Development of innovative behaviors Android application and website for teachers using the waterfall method

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ABSTRACT

This research explores the pivotal role of innovation in education, particularly in response to the COVID-19 pandemic. It focuses on developing the Guru Inovatif Android app and website to enhance educators' innovative teaching practices. These platforms feature a survey to assess innovation levels and training modules to develop innovative skills, aiming to revolutionize teaching methodologies. (In this research, the waterfall methodology is employed, which is used to develop software from start to finish. This model involves a sequential design process, where progress flows in one direction through phases such as requirements, design, implementation, verification, and maintenance. It is utilized to create both an Android-based application and a Laravel-based website.) Testing involved 109 teachers from various educational levels across six regions in Java. Data were collected via a structured Likert-scale survey and analyzed for usability and satisfaction. Results indicated high user-friendliness (4.43) and satisfaction (4.28) but highlighted the need for design consistency (2.37) and error reduction (2.27). By addressing these issues, the Guru Inovatif platforms can better support educators in adopting innovative teaching practices.

INTRODUCTION

Innovation is one of the keys to supporting people in their work and moving forward to improve their work subjects. Innovation can give opportunities essential to the success and growth of the people and their company so they can survive (Zainal & Matore, 2019). In the education industry, COVID-19 has had a lot of impact on schools and made them close (Scull et al., 2020). Karim et al., 2022 and Paragae, 2023 identified in this study lies in the limited implementation and recognition of online learning in developing countries, despite its potential benefits. While the COVID-19 pandemic accelerated the adoption of e-learning, significant challenges remain, such as inadequate facilities, lack of essential technology, and insufficient skills among teachers and students. The study highlights the need for targeted interventions, such as integrating Information Communication Technology (ICT) modules, offering intensive teacher training courses, and improving educational facilities. Addressing these gaps could enhance the effectiveness of online learning and support its broader adoption in developing regions. This situation improves the school's performance in delivering material or teaching more effectively and efficiently. Teachers must

improve themselves to make their teaching skills more effective and efficient by enhancing and implementing innovative behavior in their teaching. Innovative behavior can generate new ideas, new ways of communicating, and motivation for the students and teachers (Kurniawan et al., 2022; Rahmawati & Kurniawan, 2021; Wiranto, 2020).

With the use of technology, people have been improving their skills. With the help of applications, it makes everything easier. Technology has been used by many industries like government, hospitals, clinics, and even schools (Rijanandi et al., 2022). Technology, especially applications, was used to improve the quality of everything like tracking progress, quality control, health problems, information systems, and even for study (Herdiansah et al., 2021; Rijanandi et al., 2022; Sholichin, 2021; Tanuwijaya, 2018). Application in this context is desktop, mobile, and website applications. But for efficiency, websites and mobile applications are widely used by people. For example, many applications are designed for delivering teaching in schools, learning languages, and much more (Fakhruddin et al., 2024; Khair et al., 2023; Sulistyaningtyas et al., 2024; Wulandari & Ratnawati, 2024). They have a great impact on users by helping them learn more about the topics they are interested in, and they can be easily accessed at any time.

Many researchers have been making applications to improve education (Atmaja et al., 2022; Ghani et al., 2019; Nuantra et al., 2022; Ruhiawati et al., 2021). For example, game application for preschool from this research (Atmaja et al., 2022). This application helps students learn about Arithmetic by using storytelling and cartoon visuals. The game is deployed for mobile and desktop. This research shows that 4.79 out of 5 prove that this application was practical for entertainment and education. Other research is the application for library information system websites (Maryati et al., 2022). The System Usability Scale (SUS) was used to evaluate the website's performance, with a score of 57.12 showing low usability and needing revitalization. While the Android application offers useful tools for managing academic and campus activities, improvements are needed, particularly in bus tracking. Enhancing these features and integrating tools that support educational innovation could further aid teachers in adopting new teaching strategies. This would not only streamline campus life for students but also foster a more dynamic and supportive environment for both students and educators (Hossain et al., 2023). However, based on the referenced research, there is still no application focused on developing and training the innovation levels of teachers. Teachers play a crucial role in imparting knowledge to students and are expected to have a high level of innovation in their teaching methods to ensure that the material is delivered effectively and engagingly.

