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Digital Differentiated Learning: A Web-Based Educational Innovation for Pacitan

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ABSTRACT
Technology has the potential to improve the quality and effectiveness of education, especially in remote areas. In Pacitan Regency, East Java, the challenges include limited educational resources and a lack of teaching methods capable of accommodating the diverse needs of students. This gap may impact educational quality, particularly for students with varying levels of understanding and interest. This study aims to design and develop the DGDL (Digital Differentiated Learning) to support differentiated learning in primary and junior high schools in Pacitan. The research employed a development research method, following a systematic approach to designing, developing, and evaluating the DGDL application. The process involved requirement analysis, system design, implementation using PHP, and iterative testing. The development process involved collaboration with the Pacitan Regency Education Office and several local primary and junior high schools. The application was tested through a series of trials involving representative teachers from these schools. Feedback from 17 respondents showed an average score of 4.43 on a scale of 1 to 5, this application was evaluated based on four key aspects: functionality, usability, security, and system performance indicating a high level of appreciation for the application's benefits. This application had proven to be an innovative and relevant solution to address educational challenges in Pacitan, particularly in promoting equitable understanding and enhancing learning quality for all students. Furthermore, future development is expected to adapt the application to various dynamic field conditions and improve its effectiveness in other remote areas.

INTRODUCTION

Advancements in information and communication technology (ICT) have significantly impacted various sectors, including education (Hikmahwan, et al., 2023a). Today, technology serves not only as a teaching aid but also as an innovative solution to address the challenges faced by educational

institutions, particularly in remote areas (Manalu et al., 2024; Putri & Jumardi, 2023; Fakhruddin et al., 2024). One region experiencing these challenges is the Pacitan Regency in East Java (Putra et al., 2024). These challenges include limited human resources, inadequate facilities, and teaching methods that fail to accommodate the diversity of students in terms of abilities, needs, and interests (Nashir et al., 2024; Susila & Aryasuari, 2023). This disparity results in unequal educational quality between students in this region and their urban counterparts with better access to educational resources (Arriany et al., 2020; Siddiqui et al., 2020).

Quality education should meet the individual needs of every student (Dewi et al., 2022; Kurniasandi et al., 2023; Nahdhiah & Suciptaningsih, 2024). One approach to addressing this diversity is differentiated learning, a method enabling teachers to adjust lesson content and delivery based on the student's abilities and needs (Sopianti, 2022; Wahyuningsari et al., 2022). However, implementing this method requires careful planning and adequate resources (Wulandari, 2022; Handayaningsih et al., 2024). In remote areas like Pacitan, applying differentiated learning becomes more challenging due to limited access to adequate teacher training, diverse teaching materials, and supporting technology (Famukhit, 2020).

Technology has advanced rapidly in the global sector in recent years (Hikmahwan et al., 2023b; Hikmahwan et al., 2024). In this context, the role of technology, particularly digital applications, becomes crucial. Technology-based educational applications can help teachers prepare materials, manage classrooms, and tailor lessons for different levels of student ability (Baharuddin et al., 2022; Gunawan et al., 2024). In developing countries, using technology in education has proven to bridge gaps between urban and rural areas and among students with different needs (Sinaga et al., 2024). By leveraging technology, teachers can more effectively implement differentiated learning methods while providing personalized support to students (Fahyuni et al., 2020; Ryan & Bowman, 2022).

This study focuses on developing the Digital Differentiated Learning (DGDL) application using the PHP programming language, designed to assist primary and junior high school teachers in Pacitan Regency in implementing differentiated learning. The urgency of this study lies in the pressing need for accessible teaching tools in remote areas like Pacitan. Given the limited available resources, PHP-based technology, which is relatively cost-effective and easy to implement, serves as a viable solution (Hidayat et al., 2022; Regitaningtyas et al., 2022). Furthermore, the results of this research are expected to make tangible contributions to the development of teaching methods in other regions facing similar challenges (Rachmawati & Widayani, 2022).

