

Development of Web-based Differentiated Learning Media on Statistics Materials to Train Critical Thinking Skills at SMKN 1 Kraksaan

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Abstract: This study aims to develop website-based differentiated learning media as a means of supporting mathematics learning, especially on statistics material for Vocational High School (SMK) level students. This learning media is designed to suit the various learning styles of students-visual, auditory, and kinesthetic-and to improve critical thinking skills through the integration of information technology and digital media in the learning process. The method used follows the development model (ADDIE) which includes the stages of analysis, design, development, implementation and evaluation, by integrating various types of media, such as ebooks, learning videos, and educational games. The results showed that the media developed averaged 91% expert test and 92.25% peer test, this means that the teaching materials are feasible to be applied to learning activities and are able to provide varied learning experiences and in accordance with the learning characteristics of students, thus having a positive impact on their motivation and critical thinking skills.

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Introduction

Advances in information and communication technology have driven a significant transformation in the field of education, especially through the presence of various media and digital-based learning systems. This change not only affects teaching methods, but also has an impact on values, norms, and order in the education process. Although today's learners are accustomed to using the internet for entertainment and information seeking, the optimal utilization of technology in the context of learning is still relatively low. In fact, technology-based learning media has great potential in facilitating the teaching and learning process and supporting the development of 21st century skills, such as critical thinking.

This condition becomes very important in learning mathematics, especially in statistics, which requires a learning approach that is in accordance with the diversity of student learning styles. Therefore, the development of differentiated learning media is seen as a strategic solution to overcome learning boredom and increase the utilization of technology in education more effectively and adaptively.

Some previous research results show that the development of digital-based learning media has proven effective in improving the quality of learning. Research by Setiawan (2020) produced educational game media "Waterpedia" which is effective in increasing the responsibility of elementary school students, with expert validation showing a "very good" category. Oktriani (2023) developed Flipaclip-based "Poly Game" media for math learning, which was proven to improve students' problem solving skills with a high gain index. Putra et al. (2020) developed an e-learning website based on responsive web design which is very valid to support Geography learning in high school. Meanwhile, Maemunah et al. (2023) developed website-based Indonesian learning media for transitive and intransitive sentences with a validation level of 100%, showing its effectiveness in improving learning efficiency. These findings support the importance of digital media innovation in creating learning that is adaptive, interesting, and suits the needs of students.

The development of website-based differentiated learning media that is integrated with various types of learning media provides learners with the option to learn according to their learning styles which are categorized into visual, auditory, and kinesthetic learning styles. This media not only provides variations in learning resources, but also in the learning process and the form of products or learning outcomes that can be adjusted to the preferences of each learner.

With a fun and adaptive approach to individual learning characteristics, students tend to feel more comfortable during the learning process, making it easier to develop critical thinking skills and understand the material more effectively.

Research Method

This study aims to develop website-based differentiated learning media on class X vocational statistics material. The development model used is ADDIE (Analysis, Design, Development, Implementation, and Evaluation), this model was chosen because it has structured stages that make it easier for researchers to understand each step in the development and can accommodate the dynamics of education which is influenced by the development of information technology. This research was conducted because the conditions in the field students generally still learn uniformly following the teacher's instructions, so they do not get enough space to develop critical thinking skills optimally. This phenomenon was also identified at SMKN 1 Kraksaan, as the research location.

The analysis stage begins with the identification of needs, including the collection of learning materials, selection of supporting applications, and technical equipment required for media development. Next, the website design and installation process is carried out, followed by the input of teaching materials into the system. The learning media developed is designed to be flexible and integrated with various learning resources and evaluation tools that are already available, making it possible to be further developed according to the needs of students and technological developments. In the implementation stage, the media will go through a validity test process by material and media experts to ensure the feasibility and effectiveness of its use in the learning process. The evaluation stage is carried out to gather constructive feedback, which will be used as the basis for further development of innovative and adaptive differentiated learning media in the future. The development of website-based differentiated learning media in this research is based on the need for learning innovations that can accommodate technological developments and the diversity of student learning styles.

