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THE DEVELOPMENT OF THE TELEGRAM BOTT AS A PERSONALIZE LEARNING MODEL PROJECT BASED LEARNING MEDIA IN KINEMATIC MATERIALS

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ABSTRACT

Online learning poses challenges in teacher-student interaction, particularly in directing individualized attention to students. Effective learning media are critical to stimulating engagement and ensuring structured guidance. This study addresses the need for innovative tools to optimize project-based learning (PjBL) in physics, specifically for kinematic materials (quantities and units, uniformly changing straight motion, and free fall motion). This research aims to develop a personalized Telegram bot as a PjBL-compatible learning medium to enhance interaction and direction in online physics instruction. The study employs a Research and Development (R&D) framework guided by the design thinking model, comprising five stages: (1) empathize (understanding user needs), (2) define (problem identification), (3) ideate (solution brainstorming), (4) prototype (bot development), and (5) test (iterative evaluation). Testing involved three phases: blackbox testing (functionality), media expert validation (usability), and material expert validation (content relevance). The developed Telegram bot (accessible at https://t.me/learningphysicsbot) achieved a feasibility score of 92.94% from media experts (one physics education lecturer) and 95.00% from material experts (two physics education lecturers), both categorized as "very feasible." The bot successfully integrates PjBL principles, enabling structured, interactive, and self-directed learning for kinematic topics. This study demonstrates that a personalized Telegram bot is a highly feasible solution to overcome interaction barriers in online learning. It offers educators a practical tool to implement project-based methodologies effectively, fostering student engagement and autonomous learning. The findings highlight the potential of chatbot technology to transform digital classrooms into dynamic, student-centered environments.

1. INTRODUCTION

a. Background of the Study

Learning media play a pivotal role in the teaching and learning process, serving as tools to facilitate communication and information exchange between teachers and students. According to Ardimansyah & Widianto (2021), media act as intermediaries to optimize interaction and knowledge transfer. Teni (2018) further emphasizes that media, whether

physical or digital, enable individuals to acquire knowledge, skills, and attitudes in an engaging manner. In education, media are integral to curriculum implementation, ensuring that learning systems operate effectively (Syakur, 2020). However, the shift to online learning during the COVID-19 pandemic has exposed significant challenges, particularly in maintaining teacher-student interaction and sustaining student engagement. Traditional methods often lead to monotony and disengagement, hindering the transfer of knowledge (Ahamad, 2021). This highlights the urgent need for innovative, technology-driven media that align with modern pedagogical approaches, such as project-based learning (PjBL), to foster creativity, problem-solving skills, and scientific reasoning among students.

b. Rationale of the Study

The integration of technology in education has transformed learning paradigms, yet gaps persist in leveraging digital tools for personalized, project-based instruction. Physics education, particularly in kinematics (quantities and units, uniformly changing straight motion, and free fall motion), often relies on conventional methods that fail to captivate tech-savvy learners. A preliminary survey of Physics Education students at Universitas Jambi (2020) revealed that 91.32% of respondents demanded interactive media to enhance online learning. Despite the proliferation of chatbots and social platforms like Telegram, no prior studies have developed Telegram bot-based media tailored to PjBL in physics. This study addresses this gap by creating a personalized learning tool that combines Telegram's accessibility with PjBL's collaborative and inquiry-driven framework, aiming to revitalize online physics education.

c. Literature Review

Existing literature underscores the critical role of media in education. Teni (2018) posits that media are essential for structured communication within learning systems, while Syakur (2020) asserts that media-free instruction risks inefficiency. Project-based learning models, as noted by Baran (2018), bridge theoretical knowledge and practical application, nurturing skills like decision-making and scientific reasoning. However, studies on integrating PjBL with digital tools remain limited. Research by Maulidina & Bhakti (2020) highlights the potential of technology to foster student-centered learning, yet few explore chatbot-based platforms like Telegram. While chatbots have been used in education (Baran, 2018), their application in physics, particularly kinematics, remains underexplored. This study builds on these foundations, proposing a novel approach to combine Telegram's interactive features with PjBL's pedagogical strengths.

d. Gap Analysis

Current research on learning media and PjBL reveals three critical gaps:

1. Technological-Pedagogical Disconnect: Despite advancements in educational technology, few studies integrate chatbots with PjBL models to address physics-specific challenges.
2. Personalization in Kinematics: Existing media lack personalization for kinematics topics, failing to accommodate diverse learning paces and styles in online settings.
3. Contextual Engagement: Traditional media often neglect students' preference for tech-driven, interactive formats, leading to disengagement (Baran, 2018).

