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STRENGTHENING EARLY DETECTION OF PREGNANCY RISKS VIA AN INTELLIGENT SYSTEM IN RURAL COMMUNITIES

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ABSTRAK

Kesehatan ibu hamil merupakan indikator utama kualitas kesehatan masyarakat, namun pemantauan di wilayah pedesaan masih sering dilakukan secara manual dengan literasi teknologi yang rendah. Penelitian pengabdian ini bertujuan untuk mengevaluasi efektivitas edukasi berbasis teknologi menggunakan aplikasi web dalam meningkatkan pengetahuan dan keterampilan kader kesehatan terkait tanda bahaya kehamilan, gizi ibu dan anak, serta deteksi dini risiko kehamilan. Metode yang digunakan adalah pendekatan partisipatif berbasis *community engagement* yang diadaptasi dengan kerangka *design sprint*, meliputi tahap *understand, define, develop, deliver,* dan *evaluate*. Kegiatan melibatkan 30 kader kesehatan di Desa Karangrau melalui penyuluhan, diskusi, dan simulasi aplikasi berbasis web. Evaluasi menggunakan kuesioner *pre-test* dan *post-test* skala Likert yang dianalisis secara deskriptif. Hasil menunjukkan peningkatan pemahaman peserta yang signifikan, dengan nilai rata-rata meningkat dari 89% pada *pre-test* menjadi 99% pada *post-test*. Penggunaan aplikasi berbasis web terbukti efektif memvisualisasikan data kesehatan secara konkret. Kesimpulannya, integrasi edukasi partisipatif dan teknologi interaktif efektif meningkatkan kapasitas kader dan berpotensi menjadi model edukasi berkelanjutan. Program ini diharapkan dapat mendorong pemanfaatan teknologi sederhana sebagai media pendukung penyampaian informasi kesehatan di tingkat komunitas.

Kata Kunci: Deteksi Dini Kehamilan; Edukasi Kesehatan; Kader Kesehatan

ABSTRACT

Maternal health is a crucial indicator of public health quality, yet monitoring in rural areas is often conducted manually with low technological literacy. This study aims to evaluate the effectiveness of technology-based education using a web-based application in improving health cadres' knowledge and skills regarding pregnancy danger signs, maternal and child nutrition, and early pregnancy risk detection. The method used is a participatory approach based on community engagement adapted with a design sprint framework, encompassing understand, define, develop, deliver, and evaluate stages. The activity involved 30 health cadres in Karangrau Village through counseling, discussions, and web-based application simulations. Evaluation used a descriptive Likert-scale pre-test and post-test questionnaire. Results showed a significant improvement in participants' understanding, with average

scores increasing from 89% in the pre-test to 99% in the post-test. The use of a web-based application proved effective in concretely visualizing health data. In conclusion, the integration of participatory education and interactive technology effectively enhances cadre capacity and has the potential to become a sustainable educational model. This program is expected to encourage the utilization of simple technology as a medium for delivering health information at the community level.

Keyword: Early Pregnancy Detection; Health Education; Health Cadres

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1. INTRODUCTION

Maternal health remains a crucial indicator for improving public health quality and achieving the Sustainable Development Goals (SDGs), specifically the third goal of ensuring healthy lives and well-being. Globally, the World Health Organization reports that approximately 287,000 women die annually from pregnancy and childbirth complications, with the majority of cases occurring in developing countries (Organization, 2023). In Indonesia, the Maternal Mortality Rate (MMR) remains a significant challenge, recorded at around 305 per 100,000 live births, which is still far from the SDG target of 70 per 100,000 live births (Kementrian Kesehatan, 2025). This condition highlights the urgent need to strengthen promotive and preventive efforts, particularly through the early detection of pregnancy risks at the community level.

In rural areas, maternal and child health issues are further complicated by limited access to healthcare services, low health literacy, and the suboptimal utilization of technology. Early detection of pregnancy risks is frequently conducted manually, potentially causing delays in medical decision-making and increasing the risk of life-threatening complications for both mother and fetus (DINKOMINFO, 2023). Based on initial observations and coordination in Karangrau Village, Banyumas Regency, the monitoring of pregnant women's health is still carried out conventionally without digital integration. Furthermore, health cadres lack a structured system for rapid and accurate risk identification, a problem exacerbated by their limited digital literacy in utilizing technology as a health support tool (Thakur et al., 2025b, 2025a).

Maternal health conditions during pregnancy are also intricately linked to nutritional status and child development outcomes. Nationally, the prevalence of stunting in Indonesia was recorded at 21.5% in 2023, indicating that nutritional issues remain a serious public health concern (Dinkominfo Kabupaten, 2025). At the regional level, Banyumas Regency shows a stunting incidence of 8.06%, reflecting a strong correlation between maternal health during

pregnancy and the nutritional status of children (Iswahyudi & Putra, 2025; Nurherliyany et al., 2023). Factors such as poor maternal nutrition, inadequate antenatal care (ANC) monitoring, and delayed risk detection are primary contributors to child growth disorders, making community-based education on maternal and child nutrition a critical preventive step (Fauziah et al., 2023).