This research presents the development of the DGDL (Digital Differentiated Learning) application, created using PHP to support differentiated learning in primary and junior high schools in Pacitan Regency, East Java. Unlike previous studies, which often focus on general e-learning systems without specifically addressing the diverse needs of students in remote areas, this research introduces a tailored solution that emphasizes adaptability to individual student abilities, interests, and learning preferences. The DGDL application stands out for its innovative approach in enabling teachers to efficiently design and manage lesson materials while promoting equitable access to quality education. The collaboration with local educational institutions and the Pacitan Regency Education Office further strengthens the practical value and contextual relevance of the application.

METHOD

This section outlines the design framework implemented to develop the application. The process includes four main aspects: system architecture design, use case diagram design, entity relationship diagram (ERD) design, and website interface design.

System Architecture Design

The differentiated e-learning application is designed to meet the needs of educational institutions by

providing an integrated online learning platform. This system facilitates interaction between teachers and students, manages learning materials, and tracks learning progress as shown in Fig.1.

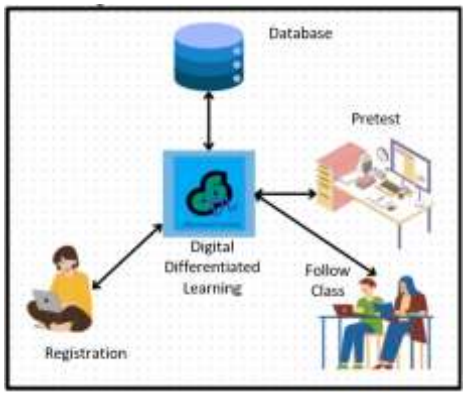

Fig. 1 *Application Flow Concept*

Use Case Diagram

The use case diagram in Fig. 2 visualizes general usage scenarios and helps identify the system's functional requirements more clearly. This diagram illustrates the primary user roles, such as students and teachers, along with the actions they can perform within the system.

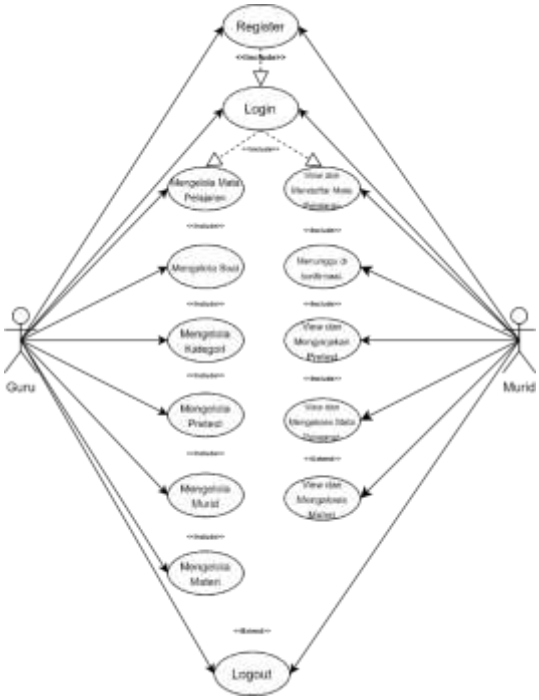

Fig. 2 *Use Case Diagram*

Entity Relationship Diagram (ERD)

The Entity Relationship Diagram (ERD) in Fig. 3 represents the data structure and relationships between entities in the developed system. This diagram helps visualize how data is organized and interacts within the system.