This paper focuses on making an Android application (Iskandar et al., 2023; Susanto et al., 2023) and a website to train teachers' innovative behavior (Najaf et al., 2023; Setyawan et al., 2023). Teachers can access the material by creating two versions of the apps to learn more about innovative behavior from their laptops or smartphones. Application Programming Interface (API) can integrate the Android application and website data, so teachers don't have to make multiple accounts. These apps have two main features: the survey function to measure the innovative behaviors of the teachers and the training material to improve innovative behavior. Highlighting the impact of COVID-19 on education, the need for teacher innovation, and the challenges in integrating technology, this research introduces a novel dual-platform approach to teacher training. The usability issues of existing applications are addressed by ensuring seamless data synchronization and providing flexible access to training materials. This contributes to the educational field by offering a practical solution to enhance teachers' innovative behavior through technology, ultimately improving educational outcomes.

METHOD

A Systems Development Life Cycle (SDLC) was used to develop this application in this research. SDLC has a lot of models that can be used. So, to adjust the current development, the researcher used the Waterfall model in SDLC (Engel et al., 2021; Rijanandi et al., 2022; Sholichin, 2021; Tanuwijaya, 2018). This waterfall model is a sequential linear model in which apps will be developed step by step from analysis, designing, implementing, testing, and maintenance, as shown in Figure 1. Each step in the waterfall model is going to be discussed below:

Requirement Analysts

The process of gathering the requirements for developing educational apps was comprehensive and aimed at harnessing educators' valuable insights and experiences. This endeavor was carried out using a Google Form survey and the invaluable input obtained during focused group discussions with 127 teachers from six private schools on the picturesque Java Island. These private schools encompassed diverse educational levels catering to elementary, junior high, and senior high school students. The participating teachers represented a wide age range from 24 to 59 years old (Kurniawan et al., 2022; Rahmawati & Kurniawan, 2021). Regarding their professional experience within the educational system, their service periods ranged from a minimum of 2 years to an impressive 36 years of dedicated teaching.
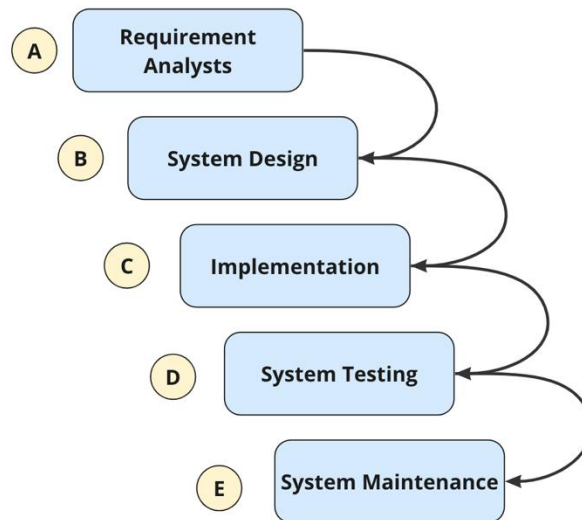

Figure 1. Systems Development Life Cycle (SDLC) Waterfall Model

The focus group discussions were conducted with great care and attention to detail. They commenced with an informative session that underscored the importance of fostering innovative behavior within the teaching community. This introductory segment served as a platform for participants to understand the significance of innovation in the educational realm.

Following this, a dynamic question and answer session was held, during which participants engaged in lively discussions about innovative behavior. This interactive dialogue allowed teachers to share their personal experiences, insights, and challenges in integrating innovative practices into their teaching methodologies.

These enlightening discussions culminated in comprehensively exploring the specific features and functionalities essential for developing educational apps. Through this collaborative process, teachers identified and prioritized the key elements that would empower them to enhance their teaching methods and make learning more engaging and effective for their students.

System Design

In this phase of the Software Development Life Cycle (SDLC), the focus is on designing the system for an upcoming application. The researcher uses insights from previous analyses to create a comprehensive blueprint for the application's architecture. This includes defining client and server specifications to ensure seamless communication and performance alignment with project objectives. Additionally, the selection of a programming library is carefully considered, considering factors like compatibility and scalability. Alongside these decisions, the researcher creates essential visual components such as system diagrams, use case diagrams, database diagrams, and user interface mock-ups. These elements provide a clear representation of the application's architecture, functionality, and user interactions, setting the stage for subsequent development stages.