The advancement of information technology provides significant opportunities to enhance the quality of community health education (Nurhalizah & Ardianto, 2024). The use of web-based applications as interactive educational media allows information to be delivered more comprehensively through data visualization, such as growth charts and nutritional status indicators. This technology serves not only as a computational tool but also as a learning medium that fosters independent and sustainable health awareness among the community (Wiguna & Firmansyah, 2023). Health cadres play a strategic role as the frontline of health information delivery; however, their capacity regarding pregnancy danger signs, maternal and child nutrition, and early risk detection must be systematically strengthened through technology-based educational approaches (Luthfi et al., 2024).

Addressing these challenges, this community service program was conducted in Karangrau Village, involving 30 health cadres as the primary participants. The program focuses on providing education regarding pregnancy danger signs, maternal and child nutrition, and early risk detection by utilizing a web-based application as an interactive learning medium. Employing a participatory community engagement approach, the activity aims to improve the cadres' capacity and digital literacy in maternal health monitoring. Ultimately, this initiative is expected to encourage the utilization of simple technology to support health information delivery at the community level, thereby increasing awareness, knowledge, and preparedness in mitigating pregnancy risks (Kurniawati et al., 2023).

2. METHOD

This community service program was conducted in Karangrau Village, Banyumas Regency, utilizing a participatory approach based on community engagement (Kurniawati et al., 2023) integrated with an adapted design sprint framework (Anita & Diana, 2025). The methodology encompassed five systematic stages: understand, define, develop, deliver, and evaluate, ensuring a structured, contextually relevant, and solution-oriented process. The program involved 30 health cadres as the primary participants, who serve as the frontline of community health information.

To provide a comprehensive overview of the program's workflow, the design matrix and flowchart of the activities are presented in Table 1 and Figure 1, respectively. The initial phases (understand and define) relied on field observations and collaborative coordination with local partners to identify critical gaps, including the conventional manual monitoring of maternal health, limited digital literacy among cadres, and the urgent necessity for structured early risk detection and nutritional education.

Table 1. Program Design Matrix based on Design Sprint Framework

Stage	Objective	Key Activities	Expected Output
1. Understand	To identify the root problems and current conditions of the partner.	Field observation, informal interviews with health cadres, and infrastructure assessment.	Problem mapping (manual recording, low digital literacy).
2. Define	To determine program priorities and educational needs.	Focus Group Discussion (FGD) with local partners and needs analysis.	Prioritized needs (danger signs, nutrition, risk detection).
3. Develop	To design the intervention media and educational materials.	UI/UX design of the web-based application, compilation of contextual educational modules.	Web application prototype and educational modules.
4. Deliver	To implement the program and transfer knowledge/technology to cadres.	Counseling sessions, interactive discussions, and hands-on application simulation.	Increased knowledge and practical skills of the cadres.
5. Evaluate	To measure the effectiveness of the program intervention.	Administration of pre-test and post-test questionnaires, descriptive data analysis.	Evaluation report of cognitive improvement and technology adoption.

The core intervention (deliver stage) combined interactive educational sessions on pregnancy danger signs and maternal-child nutrition with the practical simulation of a user-friendly, web-based application designed for health data visualization. To assess the program's effectiveness, the final stage (evaluate) employed a quantitative descriptive approach using a 10-item Likert scale questionnaire (Lazuli et al., 2024) administered as both a pre-test and post-test. The collected data were analyzed using percentage calculations (Susylowati et al., 2023) to measure the cognitive improvement of the participants before and after the technology-based educational intervention.

3. RESULTS AND DISCUSSION

RESULTS

a. Initial Condition Assessment and Problem Identification

The initial assessment conducted in Karangrau Village revealed significant challenges in maternal health monitoring practices. Field observations demonstrated that the majority of health data recording for pregnant women was still performed manually using register books or simple notes. This conventional approach created potential delays in data recording and reporting, which could impact timely decision-making for maternal health interventions. The reliance on manual systems also increased the risk of data inconsistencies and loss of critical health information over time.

Interviews with health cadres revealed that risk identification processes depended heavily on subjective experience rather than systematic tools. One cadre stated, "*We usually rely on what we remember from training, but sometimes we forget the specific danger signs, especially when dealing with multiple cases."* This finding highlighted the absence of structured decision-support tools that could guide cadres in identifying pregnancy risks accurately and consistently. The lack of standardized protocols contributed to variations in how different cadres assessed and responded to maternal health concerns.

Human resource assessment indicated that while health cadres played an active role in community health services, they faced limitations in understanding early pregnancy risk detection concepts. The cadres demonstrated relatively low digital literacy, as evidenced by their limited use of technological devices such as smartphones or web-based applications for health activities. This technological gap represented a significant barrier to implementing modern health monitoring systems in the village. However, cadres expressed strong willingness to learn and adopt new tools that could simplify their work and improve service quality.

Table 1. Baseline Assessment of Health Cadre Capabilities and Infrastructure

Assessment Category	Indicator	Findings	Percentage
Data Recording Method	Manual recording	Register books and simple notes	100%
Digital Literacy	Smartphone usage for health	Limited application use	23%
Risk Detection Knowledge	Understanding of danger signs	Moderate understanding	67%
Technology Access	Device availability	Personal smartphones	85%
Training Background	Formal health training	Basic cadre training	100%

The baseline assessment data presented in Table 1 illustrates the existing conditions that shaped the program design. The universal reliance on manual recording methods (100%) confirmed the urgent need for digital transformation in health monitoring practices. While 85% of cadres possessed personal smartphones, only 23% utilized these devices for health-related applications, indicating a substantial gap between technology access and technology utilization. The moderate understanding of danger signs (67%) suggested that cadres had foundational knowledge but required reinforcement and systematic tools to improve accuracy. These findings collectively justified the development of a simple, accessible web-based application that could bridge the gap between existing capabilities and desired health monitoring outcomes.

