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EVALUATION OF THE PROTOTYPING METHOD IMPLEMENTATION IN MOBILE APPLICATION DEVELOPMENT FOR MATERNAL HEALTH MONITORING

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ABSTRACT

The advancement of technology has transformed the health sector, enabling efficient and accessible health monitoring through digital platforms. To support pregnancy monitoring, a mobile-based user experience (UX) design for the BiBu Mobile Health Monitoring Application was developed in 2023 using the Design Thinking method. This prototype was tailored to the needs of pregnant women and midwives in Indonesia and demonstrated feasibility for initial public use. This study involved collaboration with the Provincial Board of the Indonesian Midwives Association (PD-IBI) of Riau Province. Data was collected through Focus Group Discussions (FGDs) with key midwifery figures and midwives, along with direct surveys of potential users and the community. These efforts produced valuable feedback and recommendations for improving the prototype. The input was gathered to create a new Software Product Line (SPL), laying the foundation for future product development. Utilizing the prototyping method allowed iterative refinement, ensuring alignment with user needs and expectations, particularly for stakeholders unfamiliar with software development. This research produced a validated SPL that is ready for further development and implementation. It contributes to advancing health digitization and improving maternal health monitoring. The refined product can enhance healthcare quality in Riau Province and support broader health practices across Indonesia.

Keywords: *Maternal Health Monitoring, BiBu, Mobile Health Application, Prototyping Method, User-Centered Development.*

INTRODUCTION

The rapid advancement of technology has transformed healthcare, with mobile health (mHealth) applications becoming essential tools for improving service delivery, accessibility, and patient care. These applications are particularly beneficial in maternal health, addressing critical issues such as ensuring timely interventions, improving access to healthcare services, and enabling continuous monitoring. The World Health Organization (WHO) emphasizes that digital tools can significantly improve maternal health outcomes by making healthcare more accessible and reliable, particularly in regions with limited resources (WHO, 2023).

Despite their potential, the success of mHealth applications largely depends on their ability to meet user needs through a rigorous and iterative development process. Prototyping, a core method in agile software development, facilitates design, testing, and refinement cycles, ensuring that the application aligns with user expectations and operational requirements (Ozkaynak et al., 2022). This method is critical in maternal health, where the needs of diverse stakeholders—ranging from pregnant women to healthcare providers—must be addressed to create a truly effective solution.

This study examines the application of the prototyping method in developing the BiBu Mobile Health Monitoring Application, a digital solution tailored to the needs of maternal health stakeholders in Indonesia. The application, developed using the Design Thinking methodology, emphasizes a user-centered design approach. Collaboration with the Provincial Board of the Indonesian Midwives Association (PD-IBI) of Riau Province played a pivotal role in ensuring that the application's features and functionalities were closely aligned with the real-world needs of midwives and pregnant women. Focus Group Discussions (FGDs) and surveys with key stakeholders provided valuable feedback, contributing to the iterative design and testing process.

The study contributes to the growing knowledge of applying design and prototyping methodologies in developing mobile health (mHealth) technologies. It underscores the importance of a user-centered approach, which prioritizes the needs, limitations, and preferences of end-users throughout the development process (Trisnadoli et al., 2023). By emphasizing stakeholder collaboration, this research highlights how involving users at every stage of the development cycle can ensure the creation of effective and sustainable digital health tools.

Through its focus on iterative development and continuous user engagement, this research offers valuable insights for improving mHealth solutions, particularly in resource-limited settings. By demonstrating the effectiveness of the prototyping method in refining the BiBu application, the study provides lessons for developing user-centered health applications that can foster innovation and improve health outcomes. These insights are critical

not only for the development of maternal health monitoring solutions but also for advancing digital health technologies in diverse and underserved regions.

METHODS

The methodology employed in this study was designed to systematically evaluate the implementation of the prototyping method in the development of the BiBu Mobile Health Monitoring Application. This study was conducted in several stages to ensure comprehensive data collection, iterative development, and robust evaluation, building on prior research outcomes.

Figure 1. Research Methodology.

Phase 1: Preliminary Research and Planning

This phase reviewed feedback and challenges from the previous BiBu application developed in 2023. Critical benchmarks for quality, usability, and functionality were established, and collaboration with the Provincial Board of the Indonesian Midwives Association (PD-IBI) of Riau Province was initiated to define the data collection scope.

Phase 2: Data Collection

Data was gathered using both qualitative and quantitative methods. Focus Group Discussions (FGDs) with midwives and surveys with pregnant women provided valuable insights into the application's challenges, preferences, and usability concerns.

Phase 3: Iterative Prototyping and Testing

Prototypes were developed and tested with stakeholders, incorporating feedback from each iteration. This process of continuous refinement ensured the application met user needs and addressed challenges identified in earlier phases.

Phase 4: Data Analysis

FGD data were analyzed thematically to identify usability issues and feature preferences. In contrast, survey data were analyzed quantitatively to measure user satisfaction and feature relevance, providing a comprehensive understanding of user requirements.

Phase 5: Final Evaluation and Goal Alignment

The validated prototype was evaluated against predefined benchmarks, ensuring it met the needs of pregnant women and midwives. A Software Product Line (SPL) was produced and is ready for further development and real-world implementation.

The main goal of this study was to evaluate the prototyping method's effectiveness in creating a user-centered mobile health application for maternal health monitoring. By involving stakeholders throughout, this research ensured the app addressed vital challenges and met user expectations, offering valuable insights into using prototyping and Design Thinking in mobile health technology.

