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"CHANCIFY" PWA (Progressive Web App) Learning Application to Enhance Motivation and Support Critical Thinking Skills

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Abstract

The development of technology in the 21st century has brought significant changes across various sectors, including education. Education must continuously adapt to remain relevant by leveraging technology, such as developing technology-based learning applications. The "Chancify" PWA (Progressive Web App) was developed to enhance student learning motivation and support students' critical thinking skills. This application provides comprehensive materials, practice questions, quick calculation features, interactive quizzes, and a chat feature to support learning. This research used a development research method, which included stages of preliminary study, planning, validation, final product review, and dissemination. Validation results showed that the application is valid with a score of 84.72% from media experts and 92.5% from subject matter experts. The practicality of the application was rated at 82.75% by users, indicating that the application is practical and valid. Motivation survey results showed a significant increase in students' learning motivation. The findings of this study are expected to improve the quality of education and student achievement.

Keywords: *Learning Application, Critical Thinking Skills, PWA, Motivation*

INTRODUCTION

The 21st century has seen significant global changes, driven primarily by rapid advancements in technology, information, and communication. These transformations have permeated all aspects of life, profoundly impacting various sectors, particularly education. The swift pace of change has introduced new challenges while also creating opportunities, compelling the education sector to continuously adapt and innovate to remain relevant. In this context, it is crucial for education to intelligently and effectively harness technological advancements to enhance the overall quality and standard of education.

One important effort to address these challenges is the development of technology-based learning applications. The advancements in technology, especially through applications accessible via smartphones, computers, and the internet, allow individuals to maximize their activities more efficiently and effectively. According to Arzfi et al. (2022), the use of modern technology has made it easier for individuals to carry out activities more efficiently. Anesya & Mansurdin (2023) also state that technological advancements offer new opportunities to enhance interaction between students and teachers, thereby enriching the students' learning experience.

Quality education plays a crucial role in preparing students to face various future challenges. One vital aspect of education is critical thinking skills, which enable students to develop a deeper and more analytical understanding of the subject matter. In addition, the psychological aspect is also significant. Students' psychological well-being must be well-prepared to ensure that the learning process is meaningful and enjoyable. High learning motivation helps maximize students' potential. Therefore, teachers need to create a conducive learning environment to facilitate effective learning. Teachers' efforts to boost students' learning motivation and instill enthusiasm should be integrated into the learning activities. Teachers need to innovate by developing engaging and effective learning media to support the success of the learning process. Teachers should also address students' learning needs to help them quickly and easily remember and retain information (M. Isnaini, 2018). The media used should help make abstract material more concrete for students. At SMA Negeri 1 Sirampog, many students complain about the difficulty of learning due to having to carry many books, making the learning process impractical and limiting the flexibility to study anytime. An interview with one of the students revealed, "I want to study, but I'm reluctant when I have to carry books with hundreds of pages, which makes it impractical when I want to study."

To address this issue, the development of the "Chancify" PWA (Progressive Web App) learning application is highly relevant and important. This application is designed to tackle students' understanding and critical thinking skills by providing various features that support the learning process. The application offers comprehensive and

structured learning materials, as well as practice questions designed to effectively train students' understanding and critical thinking skills. Additionally, the quick calculation feature in this application enables students to complete tasks more efficiently. There is also an interactive quiz feature designed to test and enhance students' critical thinking abilities. Equally important, the chat feature in this application allows students to easily interact with teachers or classmates and seek help when needed.

With the "Chancify" PWA learning application, it is expected that the challenges in the learning process can be better addressed. This application aims to provide an interactive, easily accessible, and effective solution to improve students' understanding and critical thinking skills. With features that support engaging and beneficial learning, this application is expected to become an effective learning tool that helps students achieve better academic performance.

METHODS

This research falls under the category of development research. According to Sugiyono (2020), the research and development method is a process used to produce a specific product and test its effectiveness. This study consists of several stages: the preliminary study, planning, validation, final product review, and dissemination stages. According to Sukmadinata (2013: 164), research and development is a process or series of steps to create new products or refine existing ones, with clear accountability. Development research is primarily aimed at producing a specific product that is then tested for effectiveness to ensure it is ready for practical use. The product developed in this research is the "Chancify" PWA application, designed to enhance students' learning motivation and support their critical thinking skills. The research design involves a sample class used as a test class (One Group Pre-Test and Post-Test Design). Data collection techniques in this research include questionnaires and documentation. The questionnaire is used to gather data on the feasibility of the learning media created, which will be completed by relevant respondents, including subject matter experts, media experts, and students as users of the learning media.