Figure 1. Problem Identification Flowchart

The problem identification flowchart visually represents the interconnected challenges discovered during the initial assessment phase. The diagram illustrates how manual recording systems create a cascade of problems, including delayed data processing, inconsistent risk identification, and ultimately compromised maternal health outcomes. The visual mapping helped stakeholders understand the systemic nature of the problems and facilitated consensus on intervention priorities. This structured visualization also served as a reference point throughout the program development to ensure that solutions addressed the root causes rather than merely treating symptoms.

b. Needs Analysis and Program Design

The needs formulation process involved extensive discussions with local partners to establish program priorities that aligned with field conditions and participant characteristics. Through collaborative dialogue, the primary needs were identified as improving cadre understanding of pregnancy danger signs, maternal and child nutrition, and early pregnancy risk detection as preventive measures. These priorities directly addressed the gaps identified during the initial assessment and reflected the most pressing concerns expressed by health workers and community members. The participatory approach ensured that the program design was grounded in local realities rather than imposed external assumptions.

Educational material development considered the participants' educational backgrounds and digital literacy levels to ensure accessibility and comprehension. Since most participants were cadres with non-technical backgrounds and limited digital literacy, the educational approach needed to be informative yet easy to understand and apply in daily practice. The materials were designed using simple language and contextualized with case examples relevant to everyday situations in the community. This contextualization strategy helped participants connect theoretical concepts with practical scenarios they encountered regularly in their work.

The identification of needs for interactive educational media became a central focus during this phase, as conventional delivery methods were deemed insufficient for deep conceptual understanding. Discussions with partners revealed that traditional lecture-based

approaches did not adequately help participants grasp health concepts in a meaningful way. Consequently, technology-based educational media was selected as an alternative solution to enhance learning effectiveness through visual presentation of information. The web-based application was designed to display data visually, enabling participants to understand the relationship between health parameters and displayed outcomes more intuitively.

Table 2. Educational Needs Assessment Results

Need Category	Priority Level	Current Status	Target Outcome
Danger Signs Knowledge	High	Inconsistent recognition	Systematic identification
Nutrition Understanding	High	Basic awareness	Comprehensive knowledge
Risk Detection Skills	Critical	Experience-based	Tool-assisted detection
Digital Literacy	Medium	Low application use	Confident technology use
Data Management	High	Manual recording	Digital documentation

The educational needs assessment results in Table 2 demonstrate the hierarchical prioritization that guided program development. Risk detection skills received critical priority status due to their direct impact on maternal mortality prevention, while digital literacy was categorized as medium priority since it served as an enabling factor rather than an end goal. The gap analysis between current status and target outcomes revealed that systematic, tool-assisted approaches were necessary to achieve desired improvements. This structured needs assessment ensured that the program addressed the most impactful areas while building progressively on existing knowledge and capabilities.

Figure 2. Program Design Framework

The program design framework diagram illustrates the logical flow from identified needs to planned interventions and expected outcomes. The visual representation shows how each component of the program connects to specific needs identified during the assessment phase, creating a coherent theory of change. This framework facilitated communication among stakeholders by providing a clear roadmap of program activities and their intended effects.

The systematic design approach ensured that all program elements worked synergistically toward the overarching goal of improving maternal health monitoring through enhanced cadre capacity.

c. Development of Web-Based Educational Media

The web-based application development prioritized user-friendly design principles to accommodate participants with limited technical backgrounds. The interface was designed with intuitive navigation and simple language to ensure accessibility for non-technical users. Special attention was given to minimizing dependence on stable internet connectivity, recognizing the infrastructure limitations in rural areas. The application could run on commonly available devices such as smartphones or laptops without requiring high technical specifications, making it practical for widespread adoption among health cadres.

The application featured a primary data input form that collected fundamental information including age in months, weight, height, and gender. This input data was then processed by the system to generate output in the form of visual growth charts, including indicators for weight-for-age (W/A), height-for-age (H/A), and weight-for-height (W/H). The system also provided simple interpretations related to nutritional status categories that participants could understand immediately without requiring advanced analytical skills. This automated analysis feature reduced the cognitive burden on cadres and minimized the risk of calculation errors.

The educational media was developed not merely as a calculation tool but as a learning instrument capable of bridging participants' understanding of abstract health concepts. Through data visualization in the form of graphs and clear indicators, participants could more concretely understand the relationship between inputted health parameters and resulting conditions. One cadre commented during the simulation, "Seeing the graph makes it so much clearer than just numbers in a book. I can actually see if a child is growing properly." This visual learning approach enhanced the effectiveness of the educational process and encouraged participants to actively understand and monitor health conditions independently.

Table 3. Web Application Features and Functions

Feature	Function	User Benefit	Technical Requirement
Data Input Form	Collect basic health metrics	Standardized data entry	Minimal typing skills
Growth Chart Visualization	Display W/A, H/A, W/H indicators	Immediate visual feedback	Browser compatibility
Nutritional Status Interpretation	Auto-categorize health status	Eliminate manual calculation	Built-in algorithm
Simple Navigation	Guide users through process	Reduce learning curve	Intuitive interface design
Offline Capability	Function with limited connectivity	Ensure accessibility in rural areas	Local data storage

The feature specification table demonstrates how each application component was designed to address specific user needs while maintaining technical simplicity. The growth

chart visualization feature directly responded to the identified need for concrete understanding of health concepts, while the offline capability addressed infrastructure limitations in the village setting. The automated nutritional status interpretation eliminated the need for cadres to memorize complex classification criteria, reducing the potential for errors in health assessments. These carefully selected features ensured that the technology served as an enabler rather than a barrier to improved health monitoring practices.