Implementation

The subsequent phase within the Software Development Life Cycle (SDLC) is the crucial implementation stage. During this pivotal phase, the development process transitions from planning and design to the actual construction of the software application. To achieve this, distinct technologies are leveraged for different aspects of the project. Specifically, for mobile application development, the development team harnesses the capabilities of Android Studio, a robust and versatile integrated development environment (IDE). Android Studio empowers developers to create mobile applications tailored for the Android platform, offering a comprehensive suite of tools and resources to craft user-friendly and feature-rich applications. Simultaneously, for developing websites and creating APIs (Application Programming Interfaces), the development team embraces the Laravel framework. Laravel is a highly regarded PHP framework known for its efficiency and adaptability in building web-based solutions and robust APIs. By adhering to the Model-View-Controller (MVC) architectural pattern, Laravel provides developers with a structured and organized framework for systematically developing dynamic web applications and APIs. This approach ensures adherence to industry best practices, scalability, and maintainability throughout development.

Furthermore, a commitment to effective system design principles is integrated into this implementation phase. This encompasses applying fundamental concepts such as the Model-View-Controller (MVC) architectural pattern, which ensures a clear separation of concerns within the application's structure. Additionally, essential design artifacts like Entity-Relationship Diagrams (ERD) and mock-ups are diligently incorporated into the application and website development processes. ERDs help define the data structure and relationships, while mock-ups provide visual representations of the user interface, aiding in user experience design. These design principles and artifacts collectively create a well-structured, user-friendly, and functional software product that aligns precisely with predefined specifications and objectives. The successful execution of the implementation phase sets the stage for a software application and website that not only meets but surpasses the expectations and requirements of its intended users, offering a valuable and dependable technological solution in today's dynamic digital landscape.

System Testing

Within the Software Development Life Cycle (SDLC), the testing phase is paramount in ensuring the application and website's quality and usability. During this critical phase, the developed software components undergo rigorous testing protocols, emphasizing user experience (UX) and user interface (UI) evaluations.

The testing process is initiated by engaging educators from various schools across six distinct regions within Java. These educators, hailing from elementary, junior high, and senior high schools, constitute the primary user base for the application. They are invited to actively participate in the testing process by interacting with the application and website, providing invaluable insights into the software's ease of use and overall usability. These educators are requested to offer candid feedback, drawing from their experiences while navigating the application. Their feedback is instrumental in assessing the interface's intuitiveness, identifying navigation complexities, and reporting errors or anomalies encountered during interactions shown in Table 1. Moreover, this comprehensive evaluation encompasses an in-depth examination of the software's UI and UX, ensuring that it aligns seamlessly with educators' diverse needs and expectations.

Table 1. Question for Testing

No.	Question
1	I Find the Application or Website Easy to Use.
2	I Feel that this Application Lacks Consistency in many Aspects (Colors, Fonts, or Wording).
3	I Find the Buttons in the Application Comfortable (not too High, Low, Close to the Edge, or in Size).
4	I Find the Appearance of each Page in the Application Comfortable.
5	I Find the Appearance of this Application Easy to Understand.
6	I Find the Use of Colors in the Application Appropriate.
7	I Find it Easy to Use the Survey Feature.

No.	Question
8	I Find it Easy to Understand the Results of my Survey.
9	I Find it Easy to Use the Training Feature.
10	I Find it Easy to Download Training Module Materials.
11	I Find it Easy to View Training Video Materials.
12	I Find it Easy to Upload Assignments Provided in the Application.
13	I am Satisfied with the Features Available in the Application.
14	I Feel confident in Operating the Application.
15	I Feel the Need to Learn more about Using the Application.
16	I Often Experience Errors while Operating the Application.
17	I Understand the Instructions Provided in the Application.

System Maintenance

After receiving input from schoolteachers, the system undergoes maintenance by the defined stages of the Software Development Life Cycle (SDLC). This phase entails a meticulous process of addressing identified issues, refining functionalities, and implementing necessary updates to enhance the system's performance, security, and usability. It is a critical component of the SDLC, ensuring that the software remains current, reliable, and aligned with the evolving needs of its users.

Maintenance activities encompass various aspects, including bug fixes, security enhancements, performance optimizations, and the incorporation of feature enhancements. These efforts are undertaken systematically, carefully considering the priorities established based on the feedback received from the schoolteachers. The ultimate objective of this phase is to sustain the system's effectiveness and longevity, ensuring it continues to serve as a valuable and dependable tool within the educational context.

RESULTS AND DISCUSSION

Results

In this section, we will delve into the results and discussion concerning the research on the Guru Inovatif application and website. Based on the research findings, it has been determined that the Android application's usage is more dominant than that of iOS. Consequently, to cater to users' needs across various platforms, the decision was made to develop the Guru Inovatif website, ensuring accessibility for all platforms. The discernible prevalence of Android users drove this strategic decision, underscoring the commitment to inclusivity and universality in providing access to the Guru Inovatif platform. By offering both the Android application and a dedicated website, we aim to accommodate users regardless of their chosen operating system, thus ensuring that the benefits and resources of the Guru Inovatif platform are accessible to the broadest possible audience.