RESULTS AND DISCUSSION

Results

The evaluation of the BiBu Mobile Health Monitoring Application, conducted through an iterative prototyping method and supported by direct stakeholder engagement, yielded several significant outcomes. These findings reflect improvements in functionality, usability, and alignment with user needs. These were systematically identified through Focus Group Discussions (FGDs), direct user statements, surveys, interviews, and questionnaire-based data collection.

Table 1. Evaluation Result.

No	Evaluation Result
1	Payment feature using transfer method within the application
2	Feature to view password during login
3	Midwives' registration requires SIP (Surat Izin Praktik) verification
4	Addition of variables in the fetal statistics chart
5	Notification feature for midwives and pregnant women
6	Monthly evaluation data enabling midwives to retrieve monthly reports and coordinate with local health centers (puskesmas)
7	Standardized average weight gain for fetus and pregnant women based on BMI and triple elimination lab results
8	Detailed fetal condition evaluation feature
9	Automatic scheduling for the next visit feature
10	Display of pregnant women’s medical history in the midwives’ accounts
11	Improvement of cohort features to align with healthcare standards
12	Addition of fetal photos based on gestational age in the fetal profile

Based on the results presented in Table 1, the following is a detailed explanation of the evaluation notes:

1. **Payment Feature via Transfer**
   A transfer method payment feature was added in response to user feedback from FGDs with midwives and pregnant women, who emphasized the need for convenient financial transactions. Surveys also showed strong interest in integrating payment solutions for seamless service use.
2. **Password Visibility Option**
   Users found logging in challenging during interviews. A password visibility feature was added to improve access and reduce errors, making it easier for non-technical users to log in.
3. **SIP Verification for Midwife Registration**
   Midwives in FGDs emphasized the need for professional verification. The requirement to upload a valid Surat Izin Praktik (SIP) during registration was introduced to ensure credibility and regulatory compliance.
4. **Enhanced Fetal Statistics Variables**
   Survey responses and FGDs highlighted the need for more detailed fetal statistics. Additional variables were added to improve the accuracy of fetal health monitoring for users and midwives.
5. **Notification Feature for Midwives and Pregnant Women**
   Participants in FGDs and surveys requested timely reminders for appointments and health check-ups. A notification feature was added to facilitate better communication and proactive health management.
6. **Monthly Evaluation Data for Midwives**
   Midwives requested a feature to generate monthly evaluation reports for better coordination with local health centers (puskesmas). This feature was added to streamline reporting and enhance healthcare service efficiency.
7. **Standardized Weight Gain Based on BMI and Laboratory Results**
   FGDs and surveys revealed the need for personalized health metrics. The app now includes standardized guidelines for weight gain based on BMI and lab results, ensuring evidence-based maternal health guidance.
8. **Detailed Fetal Condition Evaluation**
   Feedback from midwives emphasized the need for more detailed fetal assessments. An expanded evaluation module was added to enable midwives to provide more precise recommendations.
9. **Automatic Scheduling for Next Visits**
   Users mentioned difficulty remembering follow-up appointments. An automatic scheduling feature was added to ensure timely prenatal visits and adherence to recommended care schedules.
10. **Pregnant Women's Medical History for Midwives**

Midwives emphasized the importance of accessing a pregnant woman's medical history for informed decision-making. This feature allows midwives to view medical histories directly, improving care quality.

11. **Improvement in Cohort Features**
    Feedback from FGDs and surveys pointed out areas for improvement in cohort data. Adjustments were made to align the cohort feature with healthcare standards for accurate data recording.
12. **Fetal Profile Pictures Based on Gestational Age**
    Pregnant women requested more visual features. Fetal profile images corresponding to gestational age were added to increase emotional connection and awareness of fetal development.

Discussion

The comprehensive data collection methods, including FGDs, direct user statements, surveys, and questionnaires, ensured the application development process was deeply user-centered. Feedback from midwives and pregnant women provided specific insights into the functional and operational requirements, while the broader survey responses captured diverse perspectives from potential users in the general public.

Including regulatory features, such as SIP verification, improved the application's credibility and ensured compliance with professional standards. Similarly, features like monthly evaluation data and standardized weight metrics align with the goals of evidence-based maternal health practices, bridging the gap between traditional healthcare delivery and modern digital solutions.

Enhancements in usability, such as password visibility and notification features, reflect the application's focus on creating an intuitive user experience. These updates cater to varying levels of digital literacy, ensuring the application's accessibility and effectiveness for many users.

From a broader perspective, the iterative prototyping method facilitated continuous application refinement, ensuring that user feedback was effectively integrated at each stage. The FGDs and surveys played a pivotal role in shaping the application, demonstrating the importance of stakeholder collaboration in health technology development.

CONCLUSION

Implementing the prototyping method in developing the BiBu Mobile Health Monitoring Application proved highly effective in addressing user needs and improving the overall user experience. The iterative design process, guided by feedback from midwives, pregnant women, and surveys, incorporated vital features such as payment integration, detailed fetal monitoring, automated scheduling, and enhanced communication tools. These

updates align the application more closely with the expectations of its users and healthcare standards, providing a robust and user-centered tool for maternal health monitoring. The findings underscore the value of involving end-users in the development process and highlight the potential for mobile health applications to enhance healthcare accessibility and quality in Indonesia, particularly in underserved areas.

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