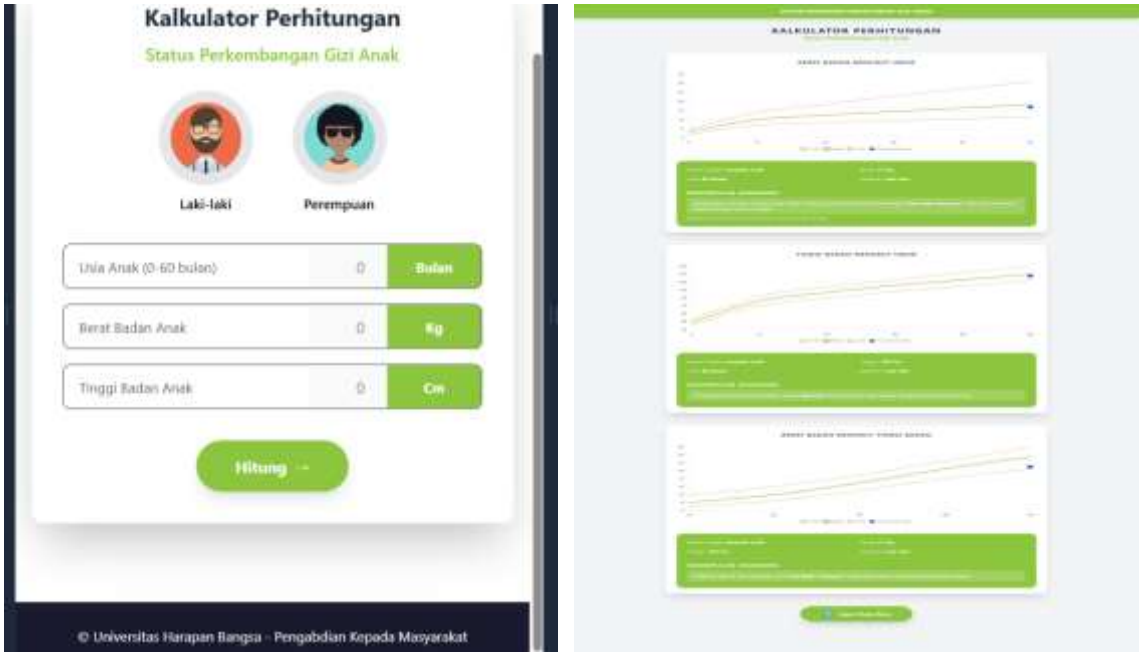

Figure 3. Application Interface Design

The application interface design showcases the transformation from data input to visual output, demonstrating the user journey through the system. The input interface presents a clean, uncluttered form that guides users through the data entry process without overwhelming them with technical complexity. The output interface displays growth charts with clear visual indicators that make health status immediately apparent, even to users with limited technical training. This visual design approach aligns with cognitive learning principles by presenting information in formats that are easier to process and remember than numerical data alone.

d. Program Implementation and Participant Engagement

The program implementation involved 30 health cadres representing community members at the RT and RW levels in Karangrau Village. The activity was conducted through integrated education that included material delivery, interactive discussions, and hands-on practice through web-based application simulation. The implementation was systematically designed to ensure participants not only received theoretical material but also gained direct learning experiences that could be applied in their daily work. This practical orientation distinguished the program from conventional training approaches that often fail to translate knowledge into practice.

The activity began with the delivery of educational materials covering pregnancy danger signs, maternal and child nutrition, and the importance of early pregnancy risk detection. Material delivery was conducted communicatively using simple language adapted to participants' comprehension levels, with case examples frequently encountered in community settings. This contextualization strategy helped participants more easily understand and connect the material with real conditions in the field. Participants demonstrated high engagement during these sessions, asking relevant questions and sharing their own experiences with similar cases.

The simulation session provided participants with opportunities to directly try using the application by entering simple data such as age, weight, and height. The results displayed in the form of graphs and health status information helped participants understand the relationship between inputted data and generated health conditions. This simulation process provided practical learning-by-doing experiences, enabling participants to understand the material more deeply through active engagement. During the simulation, participants showed high enthusiasm, evident from their activeness in asking questions, discussing, and trying to use the system independently.

Table 4. Participant Engagement Indicators

Engagement Metric	Observation	Frequency	Percentage
Question Asking	Active participation	47 questions	100% participation
Discussion Contribution	Sharing experiences	23 contributions	77% participation
System Trial	Independent application use	30 participants	100% participation
Material Comprehension	Correct answers during Q&A	28/30 correct	93% accuracy
Session Attendance	Full participation	30/30 present	100% attendance

The participant engagement indicators in Table 4 reveal exceptionally high levels of involvement throughout the program implementation. The 100% participation rate in both question-asking and system trial activities demonstrates that the program successfully created an inclusive learning environment where all participants felt comfortable engaging with the material and technology. The 93% accuracy rate in answering questions during the session indicated that participants were not merely present but were actively processing and understanding the information being presented. These engagement metrics suggest that the combination of interactive discussion and hands-on simulation effectively maintained participant interest and facilitated meaningful learning.