Moreover, the development of the website not only expands the platform's reach and enhances user convenience and accessibility. It allows users to access the Innovative Teacher resources from various devices, including smartphones, tablets, and desktop computers. This adaptability further strengthens the platform's utility and relevance in today's diverse and dynamic educational landscape.

The Guru Inovatif application and website have been designed with identical features. The first feature is the survey, where users, specifically school teachers, can assess their level of innovativeness in teaching across seven indicators, as determined by the research titled "Teachers' Innovative Behaviors based on Stakeholder Expectations." The second feature is the training module, which provides materials to enhance proficiency in the seven indicators above. The training materials encompass PDF documents, instructional videos embedded from YouTube by the researchers, assignments, and a submission portal. This research-based feature has been developed as part of a specialized learning management system tailored to the specific needs of innovative educators. The uniformity of features between the application and website ensures a seamless user experience, irrespective of the platform chosen for access. This approach is deliberate, underscoring the commitment to providing consistent and comprehensive support to educators seeking to cultivate

innovative teaching practices. Furthermore, including a learning management system emphasizes the importance of structured and organized teacher training. It streamlines the learning process, making it more efficient and effective while providing a means for educators to track their progress and development over time.

The interface of the Innovative Teacher application and website is designed in a purple color scheme, with the color choice informed by the psychology of colors. The Android application's design is similar to that depicted in Figure 2, while the website, developed using Laravel, follows the design elements illustrated in Figure 3.

Figure 4 portrays the user interface dedicated to the survey feature, a vital tool that measures teachers' innovativeness levels when accessed through the website. This interface has been meticulously designed to provide educators with an engaging and intuitive experience. Using this feature, teachers can comprehensively self-assess their innovative teaching practices based on the research's seven indicators. On the other hand, Figure 5 showcases the Android application's counterpart to the survey feature. This mobile platform offers teachers the same valuable capability to gauge their innovativeness as they would on the website. The user interface design for the Android application mirrors the website's design philosophy, ensuring consistency and ease of use for educators, regardless of their chosen platform. For both the website and the application, the sequential layout consists of the following elements: on the left-hand side, there is the selection of indicators users wish to assess; in the middle, you can find the source of the questions and the results after answering; and on the right, there is the survey interface.

In Figure 6, you can observe the training interface, which includes a compilation of training materials, including modules and videos, as well as a submission feature for submitting assignments. It's worth noting that this submission feature is seamlessly interconnected between the website and the Android application, as illustrated in Figure 7. This integration streamlines the process for educators, allowing them to submit their assignments on either platform, with the assurance that the data is synchronized between the website and the Android application.
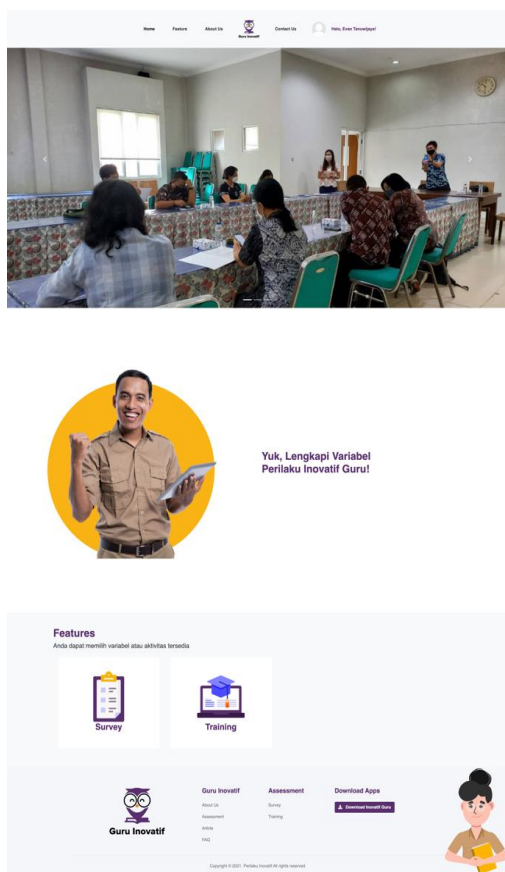

