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A Pilot Evaluation of Educational Game Media on Pregnant Women's Knowledge and Readiness for Safe Childbirth

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ABSTRACT

Background: Interactive digital education may strengthen childbirth preparation by presenting clinically relevant information in an engaging and repeatable format. **Purpose:** This study evaluated the effectiveness of educational game media in improving pregnant women's knowledge and readiness for safe childbirth. **Methods:** A quasi-experimental one-group pretest–posttest study was conducted with 35 pregnant women receiving antenatal care in Balikpapan, Indonesia. Knowledge was measured with five dichotomous items, and childbirth readiness with five Likert-type items. Descriptive statistics, validity and reliability screening, Shapiro–Wilk tests, paired t-tests, Wilcoxon signed-rank sensitivity tests, effect-size analysis, and Spearman correlation were applied. **Results:** Mean knowledge increased from 2.43 (standard deviation 0.95) to 3.54 (standard deviation 0.92), with a mean change of 1.11 points and $p < .001$. Mean readiness increased from 15.46 (standard deviation 2.12) to 21.31 (standard deviation 1.88), with a mean change of 5.86 points and $p < .001$. Wilcoxon tests confirmed significant improvements in both outcomes. The mean game-use score was 22.49/25, and the association between game-use score and post-intervention readiness was not significant. Internal consistency was limited across the three brief scales. **Conclusions:** The educational game was associated with significant short-term improvements in knowledge and childbirth readiness. It may complement antenatal education, although the one-group design, small sample, and limited internal consistency of the instruments require cautious interpretation and further controlled validation.

KEYWORDS

Pregnancy, Health education, Educational technology, Parturition, Patient education as topic

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1. BACKGROUND

Preparation for childbirth is not limited to recognizing the onset of labor. It requires pregnant women to understand normal physiological processes, warning signs, choices regarding place of birth and skilled birth attendance, transport and financial arrangements, available support, and decisions that may need to be made quickly when complications arise. Knowledge is therefore a practical component of birth preparedness because it supports timely interpretation of symptoms and informed use of maternity services. Evidence from

rural and resource-constrained settings consistently shows that maternal knowledge is associated with more appropriate use of antenatal services and better birth-preparedness practices (Afaya et al., 2020; Girma et al., 2022). Antenatal education also has a broader health-literacy function: it helps women and families transform information into actions, questions, plans, and shared decisions rather than treating education as one-way information transfer (Downer et al., 2020).

The educational environment surrounding pregnancy has changed rapidly. Pregnant women now obtain information from clinicians, printed materials, family networks, social media, websites, and mobile applications, and the quality of those sources is uneven. A systematic review of pregnant women's information needs found recurring demand for reliable, accessible information about fetal development, maternal changes, childbirth, and the postpartum period. At the same time, barriers included inconsistent advice and uncertainty regarding source credibility (Ghiasi, 2021). Women also evaluate sources based on perceived trustworthiness and convenience, suggesting that maternity education must be both evidence-based and user-friendly (Vogels-Broeke et al., 2022). Digital formats enable the repeated delivery of standardized information, but their design should complement professional care rather than substitute for clinical assessment.

Digital antenatal care has expanded from appointment communication and teleconsultation to remote monitoring, mobile self-management, tailored health education, and interactive learning. A recent scoping review of 126 studies found that digital technologies in antenatal care were commonly used to supplement standard services and were frequently reported to improve access, satisfaction, knowledge, self-management, and birth preparedness (Mohamed et al., 2025). Earlier reviews similarly identified eHealth as an emerging component of perinatal care, with potential benefits in information exchange and patient involvement while also raising questions about digital inequality, privacy, and implementation quality (van den Heuvel et al., 2018). Pregnancy applications can increase convenience for culturally and linguistically diverse users, but poorly curated applications may also reproduce misinformation or create barriers when literacy and language are not considered (Hughson et al., 2018).

Within this digital landscape, educational games and gamification are relevant because they add active participation, immediate feedback, progressive challenges, repetition, and a sense of achievement to conventional learning. A systematic review of health professions education found that serious games and gamified approaches can improve knowledge, skills, attitudes, and learner engagement. However, outcomes depend heavily on instructional design and study quality (Gentry et al., 2019). More recent evidence specific to midwifery education similarly shows growing use of game elements to encourage engagement and learning, while emphasizing that rigorous evaluation and appropriate outcome measurement are necessary to separate genuine educational benefit from novelty effects (Fathi Najafi et al., 2025). For pregnant women, the educational mechanism is especially plausible: brief game scenarios can rehearse recognition of labor signs, danger signs, practical preparation, and decision pathways without exposing the learner to clinical risk.