This study fills these gaps by developing a Telegram bot that embeds PjBL principles into kinematics instruction. By aligning with design thinking methodologies—empathizing with user needs, prototyping iteratively, and validating through expert feedback—the research offers a scalable solution to enhance online physics education. The tool's feasibility, validated by media (92.94%) and material experts (95.00%), underscores its potential to transform digital classrooms into dynamic, student-centric environments.

2. METHOD

This research employs a design thinking approach in developing a personalized learning medium based on a Telegram bot using the Project-Based Learning (PBL) model. The study consists of five main stages: empathize, define, ideate, prototype, and test. The participants of this study are students from the Physics Education Program at Universitas Jambi, who have participated in online learning for Basic Physics courses, particularly on the topics of quantities and units, uniformly changing straight motion, and free fall motion. The purposive sampling technique is used to select students from the 2020 cohort who have experience with online learning and prior knowledge of the physics concepts targeted in the study.

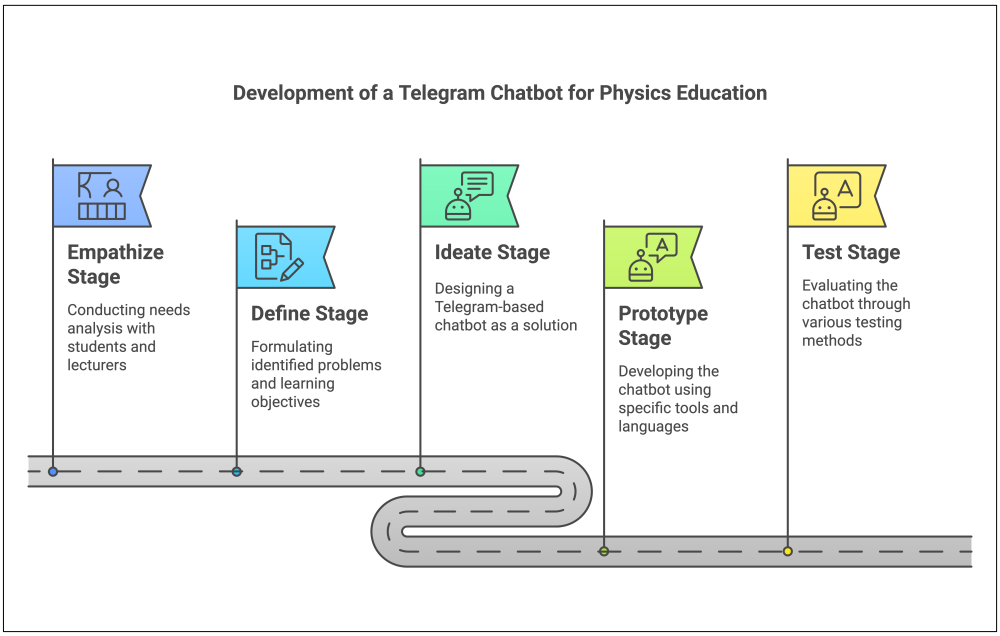

Figure 1. Development of a Telegram Chatbot for Physics Education

The research instruments used include expert validation sheets, user perception questionnaires, and blackbox testing. The expert validation sheets consist of media validation conducted by media experts who assess aspects of usability, functionality, and visual communication, as well as content validation conducted by subject matter experts who evaluate the instructional quality of the developed media. The user perception questionnaire is designed to measure students' engagement and the effectiveness of learning through the Telegram chatbot using a Likert scale (1-5). Blackbox testing is carried out to evaluate the chatbot's functionality in responding to user interactions. To ensure the validity and reliability of the instruments, expert validation is conducted before implementation, while Cronbach's Alpha is used to assess reliability.