Figure 4. Implementation Activity Flow

The implementation activity flow documentation captures the progression from theoretical material delivery to practical application through simulation. The images show participants actively engaged in both listening sessions and hands-on practice, demonstrating the program's balanced approach to knowledge transfer. The visual documentation reveals the collaborative atmosphere of the sessions, with participants working together to understand and apply the new tools and concepts. This active learning environment contrasted sharply with the passive reception characteristic of traditional lecture-based training, contributing to the program's effectiveness in building lasting capacity.

e. Evaluation of Knowledge Improvement

The evaluation phase measured program effectiveness through pre-test and post-test questionnaires administered before and after the activity. The instrument consisted of 10 Likert-scale questions systematically arranged to measure participants' understanding of pregnancy danger signs, maternal and child nutrition, and early pregnancy risk detection. Each question was designed to represent knowledge indicators relevant to the delivered material, ensuring that evaluation results could comprehensively depict participants' understanding levels. The quantitative approach allowed for objective comparison of knowledge levels before and after the educational intervention.

Data analysis using descriptive percentage methods revealed significant improvements in participant understanding across all measured indicators. The average participant score increased from 89% in the pre-test to 99% in the post-test, demonstrating the positive impact of the educational intervention. Although initial scores were already relatively high, the improvement indicated meaningful reinforcement of existing knowledge, particularly in aspects of early detection and technology utilization for education. This enhancement suggested that participants not only acquired new information but also deepened their understanding of previously held knowledge.

The use of web-based applications as educational media contributed to improved participant understanding through more easily comprehensible data visualization. This approach enabled participants to learn interactively and practically, making the learning process more effective and memorable. One participant reflected, "Before this training, I knew the danger signs but I wasn't confident in identifying them. Now with the application showing the graphs, I feel much more certain about my assessments." The integration of participatory education methods and interactive technology proved effective in enhancing health cadre capacity, creating a sustainable model for community health education.

Table 5. Pre-Test and Post-Test Comparison Results

Knowledge Domain	Pre-Test Average	Post-Test Average	Improvement	Percentage Gain
Danger Signs Recognition	87%	98%	+11%	12.6%
Nutrition Knowledge	90%	99%	+9%	10.0%
Risk Detection	88%	99%	+11%	12.5%
Technology Application	85%	98%	+13%	15.3%
Overall Score	89%	99%	+10%	11.2%

The pre-test and post-test comparison results in Table 5 demonstrate consistent improvement across all knowledge domains, with technology application showing the highest percentage gain at 15.3%. This finding indicates that participants not only improved their health knowledge but also developed confidence in using digital tools for health monitoring. The relatively high pre-test scores (ranging from 85% to 90%) suggested that cadres entered the program with solid foundational knowledge, which the program successfully strengthened and systematized. The post-test scores approaching 99% across all domains indicated that the program achieved near-universal comprehension of the essential concepts and skills.

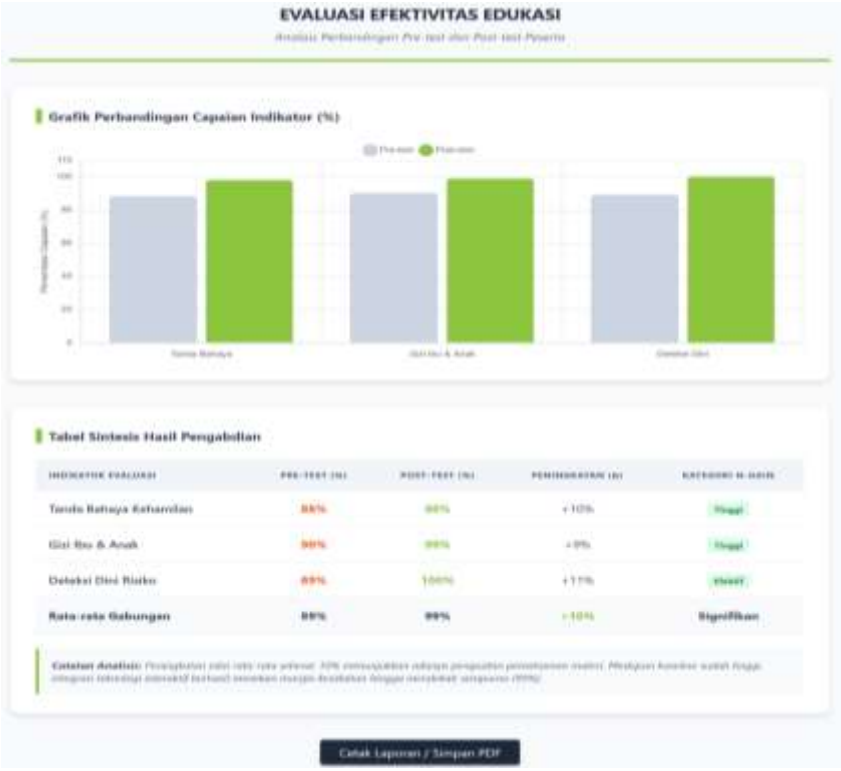

Figure 5. Knowledge Improvement Visualization

The knowledge improvement visualization graphically represents the upward trajectory of participant understanding from pre-test to post-test across all measured domains. The visual display makes the magnitude of improvement immediately apparent, showing how the educational intervention elevated participants from good to excellent levels of comprehension. The consistent pattern of improvement across all knowledge areas suggests

that the program's integrated approach effectively addressed multiple learning objectives simultaneously. This visual evidence of program impact provides compelling documentation of the intervention's effectiveness and supports the case for scaling similar approaches to other communities facing comparable maternal health challenges.