Empirical work in maternity populations supports this possibility. D'Avila et al. (2022) reported that an educational game significantly increased pregnant women's knowledge of rights during labor and birth and was positively experienced as an innovative, participatory resource. In Indonesia, Lisnawati et al. (2022) developed the Android-based GEMBIL application and reported a significant increase in primigravida knowledge after its use. Application-based antenatal education has also been tested using behavior-change theory: Ariyani et al. (2022) demonstrated that a structured mobile intervention could improve health-promoting outcomes among pregnant women in Bali. These findings do not establish that every game will be effective. However, they indicate that a well-designed digital educational intervention can be a viable extension of antenatal education when content is clinically accurate, and the interface supports meaningful interaction.

The potential value of game-based education extends beyond factual recall. Childbirth readiness includes psychological confidence, planning, family support, and the ability to act on knowledge. Face-to-face antenatal groups remain important because interaction, social learning, and peer support can strengthen women's confidence and sense of preparedness (Spiby et al., 2022). At the same time, online and virtual antenatal education has become a sustained option

rather than a temporary pandemic response. Studies of online programs show that participants value flexible access, clear structure, trustworthy facilitators, and opportunities to ask questions, although virtual formats can weaken social connection when poorly facilitated (Wallace et al., 2023; Whitworth et al., 2024). Consequently, the central issue is not whether education is digital or conventional, but whether the format helps women process information, rehearse decisions, and connect learning to individualized care.

The present study evaluates an educational game focused on safe childbirth preparation and examines two primary outcomes: pregnant women's knowledge and childbirth readiness. The knowledge measure covers normal labor signs, danger signs, physical, logistical, and psychological preparation. At the same time, the readiness scale addresses physical and psychological preparedness, transport and financial planning, birth-companion support, and confidence in decision-making. These dimensions reflect the multifaceted nature of birth preparedness, in which factual understanding should translate into practical planning and psychological readiness. The study also assesses participants' experience of the game using five indicators: usability, perceived usefulness, motivation, adequacy of duration, and willingness to use the medium routinely.

Despite the increasing use of digital health education, evidence from Indonesian maternity settings remains limited on whether an educational game can simultaneously improve knowledge and childbirth readiness. Most previous work has emphasized knowledge gain or general health-promoting behavior rather than the combined cognitive and preparedness outcomes required for safe childbirth. Therefore, this study aimed to determine the effectiveness of educational game media in improving pregnant women's knowledge and readiness for safe childbirth. It was hypothesized that post-intervention knowledge and readiness scores would be significantly higher than pre-intervention scores.

2. METHODS

Design

This study employed a quasi-experimental one-group pretest–posttest design. The same participants completed baseline measurements of knowledge and childbirth readiness, received the educational game intervention, and

subsequently completed post-intervention measurements. This within-participant design was selected to identify short-term changes following exposure to the educational medium. Because the design did not include a concurrent control group, the findings are interpreted as within-group effectiveness estimates rather than definitive causal evidence.

Setting and Participants

The study involved 35 pregnant women receiving antenatal care in Balikpapan, Indonesia, who were in the second or third trimester of pregnancy. Participants were selected purposively according to the study criteria. Inclusion criteria were the ability to read and write, access to a smartphone, the ability to operate the educational game, and willingness to participate by providing informed consent. Exclusion criteria included severe pregnancy complications requiring special management, cognitive or communication limitations that could interfere with questionnaire completion, and failure to complete the intervention sequence. All 35 participant records were complete and included in the analysis.

Variables and Instruments

The independent variable was exposure to the educational game on safe childbirth. The dependent variables were pregnant women's knowledge of safe childbirth preparation and readiness for safe childbirth.

Five dichotomous items represent knowledge, scored 1 for a correct response and 0 for an incorrect response, yielding a total score from 0 to 5. The content domains are normal labor signs, obstetric danger signs, physical preparation, such as breathing and position, logistical preparation, including the place of birth, cost, and transport, and mental or psychological preparation. Five Likert-type items represent readiness, each scored from 1 to 5, yielding a total score from 5 to 25. The items address physical readiness, psychological readiness, transport and financial preparation, birth-companion support, and confidence in making appropriate decisions during labor.

A separate five-item game-use scale was completed after exposure to the intervention. The scale assessed ease of use, perceived contribution of the game to understanding of childbirth preparation, motivation to learn, adequacy of the duration of use, and willingness to use the

game as a routine educational medium. Each item was scored from 1 to 5, producing a total score from 5 to 25. Age, education, parity, gestational age, and family support were recorded as participant characteristics and potential contextual factors and were summarized descriptively.