International Journal of Multi Discipline Science
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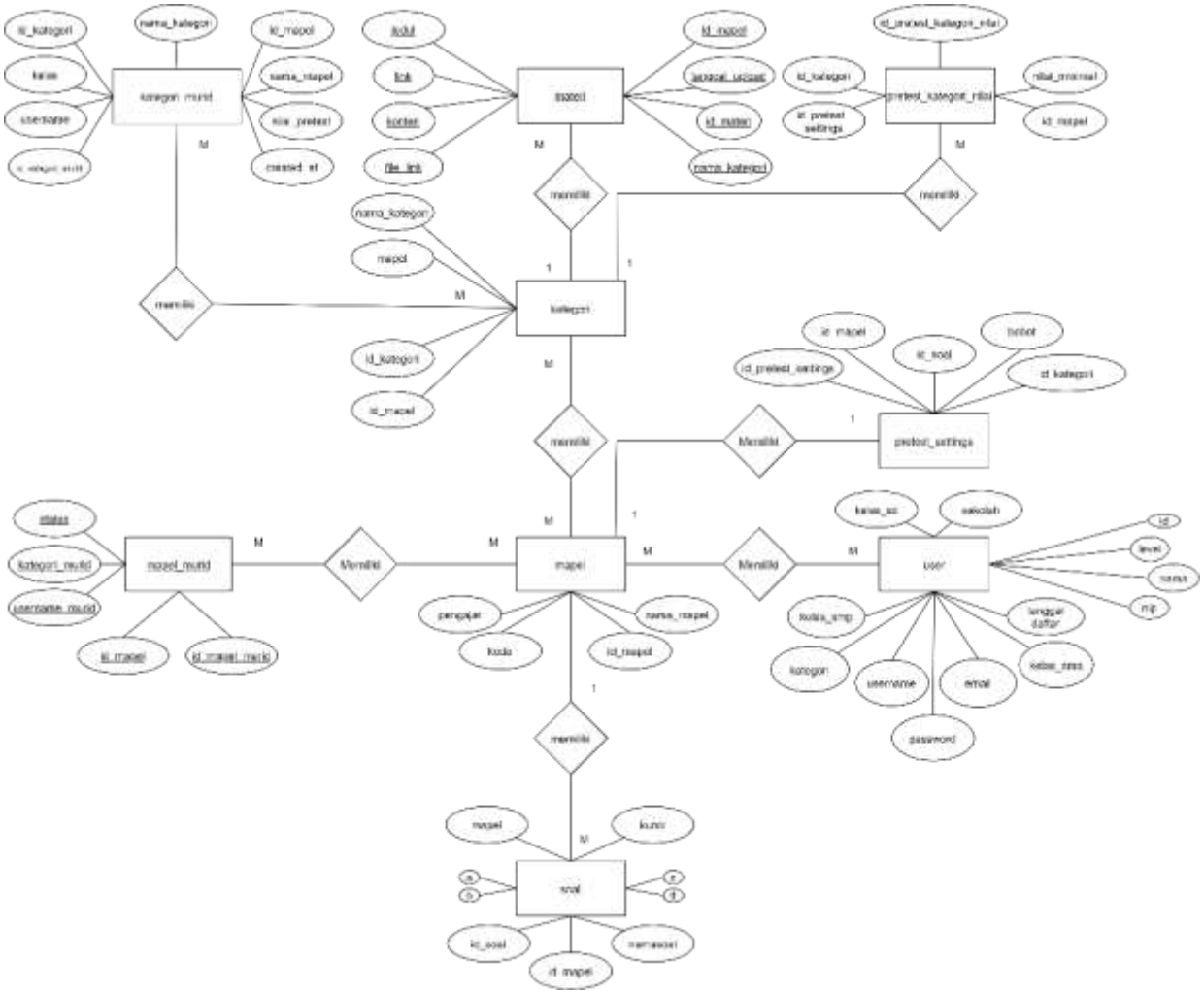

Fig. 3 *Entity Relation Diagram*

Website Interface Design

This section discusses the process of creating the DGDL (Differentiated General Digital Learning) website interface, following the previously designed stages. The website interface is developed using the PHP programming language to ensure a user-friendly and interactive design.