Figure 2. Guru Inovatif Website
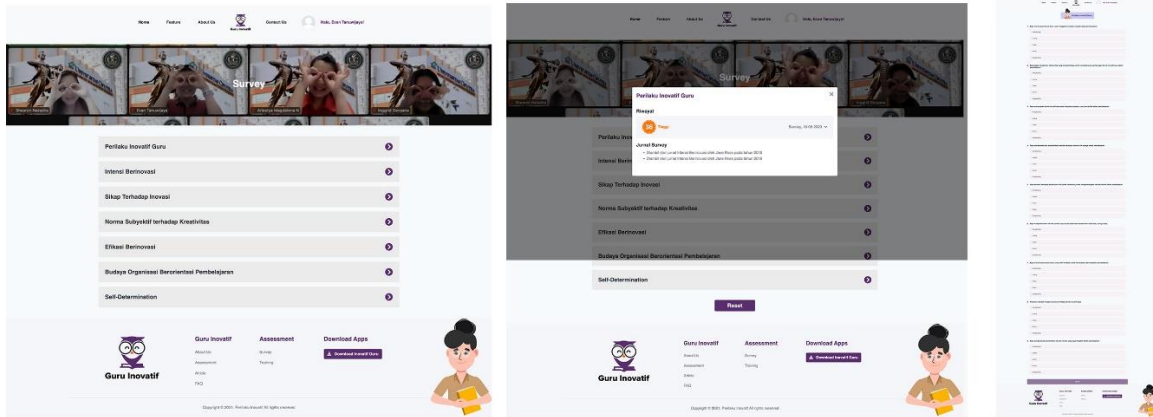

Figure 3. Guru Inovatif Android Application

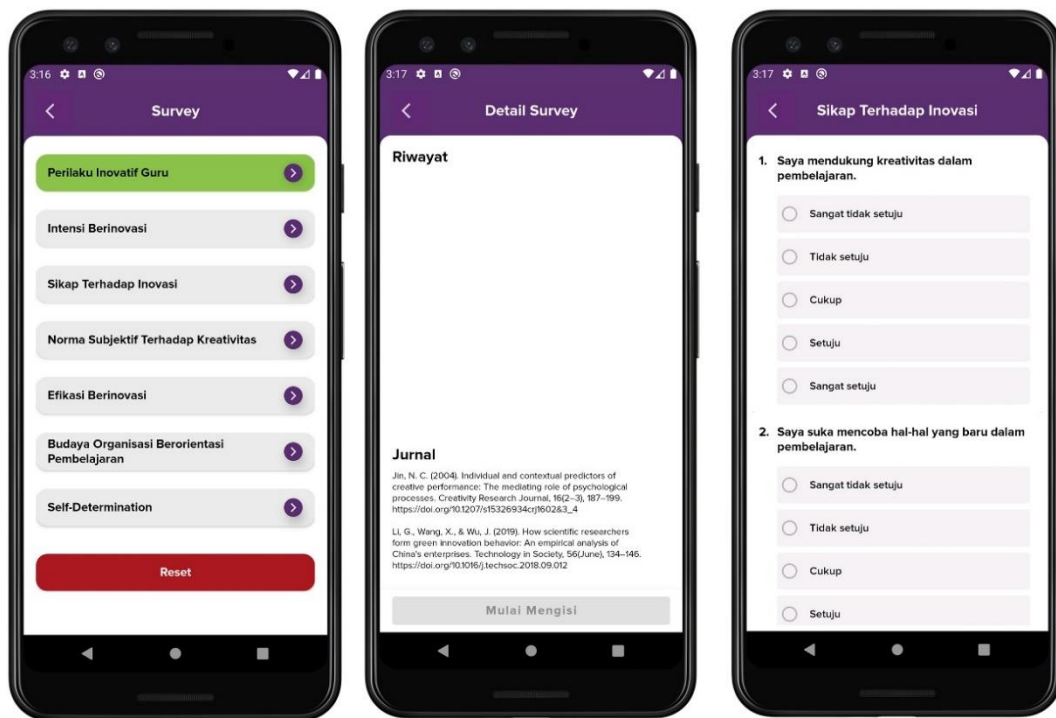Figure 4. Survey Feature on the Website

Figure 5. Survey Feature in Android Application

The system's backend utilizes Laravel API and an SQL database, as depicted in Figure 8. This robust combination of technologies ensures efficient and secure data handling and communication between the website and the Android application. Laravel API is the intermediary that facilitates seamless interactions between the frontend interfaces and the database, allowing for the retrieval and storage of user data, survey responses, training materials, and assignment submissions. The SQL database, on the other hand, provides a structured and reliable foundation for data storage and management, ensuring the integrity and accessibility of crucial information within the Guru Inovatif platform. Together, these backend components form a cohesive and dependable system that underpins the functionality and connectivity of the platform.

