksheets to ensure their effectiveness in helping students learn about building flat 3D shapes.

The study employed both non-test and test instrument data collection techniques. The non-test instruments included validation sheets from construct experts, content experts, media experts, validation sheets from teacher answer questionnaires, and validation sheets from student responses. The test instrument was in the form of test questions given after the implementation was complete. Data analysis was conducted to determine the viability of the redesigned website-based worksheets, and the results were utilized as input for improving learning resources. Techniques for analyzing data from analyses of product feasibility data, product usability data, and product effectiveness data were used. Table 1 shows the criteria for the level of product validity according to Azwar (2013).

Table 1. The Criteria for the Level of Product Validity

V-Index Range	Category
$V \geq 0.667$	Valid
$V < 0.667$	Invalid

In addition to the validity assessment, a practicality assessment was also conducted in this study. According to Purwanto (2010), practicality assessment is used to evaluate the ease of use, flexibility, and efficiency of the learning resources. This assessment was carried out to ensure that the website-based worksheets are easy to use for both students and teachers, and that they can be integrated into the learning process without any difficulties. The practicality assessment criteria used in this study can be seen in Table 2.

Table 2. Practicality Assessment Criteria

Value	Category
86%-100%	Very Practical
76%-85%	Practical
60%-75%	Pretty Practical
55%-59%	Less Practical
≤54%	Impractical

FINDINGS

The results of the study show that the website-based student worksheet developed in this study has been deemed valid, practical and effective based on the results of the feasibility test, usability test, and effectiveness test. These findings support the claim that using the ADDIE model in the development of website-based student worksheets can result in a high-quality product. The systematic approach of the ADDIE model, with its focus on detailed stages and techniques, has proven to be a valuable tool in ensuring the quality of the final product. Overall, this study highlights the potential of website-based student worksheets in improving students' learning outcomes and motivation, and highlights the importance of using systematic models like the ADDIE model in the development of such resources.

Analysis Stage

The analysis stage of developing website-based worksheets for teaching the topic of flat 3D shapes consisted of two steps: needs analysis and product analysis. The needs analysis involved gathering data about students' learning needs through observation and analyzing the curriculum. The analysis found that students needed innovative teaching materials that were flexible and based on core competencies and indicators of goal attainment (Putra & Syarifuddin, 2018).

The product analysis step involved identifying website-based student worksheet products by modifying various aspects such as the learning environment, goals, objectives, content, and delivery methodologies. The analysis revealed that the flat 3D shapes topic was crucial for students to study as it was widely used in solving problems in everyday life. Moreover, the step of determining the learning environment was critical as most students had access to devices like laptops and smartphones with internet connections, and learning was currently done online. Hence, the researchers chose to use a website as a way for students to access the worksheets.

Finally, the identification of the product helped modify the research objectives to develop website-based worksheets that cater to the needs of students and teachers. The flat 3D shapes topic was selected as a vital component to help students understand other complex materials, and the website was chosen as a delivery method due to its accessibility and availability. These findings provide insights into the development of effective teaching materials that cater to the needs of students in the digital age.

Design Stage

At the design stage, the researchers developed a plan for the teaching materials based on the needs analysis, taking into consideration the core competencies and indicators of competency achievement. They selected the format for the student worksheets, outlined the contents, designed the cover and the worksheet content. They also designed the appearance of the website and the structure of the content that would be included on it. The flowchart of the website-based student worksheets is shown in Figure 2.