The development process follows the ADDIE model which consists of five main stages. In the analysis stage, identification of needs and analysis of the characteristics of students in class X RPL 1 SMKN 1 Kraksaan were carried out, with a focus on the variety of learning styles (visual, auditory, and kinesthetic) as the basis for media design. The design stage involves the preparation of statistics material into thematic modules, as well as the integration of various types of content (text, video, audio, images, and simulations) to support differentiation in learning content, processes, and products. At the development stage, the design is realized in the form of digital media based on the Google Sites platform, with a responsive interface, user-friendly navigation, and integration of interactive and evaluative elements. Furthermore, at the implement stage, the media is tested directly in learning activities, with teacher assistance in its use and formative monitoring of the student learning process.

The test subjects in this study were 30 students of class X of the Software Engineering Department at SMKN 1 Kraksaan. The selection of this class is based on the relevance of statistics material to the curriculum of the department. All students are involved because they have diverse characteristics and learning styles, at this stage students are given a learning style test to find out their learning style type so that the web-based differentiated learning media developed is expected to be able to meet individual needs and improve the learning experience optimally.

There is an initial test (pretest) conducted to see the initial ability of students who are expected to have a relationship with their critical thinking skills, besides that the researcher also analyzes the needs of students for teaching materials developed to determine the needs of students to overcome the learning problems experienced today.

Based on the analysis above, the researcher then designs the learning media to be developed by considering several things such as the learning objectives to be achieved based on the applicable curriculum in class X SMK (Merdeka Curriculum) on Statistics material, then designs the features of differentiated website media tailored to various visual, auditory and kinesthetic learning styles. The content or features of learning media in the form of web-based modules, interactive applications, or learning videos are designed to be responsive and easy to access, and are equipped with elements that can increase active student participation, such as interactive quizzes, simulations, and case studies. In addition, the learning media is designed to contain content and activities that stimulate critical thinking skills through the presentation of reflective questions, problem solving, situation analysis, and concept comparison, so as to encourage students to not only memorize, but also understand, evaluate, and apply knowledge more deeply.

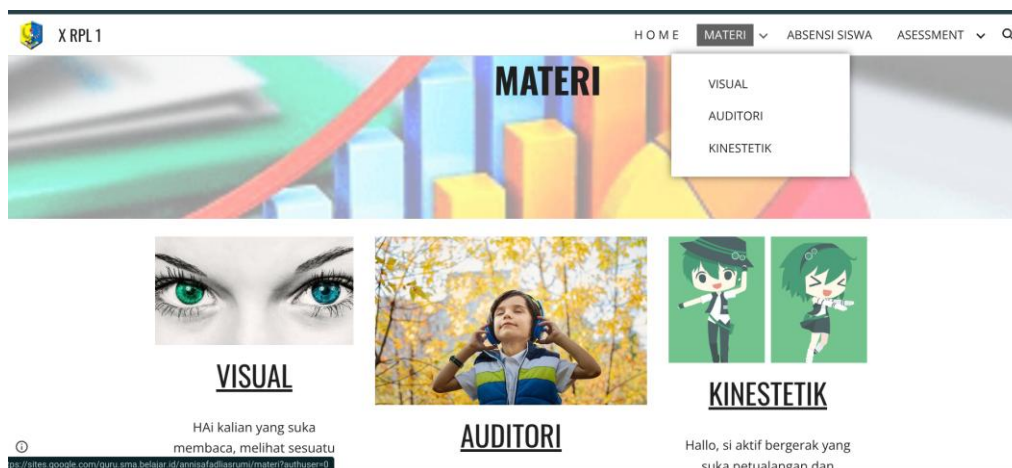


Figure 1. Display on the material menu

After the prototype is formed, the next stage is the validity test. The results of the validators in this development include material expert validators testing material validation by considering the following: material accuracy, depth, presentation, differentiation and relevance to critical thinking skills. design experts who test suitability for learning objectives, learning strategies, learning content and activities, differentiation, assessment and motivation and student involvement. Design experts Learning media experts conduct assessment/validation covering the following matters: website design, use of multimedia, interactivity and accessibility.