Intervention and Data Collection

The intervention consisted of a digital educational game containing information on safe childbirth preparation. The content addressed recognition of normal labor signs and danger signs, physical and psychological preparation, and practical arrangements such as place of birth, costs, transport, and support during labor. Participants completed the pretest before using the educational game and then completed the posttest after the intervention. The digital format was intended to encourage active participation and repeated engagement with childbirth-preparation content. In interpreting the intervention, the game is positioned as a complement to professional antenatal counseling rather than a replacement for clinical assessment or individualized advice (Graseck & Leitner, 2021; Mohamed et al., 2025).

Data collection followed the one-group pretest–posttest sequence. Eligible participants first completed baseline measurements of knowledge and childbirth readiness. They then received the educational game intervention and subsequently completed the post-intervention knowledge and readiness measurements. The post-intervention game-use scale was completed after participants had used the educational game. All 35 participants included in the analysis had complete study data.

Validity and Reliability

Item–total correlation and internal-consistency analyses were conducted for the knowledge, readiness, and game-use domains. For knowledge, all five items showed statistically significant item–total correlations, ranging from 0.406 to 0.654. All five readiness items were also significantly correlated with the total score, with coefficients ranging from 0.347 to 0.500. For game use, GM2, GM3, and GM5 reached $p<.05$, whereas GM1 and GM4 did not. The reported scale reliability coefficients were 0.187 for knowledge, 0.236 for readiness, and 0.333 for game use. These coefficients indicate limited internal consistency and were therefore considered when interpreting the magnitude and precision of the total-score findings.

The reliability findings were interpreted in light of the different functions of the measures. The five-item knowledge instrument is a brief, criterion-referenced quiz spanning several childbirth-preparation domains, so internal consistency alone may not fully capture its measurement quality. Nevertheless, item difficulty, discrimination, and Kuder–Richardson reliability should be examined in future validation. The readiness and game-use scales are intended to represent broader latent constructs; therefore, their low internal consistency indicates a need for further item review, content validation, and construct evaluation. Rigorous measurement is important in educational game research because engagement, novelty, and learning are related yet distinct outcomes (Gentry et al., 2019; Fathi Najafi et al., 2025).

Data Analysis and Ethical Considerations

Descriptive statistics were used to summarize age, education, parity, gestational age, family support, knowledge, readiness, and game-use scores. Shapiro–Wilk testing was used to assess distributional assumptions. The available aggregate normality output showed Total_PK W=0.99079 (p=0.98990), Total_KS W=0.97018 (p=0.44825), and Total_GM W=0.96749 (p=0.37802). Paired t-tests were used to compare pretest and posttest knowledge and readiness. Because recalculation from the participant-level dataset showed non-normal paired change scores, Wilcoxon signed-rank tests were also conducted as sensitivity analyses. Statistical significance was evaluated using a two-sided alpha level of .05.

Effect size was summarized using standardized mean change (Cohen's dz), together with mean differences and 95% confidence intervals. Spearman correlation was used to examine the association between post-intervention readiness and total game-use score. The analysis yielded rho = -0.022 (p = .900), indicating no evidence of a monotonic association between these variables in the study sample.

3. RESULTS

The study included 35 pregnant women with complete data. Mean age was 29.80 years (SD 5.63; range 20–39), and mean gestational age was 34.83 weeks (SD 3.37; range 27–40). Senior high school was the most frequent educational category (31.4%), followed by diploma and bachelor-level education (22.9% each). Primigravida participants accounted for 48.6% of the

sample, and multigravida participants for 51.4%. Family support was available for 74.3% of participants. These characteristics describe a relatively heterogeneous antenatal sample with respect to age, education, parity, and gestational age. Participant characteristics are presented in Table 1.

Table 1. Demographic and Clinical Characteristics of Pregnant Women (N = 35)

Characteristic	n	%
Age (years)	35	mean ± SD
		29.80 ± 5.63
Age range (years)		20–39
Education		
Primary school	1	2.9
Junior high school	7	20.0
Senior high school	11	31.4
Diploma	8	22.9
Bachelor's degree	8	22.9
Parity		
Primigravida	17	48.6
Multigravida	18	51.4
Gestational age (weeks)	35	mean ± SD
		34.83 ± 3.37
Gestational age range (weeks)		27–40
Family support		
Available	26	74.3
Not available	9	25.7

Note. SD = standard deviation

Instrument screening showed that the knowledge item–total coefficients ranged from 0.406 to 0.654, and all five items were statistically significant. Readiness item–total coefficients ranged from 0.347 to 0.500 and were also statistically significant. For the game-use measure, GM2, GM3, and GM5 showed significant item–total correlations, whereas GM1 (r=0.142, p=.416) and GM4 (r=0.324, p=.058) did not reach the .05 threshold. The reliability coefficients were 0.187 for knowledge, 0.236 for readiness, and 0.333 for game use. Accordingly, changes in outcomes are reported transparently, while the limited internal consistency of the instruments is treated as a measurement limitation. Psychometric screening results are presented in Table 2