Upon completing the system development process, the application and website were tested by educators from six different regions across the island of Java. The testing process was executed through the systematic implementation of scenarios for each feature, followed by the solicitation of feedback from the teachers regarding their user experience while utilizing the features available on the application or website. The survey questions were thoughtfully designed with responses

structured using a Likert scale, ranging from 1, signifying "very poor," to 5, representing "excellent." Below, Table 1 presents the questions included in the survey.

The survey garnered responses from a total of 109 participants, consisting of teachers from various educational levels, including preschool, elementary, junior high, and senior high. Among these respondents, there were 29 male teachers and 80 female teachers. The average survey responses to the 17 questions are summarized in Figure 9. The survey results offer valuable insights into the reception and user experience of the Guru Inovatif application and website among educators. On the positive side, the high rating for ease of use (4.43) is a significant endorsement of the platform's user-friendliness. This suggests that it caters to educators with varying levels of technological proficiency and provides a smooth and accessible interface. However, a notable concern arises regarding consistency in elements such as colors, fonts, and wording, with an average rating of 2.37. This points to an area that requires immediate attention. Achieving consistency in design elements is pivotal for presenting a unified and professional appearance, and addressing these concerns could significantly enhance the overall aesthetics and user experience in Figure 6.

Furthermore, the favorable scores for button and page comfort (3.80 and 4.20) indicate that the platform's visual design and layout have been well-received. This is essential as it contributes to a comfortable and visually appealing interface, fostering a more engaging and productive user experience. Positive feedback regarding the ease of understanding the appearance (4.28) and the appropriate use of colors (4.28) underscores the platform's successful design choices, aligning with user expectations. The survey also highlights the effective usability of core features, including the survey, training, and assignment uploads, all receiving high average ratings above 4. This reflects a well-structured user interface that adeptly supports educators' practical needs. Additionally, high scores for satisfaction with available features (4.28) and confidence in operating the application (4.32) denote user contentment, indicating that the platform satisfactorily fulfills its intended role in Figure 7, Figure 8, and Figure 9.
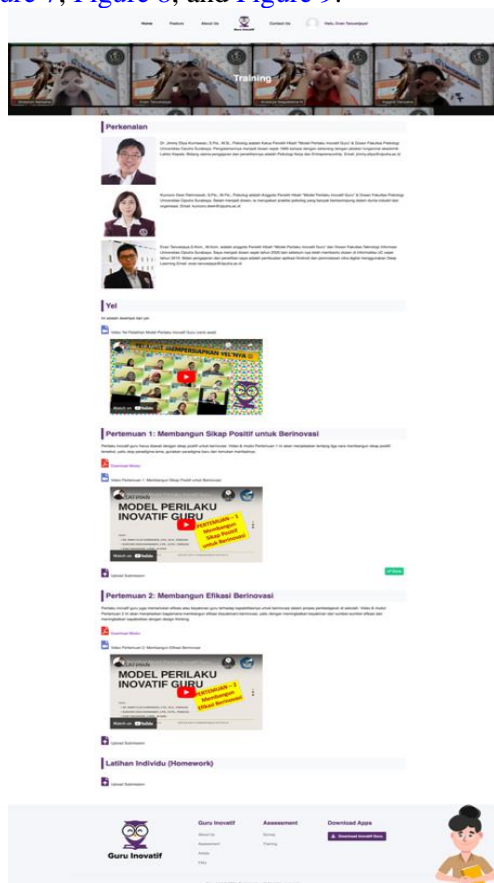