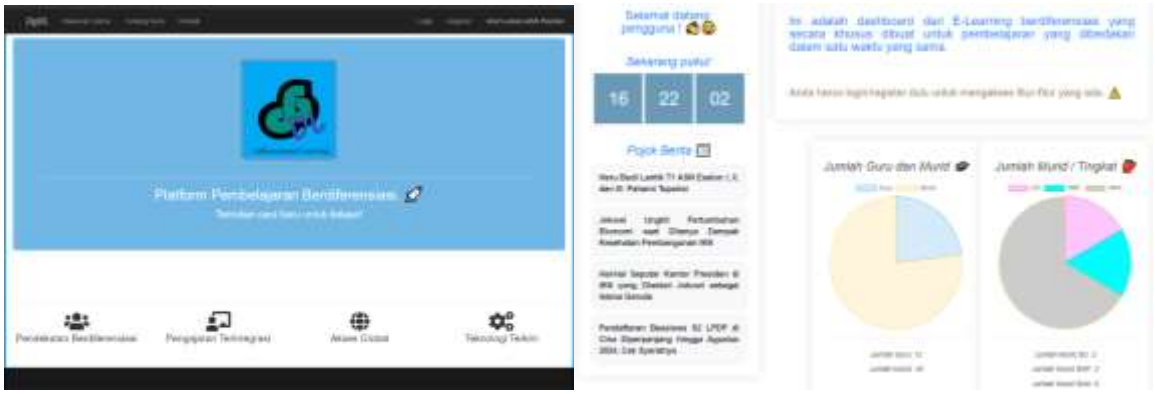

Fig. 4 *Website Interface Design*

PHP processes data on the server connects it to MySQL as the database, and displays the results through HTML. MySQL stores user data, such as login information or other dynamic content, which is

retrieved and processed by PHP. On the front end, HTML, CSS, and JavaScript are used to build an interactive and easy-to-navigate interface. The design is also responsive to ensure accessibility across various devices. Fig. 4 is an example of the DGDL website's homepage, which serves as a subject for functionality and user interface testing.

RESULTS AND DISCUSSION

This section discusses the testing results of the DGDL (Differentiated General Digital Learning) system's reliability, as developed in the previous stages. The testing aimed to ensure that the DGDL website functions effectively according to user requirements, particularly for implementing differentiated learning in elementary and middle schools.

Results

The testing process evaluated various aspects, including functionality, usability, security, and system performance. Functionality: Verify that the designed features operate smoothly and meet the initial specifications; Usability: Focused on how easy it is for teachers and students to navigate and access; Security: Ensure the system protects user data from potential external threats; System performance: How the system can handle the action of users. The results are presented as a report analyzing each tested aspect.

Table 1
Page Names on the Website and Their Uses

No.	Page Names	Uses	Aspects
1.	Dashboard	Display Brief Information about DGDL	Functionality
2.	Register	Register as a Student/Teacher	Security, System Performance
3.	Login	Go to the Home Page	Security, System Performance
4.	Daftar Mapel (Teacher)	Display the list of Subjects created (Teacher)	Usability, System Performance
5.	Profil Mapel (Teacher)	Manage a Subject (Teacher)	Usability, System Performance
6.	Atur Pretest (Teacher)	Manage Pretest Question Weights (Teacher)	Usability, System Performance
7.	Lihat Pretest (Teacher)	Review Pretest (Teacher)	Usability, System Performance
8.	Profil Kategori (Teacher)	Manage DGDL Categories and E-learning (Teacher)	Functionality, Usability
9.	Buat Soal (Teacher)	Add Pretest Questions (Teacher)	Usability, System Performance
10.	Buat Kategori Baru (Teacher)	Add DGDL Categories (Teacher)	Usability, System Performance
11.	Daftar Mapel (Student)	Display the list of Subjects available for students to join (Student)	Usability, System Performance
12.	Halaman Pretest (Student)	Display questions that students need to complete	Functionality, Usability, System Performance
13.	Tentang kami	Display Website Profile	Usability
14.	Profile	Display the Profile of the User who has successfully logged in	Functionality, Security

Table 1 lists the website pages designed for DGDL along with their detailed purposes. In DGDL, teacher and student users have distinct features. For instance, the feature to create DGDL categories is only available to teachers. This feature automatically groups students based on pretest results within teacher-defined score ranges.

International Journal of Multi Discipline Science
Vol. 8 No. 1 (February 2025)
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Fig. 5 *The Teacher After Making a Mapel*