The research procedure consists of five stages. In the empathize stage, a needs analysis is conducted with students and lecturers regarding the challenges in online physics learning. The define stage follows, where the identified problems are formulated, and the learning objectives are established. In the ideate stage, a solution is developed by designing a Telegram-based chatbot as an interactive learning medium. The prototype stage involves the development of the chatbot using XAMPP as a web server, Visual Studio Code as a coding editor, and JavaScript as the programming language. The final stage, test, includes three key evaluations: blackbox testing to examine system functionality, expert validation

to assess media and content feasibility, and pilot testing with students to collect feedback and measure usability.

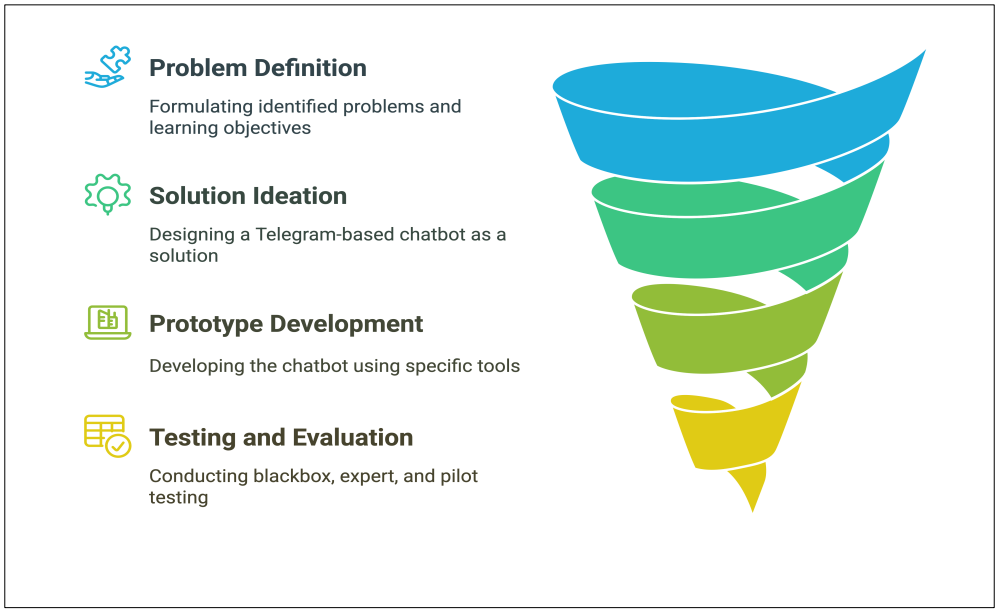

Figure 2. Developing an Interactive Learning Chatbot

Data analysis in this study is conducted using both descriptive and inferential statistical approaches. Descriptive statistics summarize expert validation results and user feedback, while inferential statistics, such as t-tests or ANOVA, are applied to compare students' perceptions before and after using the chatbot. Additionally, instrument reliability is tested using Cronbach's Alpha to ensure internal consistency. Qualitative analysis is also performed on student and expert feedback to gain deeper insights into the strengths and limitations of the developed learning medium.

With this systematic methodology, the study aims to develop a Telegram chatbot as a validated and tested personalized learning medium that can be effectively utilized to enhance students' learning experiences in Basic Physics courses.

3. RESULTS AND DISCUSSION

This study aimed to develop a personalized learning medium in the form of a Telegram bot using the Project-Based Learning (PBL) model to enhance student engagement and comprehension in Basic Physics courses. The development process followed the Design Thinking approach, consisting of five stages: empathize, define, ideate, prototype, and test. The bot was designed to provide interactive learning experiences, particularly in topics related to quantities and units, uniformly changing straight motion, and free fall motion.