DISCUSSION

The significant improvement in participants' understanding, as evidenced by the increase in average scores from 89% in the pre-test to 99% in the post-test, underscores the effectiveness of structured educational interventions for health cadres. This finding aligns with the study by Parmawati et al (2020), which emphasized that systematic training and screening programs substantially enhance cadres' knowledge and capabilities in detecting early pregnancy risk factors. Furthermore, Prafitri et al (2025) demonstrated that continuous assistance and targeted education for local health workers are critical in mitigating high-risk pregnancies at the community level. The current study corroborates these findings by showing that when cadres are equipped with standardized knowledge regarding danger signs, their confidence and accuracy in community-level early detection improve markedly, transitioning from subjective experience to evidence-based assessment.

Beyond theoretical knowledge, the integration of a web-based application as an interactive educational medium proved instrumental in helping cadres visualize abstract health concepts, particularly regarding nutritional status and growth indicators. This result strongly supports several previous studies, who developed an expert system to predict pregnancy health risks, concluding that technology-based systems significantly simplify complex medical parameters for non-technical users ***(Huyer & Nuñez, 2022; Viswanathan et al., 2025; Yeung et al., 2023)***. Similarly, several previous studies highlighted the efficacy of web-based detection systems in identifying stunting risks by transforming raw anthropometric data into comprehensible visual outputs . The current study's application, which generates visual growth charts (W/A, H/A, W/H), mirrors these technological advancements, proving that digital visualization bridges the gap between raw health data and practical, actionable insights for rural health workers.

The transition from manual recording to digital monitoring using the web-based application also addresses the critical need for modernizing maternal health surveillance in rural areas. This approach is heavily supported by Kurniawati et al. (2023), whose literature review confirmed that Mobile Health (mHealth) applications based on expert systems are highly effective tools for monitoring pregnancy danger signs and ensuring timely medical referrals. While several previous studies focused on mobile platforms, the current study demonstrates that web-based applications offer a similarly robust, accessible alternative that does not require high-end smartphone specifications, making it highly suitable for rural settings with varying device capabilities ***(Agbeyangi & Suleman, 2024; Droutsas et al., 2025)***. Both studies converge on the conclusion that digital health tools drastically reduce the delay

in identifying complications, thereby serving as a vital preventive mechanism against maternal and fetal mortality.

The educational component focusing on maternal and child nutrition directly addresses the regional and national urgency of stunting prevention. The local context in Banyumas Regency, which records a stunting incidence of 8.06% (Dinkominfo Kabupaten, 2025), necessitates aggressive community-based interventions. The findings of this program reinforce the assertions of several previous studies, who identified poor maternal nutrition and inadequate antenatal care as primary contributors to child growth disorders, emphasizing that education on these topics is a fundamental preventive step (Ali, 2021; Keats et al., 2021; Marine et al., 2026). Furthermore, the urgency of comprehensive maternal health monitoring is echoed by several previous studies, who stressed the importance of routine checks during pregnancy to detect underlying health issues. By educating cadres on the intricate link between maternal nutrition during pregnancy and child development, this program successfully operationalizes these theoretical frameworks into practical community prevention strategies (Barry et al., 2023; Chang et al., 2023).

Finally, the success of this program highlights the critical role of health cadres as the frontline of community health and the necessity of empowering them through participatory methods. The initial assessment revealed low digital literacy among cadres, yet the interactive, learning-by-doing approach successfully overcame this barrier. This aligns with several previous studies, who found that cadre performance in managing nutritional and health status is heavily influenced by their knowledge levels and the support systems provided to them (Husnida et al., 2026; Nur et al., 2025). While previous community service programs often struggle with technology adoption due to user resistance, the participatory community engagement approach used in this study ensured that the technology was not merely imposed but collaboratively adapted to the users' needs. This confirms that combining technological tools with empathetic, participatory training is the most sustainable strategy for enhancing rural health cadre performance and ensuring long-term digital literacy.

4. CONCLUSION

The community service program conducted in Karangrau Village successfully demonstrated that integrating participatory education with web-based technology significantly enhances the capacity of health cadres in early pregnancy risk detection. Through a structured approach encompassing problem identification, needs formulation, media development, implementation, and evaluation, the intervention effectively addressed critical gaps in manual health monitoring and low digital literacy among local health workers. The utilization of an interactive web application as an educational medium proved highly effective in translating abstract health and nutritional concepts into concrete, visual data. This technological integration, coupled with interactive discussions and practical simulations, not only improved the cadres' knowledge regarding pregnancy danger signs and maternal-child

nutrition but also fostered their confidence in utilizing digital tools for proactive community health surveillance.

The quantitative evaluation underscored the program's overall effectiveness, with participants' average comprehension scores increasing from 89% in the pre-test to 99% in the post-test, reflecting a substantial reinforcement of both foundational health knowledge and technical application skills. Beyond the immediate cognitive improvements, this initiative establishes a sustainable, technology-driven educational model that can be replicated in other rural communities facing similar maternal and child health challenges. Moving forward, it is highly recommended that local health authorities and village governments continue to support this digital empowerment, potentially by integrating the web application with broader regional health information systems to ensure continuous, data-driven, and accessible maternal health monitoring at the grassroots level.