Steps for Developing Learning Media

The preliminary study phase is a crucial initial step in the process of developing a learning application. This phase involves conducting in-depth literature reviews and unstructured interviews with teachers and students. The primary goal of this stage is to gather relevant and comprehensive information to optimally prepare the materials and products to be developed. The planning phase is then carried out to design the learning application. This process includes various aspects, such as the design of the application, the development of content, and the preparation of evaluations to measure the effectiveness of the application.

Once the learning application has been developed, the validation phase becomes the next critical step. In this phase, the developed

application needs to be validated by media experts, subject matter experts, peers, and teachers. The results of this validation process will serve as a reference for making the first revisions to the application draft, ensuring that it meets the desired quality standards.

The final product review phase is conducted to confirm the results of theoretical studies, relevant research, and findings from previous studies. During this phase, the feasibility and validity of the developed product are established, ensuring that the product meets the set standards and is ready for effective implementation. The final step in this process is dissemination, which involves spreading the product to relevant stakeholders. Dissemination is carried out through various channels, such as scientific seminars, journal publications, and workshops, with the aim of ensuring the product is widely distributed and effectively applied in various contexts.

Research Instruments

The research instruments used in this study include the motivation questionnaire, product validity questionnaire, and user response questionnaire to assess the product's practicality. The validity instrument is designed as a questionnaire for validation by media experts and subject matter experts. This questionnaire aims to evaluate the extent to which the developed learning application meets the quality standards set by experts in the fields of media and content. Meanwhile, the practicality instrument, in the form of a user response questionnaire, is designed to gather direct feedback from users regarding their experience with the application.

Through data collection using these instruments, two main forms of data are obtained: qualitative and quantitative data. Qualitative data are gathered from suggestions and input provided by media and subject matter experts. This feedback is crucial as it will be used as a reference for making improvements to the developed learning application, ensuring it better meets users' needs and learning objectives.

Quantitative data are obtained from the validation scores provided by media and subject matter experts, as well as from the user response scores of the learning application. The validity data obtained from the expert validation questionnaires are used to assess whether the developed learning application is suitable for use as a supplement in the learning process. On the other hand, the practicality data are obtained from the user response questionnaires, which are used to determine how the implementation subjects respond to the use of the application and to what extent the application is beneficial and effective in the learning context.

Validity analysis

The validity data analysis of this learning application is based on the results of the validation questionnaires completed by subject matter experts and media experts. The evaluation is categorized into four ratings: 1=Poor, 2=Fair, 3=Good, 4=Very Good. The data collected is then converted into validity percentage data using the following formula.

$$VP = \frac{SV}{SM}\ x\ 100\%$$

Information:

VP = Validity Percentage
SV = Total score obtained from the questionnaire by validators
SM = The maximum total score obtained by the validator on the questionnaire

After obtaining the validation scores from each validator, the total average percentage of the PWA-based learning application's validity is calculated to support critical thinking skills using the following formula.

$$EVR = \frac{\sum PV}{N}$$

Information:
EVR = Expert validation results
VP = Validity percentage
MV = Many validators

After calculating it using the formula above, it is then matched based on the validity category as presented in the following table.

Table 1. Product Validity criteria

Expert Validation Level (HVA)	Category	Information
90% ≤ HVA ≤ 100	Very Valid	No need for revision
75% ≤ HVA < 90%	Valid	Needs a little revision
65% ≤ HVA < 75%	Fairly Valid	Needs sufficient revision
55% ≤ HVA < 65%	Less Valid	Needs lots of revisions
0% ≤ HVA < 55%	Invalid	Can not be used

(Rahmawati dkk., 2020)

Based on Table 1, the learning application can be considered valid if the validation questionnaires from media experts and content experts yield a validation result with a minimum percentage of 75% or are at least categorized as valid. Additionally, qualitative descriptive analysis is conducted regarding suggestions and comments from the media and content expert validators.

Practicality analysis

The practicality analysis of this learning application is based on the student usage questionnaire completed after using the application. The evaluation is categorized into four ratings: 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Agree (A), 4 = Strongly Agree (SA). The data collected from the questionnaire is then converted into practicality percentage data using the following formula.

$$SRT = \frac{TSP}{TSM}\ x\ 4$$

Information:
SRT = Average score of learning application user re
TSP = Total score obtained from the questionnaire applications for each statement item
TSM = Maximum total score on the questionnaire fo each item

After obtaining the average score for user responses to each statement item, the next step is to calculate the overall average score from the questionnaire on the PWA-based learning application to support critical thinking skills. Subsequently, the practicality percentage is determined using the following formula.

$$RPK = \frac{SRTo}{SM\ a}\ X\ 100\%$$

Information:
RPK = Average percentage of practicality
$SRTo$ = The total average score of the questionnaire results on the use of learning applications
$SM\ a$ = Maximum questionnaire score for each statement item

After calculating it using the formula above, it is then matched based on practicality categories as presented in the following table.