Table 1. The Sample of Table Format

Aspect	Indicator	Amount	Number
Usability	Convenience	2	1,2
	Efficiency	2	3,4
	Ease of access	3	5,6,7
	Chatbot content update	3	8,9,10
Functionality	Use of the start command	2	11,12
	Use of choice of material	2	13,14
	Use record username	3	15,16,17

Aspect	Indicator	Amount	Number
	Use of video display	2	18,19
	Bot activity in replying to chat	2	20,21
Visual communication	Communication	2	22,23
	Simplicity and attractiveness	2	24,25
	Visual quality	2	26,27
	Video usage	2	28,29
	Image usage	3	30,31
	Display of information presented	2	31,32

The research began with a needs analysis involving 53 students from the Physics Education Program at Universitas Jambi. The findings showed that 91.32% of students expressed the need for interactive learning media, while 88.60% of students believed that digital media significantly improved their understanding of physics concepts. Additionally, 88.43% agreed that online learning tools facilitated the learning process, highlighting the necessity of an innovative, technology-based learning approach. Based on these findings, a Telegram chatbot was developed using XAMPP as the web and database server, Visual Studio Code as the coding environment, and JavaScript as the primary programming language. The chatbot was designed to provide interactive content, automated responses, and project-based assignments, incorporating video explanations and visualization tools to enhance student learning experiences.

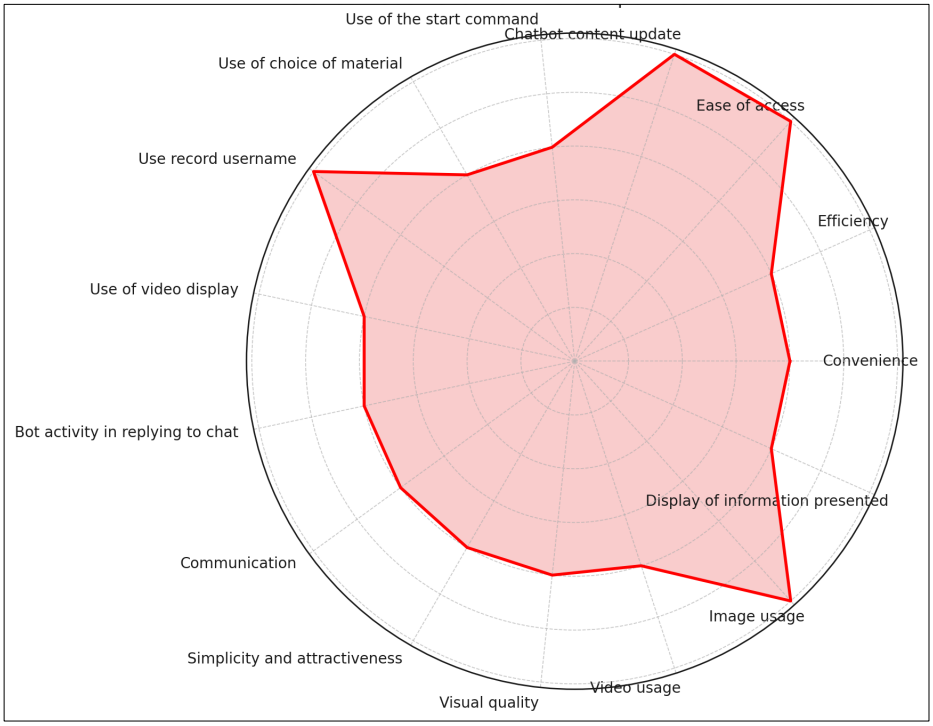

Figure 2. *Detailed Radar Chart of Media Expert Validation Indicators*

The Telegram bot underwent rigorous testing through three key evaluation phases. First, blackbox testing was conducted to ensure that the chatbot functioned correctly and responded accurately to user inputs. Second, expert validation was carried out by both media experts and subject matter experts. The media expert assessment, conducted by a Physics Education lecturer, resulted in a 92.94% feasibility score, categorizing the bot as "very feasible". Similarly, the subject matter experts, consisting of two Physics lecturers, provided a 95.00% feasibility score, further confirming its high usability and effectiveness. Lastly, user testing revealed that students found the chatbot effective in assisting their learning process, particularly due to its interactivity and real-time engagement features.