Figure 6. Training Feature on the Website

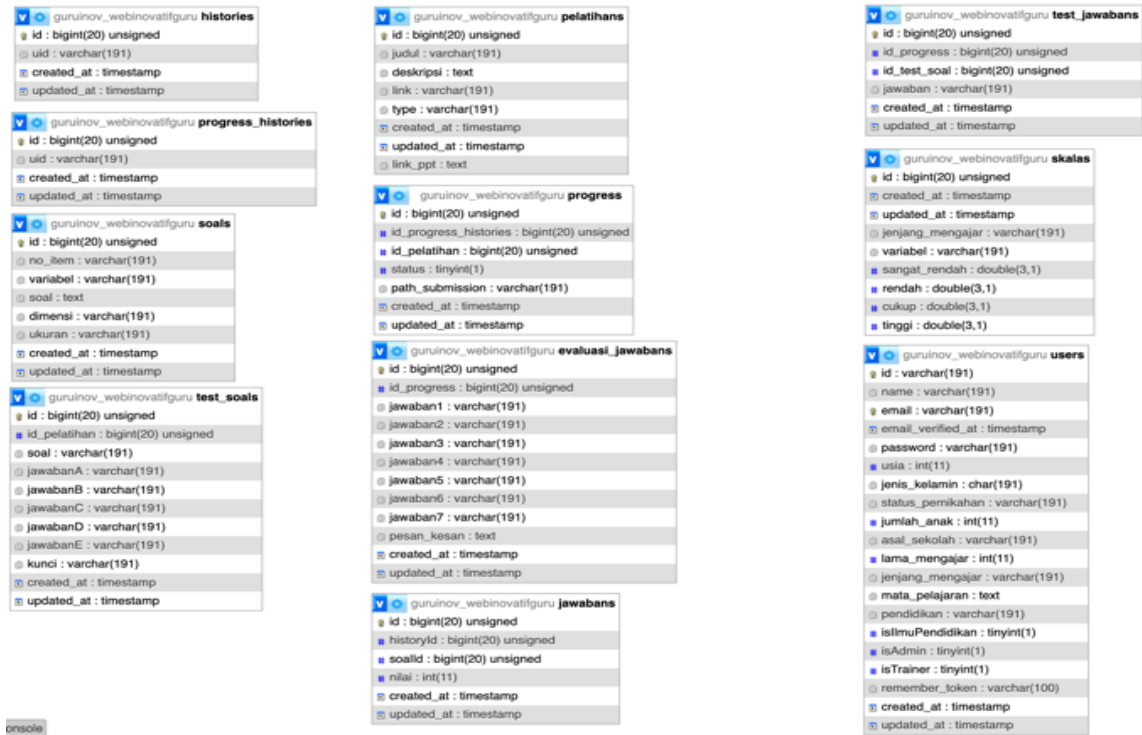Figure 7. Training Feature in Android Application
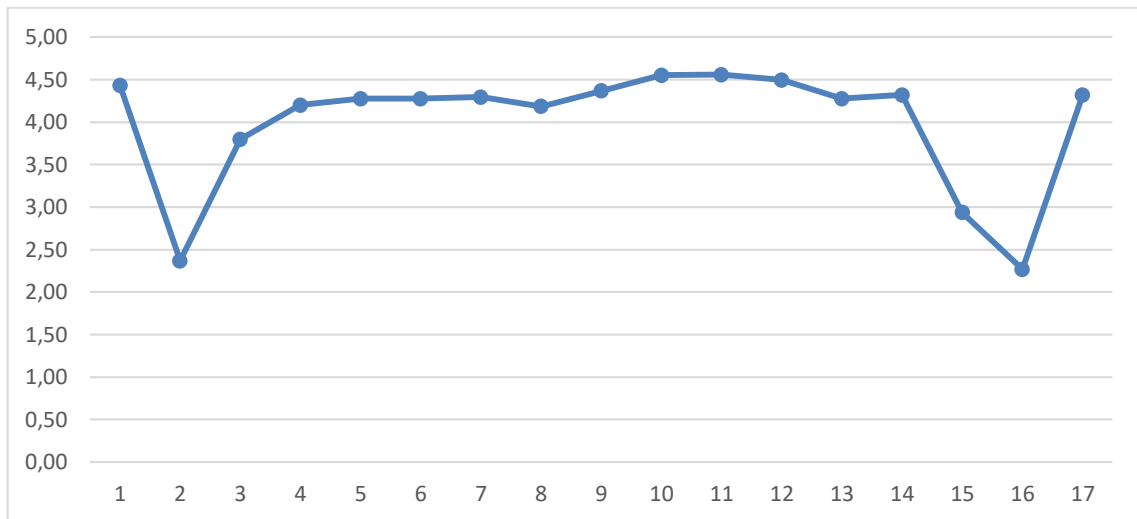
Figure 8. Database MySQL

Figure 9. Average Result from Testing Survey

Nonetheless, areas of concern include the perceived need for additional learning (2.94) and reported errors during usage (2.27). These aspects may warrant attention to enhance the platform's usability and reliability. Lastly, the positive rating for understanding instructions (4.32) underscores the significance of clear and concise guidance for efficient usage.