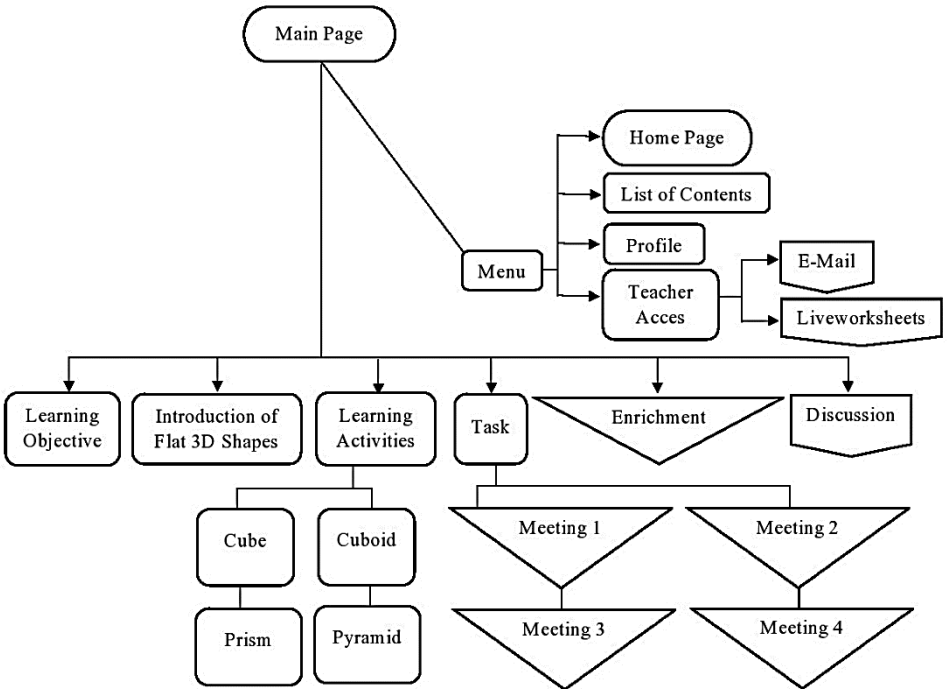

Figure 2. Website-Based Worksheets Flowchart

Development Stage

The development process comprises of two stages. The initial stage, which is referred to as actualizing the product, involves finding and collecting relevant sources to expand the content (Putra et al., 2018). This stage also includes creating necessary graphics, charts, and graphs, revising, typing, and organizing the layout of the student worksheets before digitizing it for the web. The development process commences with making the cover of the student worksheets, opening and closing the student worksheets, creating the web content, which includes practice questions with answers, and inserting the student worksheets into the web content. All these activities must be consistent with the design developed in the previous stage to ensure that the product is ready for testing. The subsequent development stage includes activities aimed at validating the updated product development draft after expert input.

The second stage of development is the validation stage, which is conducted by subject matter experts and media specialists. This stage involves seeking evaluations and feedback from experts who are knowledgeable in the field (Sugiyono, 2018). The development of educational products must prioritize the validation process to ensure the best quality products (Risnawati et al., 2019). The purpose of this stage is to assess the validity of the developed student worksheets, including aspects such as instructional design, content, language, and appearance. Worksheets validation results for all aspects are presented in Table 3.

Table 3. Website-Based Worksheets Validation Results

No.	Statement	Validity Index	Category
1.	Didactic or Presentation	0,88	Valid
2.	Material or Content	0,90	Valid
3.	Language or Legality	0,90	Valid
4.	Graphics or Display	0,89	Valid
Average Validity Index		0,89	**Valid**

The results of the validation conducted by the validators show that the average validity index for the didactic or presentation aspect was 0.88, which falls into the "valid" category. The average validity index for the material or content aspect was 0.90, which also falls into the "valid" category. The average validity index for the language or linguistic aspect was 0.89, which falls into the "valid" category, and the average validity index for the graphical or display aspect was 0.88, which falls into the "valid" category as well.

Based on the results of the validation, it can be concluded that the website-based student worksheets have a high level of validity, with an average score of 0.89 in the didactic, material, language, and graphic aspects. This indicates that the student worksheets are suitable and practical for use. The experts' assessments and students' feedback have provided valuable insights for further improvement of the product.

The evaluation process also involves a one-on-one trial, where the language clarity and student understanding of the worksheets are tested. Feedback and suggestions from students are gathered and used to improve the worksheets. A small group trial was also carried out, involving 9 students from a junior high school in Kerinci with varying abilities.

Implementation Stage

In order to evaluate the effectiveness and usefulness of the product, the development findings are being implemented in the classroom through small-group implementation to collect feedback from

students. This feedback will be used to enhance future product drafts. The practicality of learning devices is measured by the convenience of using the product for both teachers and students. To determine the feasibility of website-based Student Worksheets on the topic of flat 3D shapes in mathematics, product trials were conducted. Questionnaires were given to teachers and students who used the product to obtain their feedback on its practical value. The analysis of the teacher and student response questionnaires is presented in Table 5.