The findings of this study align with previous research on digital learning media and chatbot integration in education, reinforcing the effectiveness of interactive learning tools in enhancing student engagement. The high validation scores from both media and subject matter experts indicate that the Telegram bot is a viable educational tool that meets academic standards. Traditional online learning methods often lack real-time interaction, making it challenging for students to stay engaged. However, the Telegram bot successfully addressed this issue by providing automated responses, guided learning activities, and instant feedback, creating a more engaging and dynamic learning environment.

Additionally, the Project-Based Learning (PBL) approach embedded in the chatbot allowed students to apply theoretical physics concepts to practical assignments, fostering deeper understanding and active participation. The chatbot facilitated structured project submissions, where students could analyze physics problems, conduct experiments, and submit their findings directly through the bot. This method encouraged critical thinking and independent learning, aligning with contemporary educational strategies that emphasize student-centered learning experiences.

Despite its advantages, the study also identified several challenges and limitations. Some students encountered technical difficulties in accessing and using Telegram-based learning tools, particularly those unfamiliar with the platform. Moreover, the chatbot's functionality was limited to text-based interactions, lacking advanced features such as voice recognition or AI-powered responses. Future improvements should focus on integrating AI-based features to enhance the chatbot's adaptability and response accuracy, as well as expanding its content to cover a broader range of physics topics.

Based on these findings, several recommendations for future research can be proposed. First, further studies could explore comparative research between Telegram-based learning and traditional classroom methods to assess their relative effectiveness. Second, expanding the chatbot's content to other physics subjects could provide a more comprehensive learning experience. Finally, incorporating machine learning algorithms could enable the chatbot to personalize learning paths based on student performance, making it a more adaptive and intelligent learning tool.

In conclusion, the development of a Telegram chatbot for personalized learning in Physics Education has been proven to be highly feasible and effective. The chatbot received positive validation from experts and users, confirming its potential as an interactive and engaging learning medium. While the chatbot already demonstrates strong pedagogical and technological benefits, future enhancements, such as AI-driven responses and expanded content coverage, could further improve its effectiveness in modern digital education.

4. CONCLUSION

This study successfully developed a personalized learning medium in the form of a Telegram bot, integrating a Project-Based Learning (PBL) model to enhance students' engagement and understanding in Basic Physics courses. Using a Design Thinking approach, the chatbot was developed through five key stages: Empathize, Define, Ideate, Prototype, and Test. The findings from expert validation and user feedback confirmed that the chatbot is highly feasible and effective in supporting online learning.

The Media Expert Validation results indicated that the chatbot scored 92.94% in media feasibility and 95.00% in subject matter feasibility, categorizing it as "very feasible"

for educational use. The analysis further highlighted the importance of usability, functionality, and visual communication in chatbot-based learning. Indicators such as Ease of access, Chatbot content updates, and Image usage were rated highly, emphasizing the necessity of interactivity, accessibility, and visual engagement in online learning. Additionally, the Functionality aspect, including features like Use record username and Bot response activity, was found to be critical in ensuring smooth interaction between the bot and students.

The study also revealed several advantages of using Telegram chatbots in learning. The chatbot facilitated real-time interactions, automated content delivery, and structured project-based assignments, allowing students to apply theoretical knowledge to practical problem-solving activities. Moreover, the chatbot's integration of videos, images, and interactive text-based discussions significantly improved students' engagement and comprehension.

Despite these strengths, some limitations were identified. Technical challenges in accessing the Telegram-based platform were reported by some students, indicating the need for additional training or technical support. Furthermore, the chatbot's lack of AI-powered features and voice recognition limited its interactive capabilities, suggesting areas for future development

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AUTHOR CONTRIBUTION STATEMENT

All authors contributed significantly to this study. **Syarif Mahmud Jailani** conceptualized the research, designed the methodology, and led manuscript writing. **Wawan Kurniawan** conducted the literature review and assisted in chatbot development and data collection. **Febri Berthalita Pujaningsih** handled data validation, statistical analysis, and result interpretation. **Budi Eka Dharma** provided expert feedback on usability and pedagogical effectiveness.

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