Table 2. Product Practicality Criteria

Average Percentage of Practicality (RPK)	Category	Information
84% ≤ RPK ≤ 100%	Very Valid	No need for revision
68% ≤ RPK ≤84%	Valid	No need for revision

52% ≤ RPK ≤ 68%	Fairly Valid	No need for revision
36% ≤ RPK < 52%	Less Valid	Needs revision
0% ≤ RPK < 36%	Invalid	Needs revision

(Sumalasia dkk., 2020)

Based on Table 2, the use of the learning application is considered practical if the data obtained from the PWA-based learning application usage questionnaire for supporting critical thinking skills is at least categorized as fairly practical or if the average practicality percentage is at least 52%.

The analysis of student motivation improvement is conducted using a paired sample t-test. This is interpreted by quantitatively analyzing descriptively, comparing the average scores of the pre-test and post-test motivation assessments.

RESULTS AND DISCUSSION

The results of this study include a comprehensive analysis of the development process and the final outcome of the PWA-based learning application designed to enhance students' critical thinking skills, named "Chancify." Below is a detailed description of each aspect of the development process and the results of the learning application.

Preliminary Study Stage

Based on interviews, it was revealed that in the learning process, teachers tend to use lecture and discussion methods as the main approach, without integrating interactive teaching materials such as specialized learning applications. This has impacted students' interest in learning, which tends to be low, particularly because they feel they do not fully understand the mathematics lessons being taught. Interviews with students revealed that the dominance of the lecture method in teaching leads to many students experiencing difficulties in understanding the explanations provided by the teacher. The lack of variation in teaching methods and interactive tools hinders students from engaging actively and deeply with the subject matter.

Planning Stage

In this stage, the researcher began by designing the "Chancify" application, a PWA-based learning tool. The design includes various learning materials and two types of quizzes: the first quiz is designed to assess students' understanding of the material taught in school, while the second aims to train students' critical thinking skills in problem-solving according to set guidelines. The application features a Practice Questions section to reinforce students' understanding before taking quizzes, and a Quick Calculation feature to allow students to hone their calculation skills efficiently. The application also includes a chatbot feature that acts as a personal assistant to help users answer questions. The questions provided cover various difficulty levels, from easy to challenging, and all features are designed to offer a holistic and interactive learning experience. The next step involves developing the content of the application based on the established teaching modules. Following this, an initial product design draft is prepared, including a list of features to be implemented, such as content, practice questions,

quizzes, and chatbot. The subsequent stage is the creation of the application framework in the form of source code, followed by detailed implementation until the application is completed.

Validation Stage

The validation of the learning application is carried out by involving two media experts and two subject matter experts, who use a validation questionnaire to assess these aspects. This validation process includes a thorough evaluation of various elements of the application, including media design and the substance of the presented material. The results of this validation provide a clear picture of the application's quality in terms of compliance with media standards and effectiveness of the teaching material. The following are the detailed validation results obtained from media experts, indicating their assessment of various components of the application and their contribution to the success of the learning process. Based on data from the validation process, the evaluation results by media experts show a score of 84.72%. This score reflects that the learning application has successfully met the criteria and standards set for media evaluation. This figure indicates that the application has been rated as "Valid," meaning it meets all required standards for media quality, design, and functionality. In other words, the application is considered effective and suitable for use in educational contexts, demonstrating that it has been well-prepared in terms of media, design, and functionality and can be effectively used to support the learning process. This is consistent with the study by Syawala, A. N., & Auliya, N. N. F. (2023), which states that Android-based learning applications are considered highly valid. Some revisions include changing the font from Calibri to Times New Roman and correcting the notation of formulas.

Based on the data obtained, the validation of the PWA-based learning application by subject matter experts shows a very high score of 92.5%. This figure clearly indicates that the learning application meets very stringent quality standards and is rated as "Highly Valid." This validation shows that the material presented in the application is very well-organized, considering its relevance and suitability for students' learning needs. The validation process highlights that the application not only meets but exceeds expectations in terms of quality and effectiveness. Thus, the application can be relied upon and trusted for use in educational processes, making a significant contribution to enhancing the learning experience and academic achievement of students. This aligns with the study by Rizky, M. R. F., & Marhaeni, N. H. (2023), which states that Android-based mathematics learning applications are valid and suitable for use.