Discussion

The application includes a feature that provides materials on how teachers can become more innovative, sourced from (Brockhus et al., 2014; Chapman & Dundas, 2018; Choi, 2004; Fernet et al., 2008; Janssen, 2000). It covers the influence of the environment and personal motivation on innovation, which is integrated into the material and assignments, including exercises and quizzes.

These can be completed through the application and submitted for direct assessment by psychologists. This feature aims to improve teacher innovation behavior by offering structured guidance, practical tasks, and personalized feedback. Based on the chart at point 13, it was found that teachers reported benefiting from the application, with a rating of 4.28 on a Likert scale of 5. This indicates that the exercises provided by the application are perceived as effective, impacting their learning process positively both before and after using the application.

Teacher innovative behavior is essential for enhancing student engagement and meeting diverse learning needs in the ever-evolving educational landscape. Innovative teachers are characterized by their openness to change, creativity, and willingness to take risks while continuously learning and collaborating with peers. This behavior fosters critical thinking and adapts to technological advances, making learning more engaging and effective. However, challenges such as resistance to change, limited resources, and the need for effective professional development can hinder innovation. To promote innovative behavior, schools should provide targeted professional development, encourage risk-taking, foster collaboration, invest in necessary resources, and recognize and reward innovation. By addressing these challenges and supporting innovative practices, educators can create more dynamic and responsive learning environments (Fakhruddin et al., 2024). For teachers, this underscores the importance of adopting innovative approaches to leverage technology effectively in the classroom. Teachers who embrace and incorporate trending digital tools and applications can potentially improve student learning behaviors by making educational content more engaging and relatable (Efendy et al., 2024). Underlining the importance of continuous improvement, practical application of new methods, and adaptability, ultimately aiming to enhance teacher effectiveness and student engagement in a dynamic educational environment (Sulistyaningtyas et al., 2024; Wulandari & Ratnawati, 2024).

Other factor is Leader expectations for creativity have little impact on teachers' innovative behavior because school management often aligns with a market orientation culture that prioritizes student and parent expectations. As a result, leader influence becomes ineffective when it merely reflects these consumer expectations. The study, limited to two private schools in Java, Indonesia, suggests that other factors like attitudes towards innovation also play a significant role and call for further research on broader populations (Kurniawan et al., 2022). To enhance teacher innovation capability, schools should foster an organizational culture that supports autonomy and extensive knowledge sharing, both tacit and explicit. Creating a positive environment boosts teacher competence and engagement, ensuring effective knowledge management. The research underscores that a strong organizational culture catalyzes knowledge sharing, which is essential for improving school performance and preparing students for the knowledge society. Teachers, as key facilitators of this process, play a critical role in equipping students for success in a knowledge-driven world (Asbari, 2024a, 2024b).

CONCLUSION

Innovation plays a crucial role in driving progress, particularly in the education sector, which has witnessed significant transformations due to events like the COVID-19 pandemic. As schools adapt to new teaching methods, teachers must embrace innovative behaviors to foster creativity and motivation. Technology, including applications, has become a powerful tool across various industries, including education. This paper focuses on developing an Android application and website to empower teachers by enhancing their innovative teaching behaviors. These platforms offer a comprehensive solution, featuring a survey to assess educators' innovation levels and training modules to develop their innovative skills further. This initiative aims to revolutionize teaching methods and provide educators with the tools they need to succeed in today's ever-changing educational landscape.

The Guru Inovatif application and website have been strategically designed to cater to users' diverse preferences, with a particular emphasis on Android users. This approach led to the creation of a dedicated website to ensure inclusivity and accessibility across all platforms. The flexibility of these platforms allows educators to access Innovative Teacher resources from various devices, promoting convenience and adaptability in the dynamic educational environment. The application

and website provide consistent features, including the innovative behavior survey and training module, which underscores the commitment to offering comprehensive support to teachers striving to improve their teaching practices. The user-friendly interface design, grounded in color psychology, enhances the user experience. While the survey results have revealed strengths such as high user-friendliness (4.43) and positive feedback on interface design, there are areas for improvement, notably the need for consistency in design elements and addressing reported errors. Addressing these areas while building on existing strengths will ensure a more effective and satisfying user experience for educators. Based on the research, there are still many aspects that can be developed. From a technological perspective, the utilization of AI to provide innovative suggestions and updates related to the latest teaching technologies can be added. Additionally, the current platform uses native development, which means iOS devices can only access it through the website. Therefore, adopting a hybrid system is necessary to ensure compatibility with all operating systems. Regular updates with new material are also needed to ensure that the application remains relevant and is used consistently.

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