REFERENSI

Agbeyangi, A., & Suleman, H. (2024). Advances and Challenges in Low-Resource-Environment Software Systems: A Survey. *Informatics 2024, Vol. 11, Page 90*, *11*(4), 90. https://doi.org/10.3390/INFORMATICS11040090

Ali, A. (2021). Current Status of Malnutrition and Stunting in Pakistani Children: What Needs to Be Done? *Journal of the American College of Nutrition*, *40*(2), 180–192. https://doi.org/10.1080/07315724.2020.1750504

Anita, N., & Diana, S. A. (2025). Deteksi Dini Faktor Resiko Kehamilan dan Peningkatan Pengetahuan Kader Tentang Screening Serta Pemeriksaan Kesehatan pada Ibu Hamil di Desa Mosso. *Kolaborasi Jurnal Pengabdian Masyarakat*, *05*(02), 246–256.

Barry, M. J., Nicholson, W. K., Silverstein, M., Cabana, M. D., Chelmow, D., Coker, T. R., Davis, E. M., Donahue, K. E., Jaén, C. R., Li, L., Ogedegbe, G., Rao, G., Ruiz, J. M., Stevermer, J., Tsevat, J., Underwood, S. M., & Wong, J. B. (2023). Screening for Hypertensive Disorders of Pregnancy: US Preventive Services Task Force Final Recommendation Statement. *JAMA*, *330*(11), 1074–1082. https://doi.org/10.1001/JAMA.2023.16991

Chang, K.-J. ;, Seow, K.-M. ;, Chen, K.-H., Chang, K.-J., Seow, K.-M., & Chen, K.-H. (2023). Preeclampsia: Recent Advances in Predicting, Preventing, and Managing the Maternal and Fetal Life-Threatening Condition. *International Journal of Environmental Research and Public Health 2023, Vol. 20, Page 2994*, *20*(4), 2994. https://doi.org/10.3390/IJERPH20042994

DINKOMINFO. (2023). *Mini Lokakarya Lintas sektoral percepatan penurunan stunting tingkat Kecamatan Kedungbanteng. Https://Kedungbantengkec.Banyumaskab.Go.Id*. https://kedungbantengkec.banyumaskab.go.id/news/43628/mini-loka-karya-cegah-stunting#

Dinkominfo Kabupaten, B. (2025). *Kondisi Stunting Kabupaten Banyumas. Badan Perencanaan Pembangunan, Penelitian Dan Pengembangan Daerah*. https://static.banyumaskab.go.id/website/file/website_30052311360064757d306ea94.xlsx

Droutsas, N., Spyridonis, F., Daylamani-Zad, D., & Ghinea, G. (2025). Web accessibility barriers and their cross-disability impact in eSystems: A scoping review. *Computer Standards & Interfaces*, *92*, 103923. https://doi.org/10.1016/J.CSI.2024.103923

Fauziah, J., Trisnawati, K. D., Rini, K. P. S., & Putri, S. U. (2023). Stunting: Penyebab, Gejala, dan Pencegahan. *Jurnal Parenting Dan Anak*, *1*(2), 11. https://doi.org/10.47134/jpa.v1i2.220

Husnida, N., Rahmatina, A. N., Wiwaha, G., Adnani, Q. E. S., & Hilmanto, D. (2026). Health Cadre Mentoring Model in Stunting Prevention Programs: A Systematic Literature Review. *Journal of Multidisciplinary Healthcare*, *19*. https://doi.org/10.2147/JMDH.S594400

Huyer, S., & Nuñez, E. (2022). Breaking through the silicon wall: gendered opportunities and risks of new technologies. *Gender, Technology and Development*, *26*(3), 306–324. https://doi.org/10.1080/09718524.2022.2146001

Iswahyudi, S. N. S., & Putra, R. E. (2025). Sistem Deteksi Stunting pada Balita Berbasis Web Menggunakan Metode Random Forest. *Journal of Informatics and Computer Science (JINACS)*, *6*(03), 755–764. https://doi.org/10.26740/jinacs.v6n03.p755-764

Keats, E. C., Das, J. K., Salam, R. A., Lassi, Z. S., Imdad, A., Black, R. E., & Bhutta, Z. A. (2021). Effective interventions to address maternal and child malnutrition: an update of the evidence. *The Lancet Child and Adolescent Health*, *5*(5), 367–384. https://doi.org/10.1016/S2352-4642(20)30274-1

Kurniawati, P., Sukihananto, S., & Atin Amanah, D. (2023). Using Mobile Health Based Expert System In Monitoring Risk Signs Of Pregnancy: Literature Review. *Journal of Health and Cardiovascular Nursing*, *3*(1), 17–27. https://doi.org/10.36082/jhcn.v3i1.998

Lazuli, N. S., Trisnawati, E., & Marlenywati. (2024). Faktor yang Mempengaruhi Kinerja Kader Posyandu Berdasarkan Status Gizi di Desa Limbung. *Darussalam Nutrition Journal*, *11*(11), 2202–2210. https://garuda.kemdiktisaintek.go.id/documents/detail/4714795