Practicality Criteria

The practicality of the learning application is determined based on the user response questionnaire completed by 10th-grade students at SMA Negeri 1 Sirampog. The data collection through this questionnaire provides a comprehensive overview of students' experiences and evaluations of the application. The results of the data and questionnaire calculations show that the learning

application received an average score of 82.75%. This figure reflects that the application is rated as very practical by students. The obtained score indicates that the application not only meets but also exceeds the expected practicality standards. In other words, the application has proven to facilitate students' learning process, providing ease and comfort in accessing the necessary materials and features, and contributing to the effectiveness of their learning experience. This is consistent with the research by Dwiranata et al. (2019), which explains that Android-based mathematics learning media development is deemed practical.

Final Product Review

Student responses indicate that the material presented in the application is very easy to understand, with available features being rated as engaging and highly supportive of the learning process. Students reported that the application not only facilitates learning effectively but also provides significant ease in understanding the taught material. Additionally, the application's features contribute to increased student engagement during the learning process by making it more interactive and interesting. This creates a more enjoyable and productive learning experience, which in turn enhances student motivation and participation in the teaching and learning activities. This aligns with the research by Dwiranata et al. (2019), which explains that Android-based mathematics learning media development is practical. According to Rizky, M. R. F., & Marhaeni, N. H. (2023), the mathematics learning application is valid and suitable for use.

Figure 1. Initial View

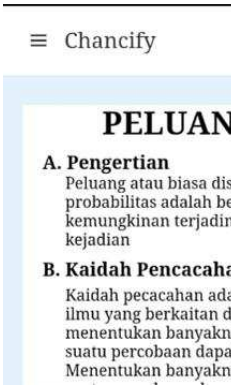

Figure 2. Material display

Figure 3. Display of Practice Questions

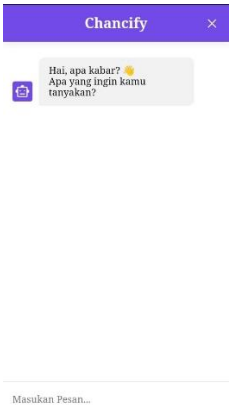

Figure 4. Chat display

Dissemination Stage

The results of the development of the PWA-based learning application involve the product distribution stage carried out online. At this stage, the application is distributed through an .apk file available for download on the platform https://github.com/Chancify/Chancify. This process is designed to facilitate user access, allowing them to easily download and install the learning application on their devices. By providing the application in .apk

format on this platform, users can directly access and obtain the application without any issues, ensuring that the learning application can be widely and efficiently used to support the educational process. With the development results validated and deemed practical, it means this educational media product can be effectively used to enhance critical thinking skills, in line with Hendi, A (2020), which indicates that interactive learning media based on metacognitive strategies significantly improves students' critical thinking skills compared to those who do not use such media.

Enhancing Learning Motivation

Students' learning motivation is analyzed based on each indicator. The measurement of students' learning motivation employs quantitative descriptive data analysis, with a maximum score of 40. Descriptive quantitative results, comparing the average pre-test and post-test scores, show that the average post-test score (36.30) is higher than the average pre-test score (32.27), indicating an improvement in students' learning motivation after using the learning media. Educational media plays a crucial role in fostering or enhancing learning motivation. This aligns with the research by Febrita Y (2019), which shows that educational media plays an important role in the teaching and learning process, making learning more engaging, encouraging students to love knowledge, and actively seek learning resources. The ability of students to learn from various sources can foster a proactive attitude in seeking information. Effective use of media can help overcome learning difficulties, shape personality, motivate learning, and offer various other benefits.

Based on the research conducted, the PWA-based "Chancify" learning application has been tested for validity, practicality, and its impact on increasing students' learning motivation at SMA N1 Sirampog.

CONCLUSION

Based on the research, development, and discussion conducted, the following conclusions can be drawn:

1. The validity of "Chancify" as a PWA-based learning application for enhancing students' critical thinking skills is assessed using material validation and media validation questionnaires. The "Chancify" PWA-based learning application has been deemed valid for use as an educational media.
2. The practicality of the "Chancify" PWA-based learning application is evaluated based on responses from X grade students at SMA N 1 Sirampog regarding its use to support critical thinking skills in probability topics. The results show an average percentage of student responses at 82.58%. This indicates that the development of the "Chancify" application has successfully achieved the desired level of practicality in supporting technology-based

learning to enhance students' critical thinking skills.
3. There is an observed increase in students' learning motivation after using "Chancify."

RECOMMENDATIONS

Based on the research and development conducted, the development of the "Chancify" PWA-based learning application for enhancing students' critical thinking skills has not yet achieved a level of 100% perfection. Therefore, several recommendations should be considered for further refinement and development, including:

1. Strengthening the integration of Artificial Intelligence (AI) technology within the learning application to enhance interaction and assist in resolving issues faced by students.
2. Adding interactive features that stimulate students' critical thinking, such as educational games.
3. Encouraging teachers to create diverse learning activities to increase student interest and engagement in the learning process.

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