Table 5. Results of Teacher and Student Questionnaire Analysis

No.	Statement	Teacher Response			Student Response		
		Score	%	Category	Score	%	Category
1.	Ease of Use	4,5	90%	Very Practical	4,34	87%	Very Practical
2.	Time Efficiency	4	80%	Practical	4,11	82%	Practical
3.	Worksheets Equivalence	4,67	93%	Very Practical	4,46	89%	Very Practical
Overall Average		4,39	88%	Very Practical	4,30	86%	Very Practical

The results of the analysis of the teacher's response questionnaire showed a practicality percentage of 88%. The results of the analysis of the student response questionnaires showed a practicality percentage of 86%. These percentage values fall within the range of 86% to 100%. This means that the website-based student worksheets are highly practical and easy to use in the learning process.

Evaluation Stage

At the product evaluation stage, the tested and revised products are applied in the learning process with the participation of eight-grade students of a junior high school in Kerinci for four meetings plus one test meeting. The effectiveness test consists of six essay questions. Based on the results of the analysis of the student learning outcomes test responses, 83% of the answers were complete. These percentage values fall within the range of 76% to 85%. This suggests that the website-based student worksheets are effective and have a positive impact on the learning process. The website-based student worksheets help improve students' completeness in learning

DISCUSSION

This development research resulted in the creation of a teaching material in the form of a website-based student worksheet on the topic of flat 3D shapes. The design of the student worksheet draft that was developed complies with the structure for creating student worksheets and is integrated with the website. To ensure the quality of the student worksheet, validity, practicality, and effectiveness tests were conducted.

Based on the validation results by the validator, the website-based worksheet on flat 3D shape topic is declared valid after fulfilling four aspects, namely didactic, content, presentation, and language aspects. Therefore, it can be concluded that the website-based student worksheet is valid and can be used in the learning process. This is because the student worksheet was designed with the aim of improving the abilities of the students by providing them with accurate, interesting, and easy-to-understand content that is presented in a consistent format and interactive manner. This aligns with the belief (Abadi et al., 2017) that the teaching material should be appropriate in order to motivate the students to learn and improve their abilities.

This result is consistent with the statement made by (Apsari & Rizki, 2018) that if the validation results obtained are more than 60%, the product meets the eligibility criteria and can be considered valid and ready for testing. The product can be considered valid if it is developed based on a strong theoretical foundation and there is internal consistency between the components of the product being developed (Rusdi, 2020).

While the website-based student worksheets are highly practical and easy to use in the learning process. This is because the use of website-based worksheets on three-dimensional (3D) shapes with flat surfaces makes it easier for teachers to conduct both face-to-face and online lessons. The advantages of these website-based student worksheets include clear pictures, which make the learning process more communicative and easier to understand, as well as easy access to the materials from anywhere. As confirmed by Mamelo (2019), the practicality of teaching materials is crucial for the successful conduct of the learning process. The practicality of a product is determined by both teachers and students who consider the product's attractive design, ease of use under normal conditions, and the quality of its content (Betyka et al., 2019).

The website-based student worksheets are also effective and have a positive impact on the learning process. The website-based student worksheets help improve students' completeness in learning (Dwijayanti & Savitri, 2022). The level of effectiveness is used to describe both the student experience and their learning outcomes (Nuryadi & Khuzaini, 2017). The effectiveness of learning devices is related to the effect or impact of the devices on student learning. In this case, the level of effectiveness of these student worksheets is determined based on the scores obtained from the student learning outcomes test questions.

This research findings is in line with the idea that the learning process should allow students to transfer and apply what they have learned to solve problems (Permata et al., 2018). An appealing student worksheet design can also stimulate students' curiosity and motivate them to engage with the learning materials on their own (Maskar & Dewi, 2020; Riza et al., 2022; Fitriani et al., 2021). The use of teaching materials can increase the effectiveness of learning and improve the quality of learning, particularly in the 2013 curriculum (Gazali, 2016).

CONCLUSION

The website-based worksheets developed have proven to be highly suitable for teaching flat 3D shapes topic. The validation process resulted in an average score of 0.89, indicating a valid category, which is an important aspect of ensuring high-quality educational products. Moreover, the implementation of these worksheets led to an average student learning outcome of 84.88, with a completion proportion of 83%, indicating the effectiveness of the product. Furthermore, this teaching material meets development standards and can be utilized by teachers and students to effectively transfer mathematical concepts in the classroom. These worksheets can also be adapted for use with other materials by adjusting the design and content to suit the needs and characteristics of students, leading to more effective and efficient learning.

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