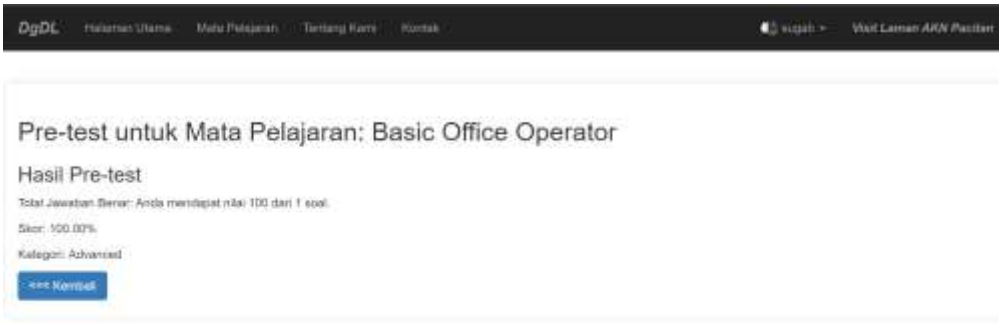

Fig. 6 *The Student Profile Page After Completing the Pretest*

As shown in Fig. 5 and Fig. 6 the system's functionality and usability were directly tested by users through a collaboration with the Pacitan Education Department. A socialization activity was organized to introduce the DGDL website to representatives from several local elementary and middle schools. At the end of the event, a questionnaire was distributed to participants to collect feedback. The questionnaire served as a systematic data collection tool designed to gather information from respondents. It aimed to measure user needs, application effectiveness, and user experience (see Fig. 7).

Based on the functionality and usability tests conducted in collaboration with the Pacitan Education Department, the DGDL system was successfully introduced to teacher representatives. This activity was essential in familiarizing teachers—key drivers of differentiated learning implementation in schools—with the application. Socialization also allowed teachers to explore the system's features firsthand.

International Journal of Multi Discipline Science
Vol. 8 No. 1 (February 2025)
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Fig. 7 *Application Socialization Activities with Teachers in Pacitan*

A questionnaire comprising 10 questions was distributed to 17 participants to evaluate critical aspects of DGDL usage. These aspects included ease of use, the system's ability to classify students based on their proficiency levels, and the application's role in supporting effective learning.

Table 2
Summary of Questionnaire Results

No.	Questions	Min / Max	Average
1.	The DGDL system can be easily used and is very helpful for teachers in classifying students based on their abilities.	5 / 3	4.625
2.	With the DGDL system, teachers can easily group students according to their abilities.	5 / 3	4.5
3.	Without the help of others, teachers are confident that they can use the DGDL system with ease.	5 / 2	4.1875
4.	With the DGDL system, students have an equal opportunity to maximize their abilities in learning the material presented by the teacher.	5 / 3	4.5
5.	The DGDL system helps students to learn the material to the fullest.	5 / 3	4.5625
6.	The features available in the DGDL system are very easy to learn and use.	5 / 3	4.375
7.	The DGDL system provides information that makes it easier for students to learn.	5 / 3	4.5
8.	I did not encounter any difficulties in managing the DGDL system.	5 / 3	4.1875
9.	The DGDL system will make it easier for teachers and students to implement differentiated learning.	5 / 4	4.4375
10.	The DGDL application will make students more enthusiastic about learning subjects.	5 / 4	4.4375

Table 2 shows that the highest-rated question was: "The DGDL system is easy to use and greatly assists teachers in classifying students based on their abilities," with an average score of 4.625. This result highlights DGDL's potential as an innovative educational tool that helps teachers map student abilities effectively.

Discussion

The questionnaire results provide valuable insights into how the DGDL application enhances the teaching and learning process by enabling structured and personalized instruction. By simplifying group management based on student abilities, DGDL ensures equal learning opportunities and helps optimize student potential (Wahyuningsari et al., 2022). These findings align with previous studies on differentiated learning, which emphasize the importance of adaptive educational technologies in improving learning outcomes. Research by Arriany et al., (2020) also highlights that digital learning platforms contribute to more efficient classroom management and better student engagement. Furthermore, usability studies on similar educational applications suggest that user-friendly interfaces and tailored learning experiences significantly impact student performance and motivation. The feedback collected from this study serves as a foundation for evaluating the effectiveness of DGDL and identifying areas for enhancement, particularly in improving system functionality, usability, security, and performance. Future research should continue refining the system while considering advancements in educational technology and best practices from recent studies.

CONCLUSIONS

The research demonstrates that the DGDL application, based on PHP and supporting differentiated learning, is effective in improving educational outcomes in Pacitan Regency. The application was evaluated based on four key aspects: functionality, usability, security, and system performance, With an average rating of 4.43 on a scale from 1 to 5 from 17 respondents. The application was highly appreciated as an innovative solution to address the limitations of educational resources, particularly in organizing and adapting lesson materials based on students' preferences, abilities, and needs. The feedback gathered from the questionnaire provided valuable suggestions for system and interface improvements, as well as additional feature recommendations for DGDL. These insights allow the author to evaluate and refine the DGDL system for future enhancement.

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