Luthfi, R., A'yuni, N. Q., Safitri, S. R., Satriya, A., Febriyantika, R., & Putra, A. P. (2024). Program Pengabdian Kepada Masyarakat: Metode Fun-Counseling Dan Outbound Sebagai Media Pembelajaran Dan Pembentukan Karakter Anak Di Desa Rowoboni Tahun 2024. *Varia Humanika*, *5*(2), 1–7. https://doi.org/10.15294/vh.v5i2.15749

Marine, B. T., Haile, Y. A., & Zewde, M. G. (2026). Maternal nutrition practices and its implications for child growth and development in Jimma Town a community based cross sectional study. *Scientific Reports 2026 16:1*, *16*(1), 15195-. https://doi.org/10.1038/s41598-026-37151-4

Nur, A., Luciana Diaz Vera da Costa, S., Goreti Pantaleon, M., Helena Dua Nita, M., Agung Ayu Mirah Adi, A., Kupang Jl Kartini, K. R., Kelapa Lima, K., & Kupang, K. (2025). Effectiveness of nutrition training in improving cadres' knowledge and skills in Kupang City. *AcTion: Aceh Nutrition Journal*, *10*(1), 77–84. https://doi.org/10.30867/ACTION.V10I1.2165

Nurhalizah, R. S., & Ardianto, R. (2024). Analisis Supervised dan Unsupervised Learning pada Machine Learning : Systematic Literature Review. *Unknown*, *4*(1), 61–72.

Nurherliyany, M., Ariani, D., Asmarani, S. U., Anggit Herdiani, D., & Maharani, A. P. (2023). Pentingnya Pemeriksaan Laboratorium Pada Ibu Hamil. *Daarul Ilmi: Jurnal Pengabdian Kepada Masyarakat*, *1*(1), 1–7. https://doi.org/10.52221/daipkm.v1i1.233

Organization, W. H. (2023). *Seorang wanita meninggal setiap dua menit karena kehamilan atau persalinan: Badan-badan PBB. Jenewa/New York/Washington*. https://www.who.int/news/item/23-02-2023-a-woman-dies-every-two-minutes-due-to-pregnancy-or-childbirth--un-agencies

Parmawati, I., Sandhi, A., Nisman, W. A., Lismidiati, W., Rustiyaningsih, A., & Kholisa, I. L. (2020). Knowledge enhancement about pregnancy complications: Optimizing the role of high risk pregnancy prepared cadres. *Journal of Community Empowerment for Health*, *3*(1), 18–27. https://doi.org/10.22146/JCOEMPH.47317

Prafitri, L. D., Suparni, S., & Setianto, G. (2025). *Pendampingan Ibu Hamil Dalam Upaya Deteksi Dini Resiko Tinggi Kehamilan. Journal of Community Development, 423–433*.

Susylowati, D., Utami, P., & Hajoeningtijas, O. D. (2023). Sosialisasi dan Penyuluhan Edible Landscaping untuk Kemandirian Ketahanan Pangan dari Pekarangan Rumah Yang Estetik Bagi Kader Nasyiatul 'Aisyiyah Banyumas. *Artha Imperium: Jurnal Pengabdian Kepada Masyarakat*, *1*(1), 20–29. https://doi.org/10.62521/VZ1N7H93

Thakur, A., Bhageerathy, R., Mithra, P., Sekaran, V. C., & Kumar, S. (2025a). From Peer Support to Program Supervision: Qualitative Insights on WhatsApp as Informal Digital Infrastructure for Community Health Workers and Public Health Officers in an Indian High-Priority Aspirational District. *Healthcare (Switzerland)*, *13*(17), 2223. https://doi.org/10.3390/HEALTHCARE13172223/S1

Thakur, A., Bhageerathy, R., Mithra, P., Sekaran, V. C., & Kumar, S. (2025b). Navigating Organizational Challenges of Digital Transformation: A Qualitative Study of Meso-Level Public Health Officers in an Indian High-Priority Aspirational District. *Administrative Sciences*, *15*(10), 397. https://doi.org/10.3390/ADMSCI15100397/S1

Viswanathan, S., Ibrahim, S., Shankar, R., Binns, R., Van Kleek, M., & Slovak, P. (2025). The Interaction Layer: An Exploration for Co-Designing User-LLM Interactions in Parental Wellbeing Support Systems. *Conference on Human Factors in Computing Systems - Proceedings* , *1*. https://doi.org/10.1145/3706598.3714088;CTYPE:STRING:BOOK

Wiguna, R. E., & Firmansyah, R. (2023). *Sistem Pakar Prediksi Resiko Kesehatan Ibu Hamil Menggunakan Algoritma k-Nearest Neighbor. EProsiding Teknik Informatika …*,. *4*(1), 90–100. http://eprosiding.ars.ac.id/index.php/pti/article/view/918%0Ahttps://eprosiding.ars.ac.id/index.php/pti/article/download/918/402

Yeung, A. W. K., Torkamani, A., Butte, A. J., Glicksberg, B. S., Schuller, B., Rodriguez, B., Ting, D. S. W., Bates, D., Schaden, E., Peng, H., Willschke, H., van der Laak, J., Car, J., Rahimi, K., Celi, L. A., Banach, M., Kletecka-Pulker, M., Kimberger, O., Eils, R., … Atanasov, A. G. (2023). The promise of digital healthcare technologies. *Frontiers in Public Health*, *11*, 1196596. https://doi.org/10.3389/FPUBH.2023.1196596/FULL