Result

This research was conducted with the main objective to develop a website-based learning media that supports the differentiation approach, especially in learning statistics material, and evaluate user responses to the media. The development process refers to the ADDIE model which consists of five stages, namely analysis, design, development, implementation, and evaluation. At the analysis stage, a series of systematic steps were carried out including analyzing learning needs, material coverage, suitability for the curriculum, characteristics of students, sources of teaching materials, and the flow of media development. Data was obtained through interviews with subject teachers and distributing questionnaires to students of class X RPL 1 at SMKN 1 Kraksaan. The findings show that the available teaching materials are not fully aligned with the needs of students and their learning styles, especially in encouraging critical thinking skills and visual presentation. The pre-test results indicated that students' understanding of statistics concepts was still low, with only a small proportion able to achieve the learning indicators optimally. Although students showed interest in mathematics and considered the textbooks adequate, they considered the conventional learning media did not support their individual learning styles. A total of 96.5% of students expressed the need for the use of web-based digital teaching materials, and almost all respondents agreed if such media were implemented. This finding shows that there is a great opportunity to utilize digital technology in order to increase the effectiveness of learning that is adaptive and responsive to the needs of students.

To create comfortable and effective learning, a survey of students' learning styles was conducted to recognize their individual preferences, whether visual, auditory, kinesthetic, or mixed. Based on the diagnostic test results of 30 students in class X RPL 1, it is known that

40% of students have a visual learning style, 26.67% auditory, and 33.3% kinesthetic. This information becomes an important basis in designing varied learning media, such as the use of videos, infographics, audio narratives, and interactive activities, to suit students' learning needs.

The results of the validation of teaching materials development show that the website-based teaching materials are considered suitable for use without revision by the three experts involved. Validation by material experts obtained the highest score of 97%, with a note that the media is very suitable for differentiated learning because it has been arranged based on student learning styles. Validation by the design expert scored 88%, with a suggestion to collaborate with the software engineering department to improve the design quality. Meanwhile, validation from media experts scored 87.5%, with suggestions to fix some typos.

After going through the development stage, the website-based learning media is then ready to be implemented as a learning media, starting with a readability trial to a peer teacher, namely Mrs. Rizkiyatusnaini as a mathematics teacher to see its feasibility and obtained a validation result of 97%, which means that the criteria category has been met. Thus the score indicates that the development of teaching materials is feasible to use in learning without revision. The next step is to test the readability of learning media to students with small groups that have been carried out on 5 students, obtained an average assessment score of 4.52 and a percentage of 90.2% with a very good category. Then the readability trial of learning media for a large group that has been carried out on 1 class with 30 students obtained an average score of 4.54 and a percentage of 90.8% with a very good category. So it can be concluded that the website-based differentiated learning media designed is feasible to be implemented in the learning process.

As well as the results of the posttest of students after they use website-based differentiated learning media get a value with the average Gain Score results obtained is 0.6 with a moderate category so it can be concluded that this website-based differentiated learning media can increase understanding which can be said that students have better critical thinking skills than before.

Conclusion

This study aims to develop a website-based differentiated learning media on statistics material and examine user responses to the resulting media. Based on the research and development process carried out in class X RPL SMKN 1 Kraksaan, an innovative and adaptive learning media has been successfully designed and produced to the needs of students. This media is designed not only to deliver material interactively, but also to support the differentiation approach in learning, so as to accommodate various learning styles of students. The trial results showed that the learning media received positive responses, both from educators and students. This media is considered effective in increasing interest and motivation to learn mathematics and encouraging students' critical thinking skills. In addition, website-based development is considered very relevant to the demands of digitizing education today, making this media a viable alternative to be applied in modern learning processes that are oriented towards optimal use of technology.

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