Table 2. Psychometric Screening of the Study Instruments

Domain	Item-total validity summary	Reliability coefficient	Interpretation
Knowledge (PK)	PK1–PK5 significant; r=0.406–0.654	0.187	Limited internal consistency; interpret cautiously and refine
Readiness (KS)	KS1–KS5 significant; r=0.347–0.500	0.236	Limited internal consistency; interpret cautiously and refine
Game use (GM)	GM2, GM3, GM5 significant; GM1 and GM4 not significant	0.333	Low internal consistency; review items and scoring

Knowledge increased from a pre-intervention mean of 2.43 out of 5 (SD 0.95) to a post-intervention mean of 3.54 (SD 0.92). The mean increase was 1.11 points (95% CI 0.87 to 1.36), equivalent to an increase from approximately 48.6% to 70.9% of the maximum possible score. The paired t-test showed a statistically significant increase, t(34)=9.18, p<.001, with a large standardized within-participant effect (dz=1.55). Because the paired change scores were non-normal, a Wilcoxon signed-rank sensitivity analysis was also conducted and confirmed a significant improvement (p<.001). Thus, both parametric and nonparametric analyses supported an increase in knowledge after the educational game intervention. The pretest–posttest comparisons are summarized in Table 3.

Table 3. Pretest–Posttest Knowledge and Childbirth Readiness Outcomes

Outcome	Pretest Mean ± SD	Posttest Mean ± SD	Mean change (95% CI)	Statistical tests	Cohen's dz
Knowledge (0–5)	2.43 ± 0.95	3.54 ± 0.92	1.11 (0.87–1.36)	t(34)=9.18, p<.001; Wilcoxon p<.001	1.55
Readiness (5–25)	15.46 ± 2.12	21.31 ± 1.88	5.86 (5.58–6.14)	t(34)=42.80, p<.001; Wilcoxon p<.001	7.23

Childbirth readiness increased from a pre-intervention mean of 15.46 out of 25 (SD 2.12) to 21.31 (SD 1.88), corresponding to approximately 61.8% and 85.3% of the maximum score. The mean increase was 5.86 points (95% CI 5.58 to 6.14). The paired t-test showed a significant improvement (t(34)=42.80, p<.001), and the Wilcoxon sensitivity analysis was also significant (p<.001). The standardized change estimate was very large (dz=7.23). Given the small sample size, one-group design, and limited scale reliability, this effect magnitude should be interpreted with caution, even though the direction of change was consistent across statistical tests.

Post-intervention game-use scores were high, with a mean of 22.49 out of 25 (SD 1.25; range 20–25), indicating favorable participant perceptions of usability, usefulness, motivation, duration, and willingness to use the medium. Spearman's analysis showed no significant association between post-intervention readiness and total game use (rho = -0.022, p = .900). Thus, participants' favorable ratings of the educational game were not associated with higher readiness scores at the individual level. This finding suggests that acceptability and educational outcome should be evaluated as distinct dimensions.

4. DISCUSSION

The principal finding of this study was a significant improvement in both knowledge and childbirth readiness after exposure to the educational game. Knowledge increased by 1.11 points on a five-item scale, while readiness increased by 5.86 points on a 25-point scale; both results remained significant under paired t-tests and Wilcoxon sensitivity analyses. These findings support the educational premise that interactive game-based learning can strengthen preparation for childbirth. However, the absence of a control group prevents attributing the change exclusively to the game. The direction of the results is consistent with D'Avila et al. (2022), who reported improved knowledge following an educational game for pregnant women, and Lisnawati et al. (2022), who found significant knowledge improvement after use of the Android-based GEMBIL application.

The observed improvement in knowledge is also consistent with the broader digital-health literature. Internet-based prenatal interventions have demonstrated positive effects across maternal health outcomes, although intervention designs and outcome measures vary substantially (Chae & Kim, 2021). Application-based education in Bali has shown that digital delivery combined with a behavioral framework can support health-promoting behavior among pregnant women (Ariyani et al., 2022). Digital prenatal education offers repeated access, self-paced review, visual explanation, and standardized content, which may be particularly useful when antenatal contacts are brief or when women need to revisit information after a clinical encounter. Nevertheless, the educational value of a digital tool depends on content governance, accessibility, usability, and integration with individualized professional advice.

The improvement in childbirth readiness is important because preparedness extends beyond factual recall to include psychological confidence, practical planning, social support, and the ability to act on information. Observational evidence indicates that knowledge of birth preparedness and danger signs is associated with stronger readiness practices (Girma et al., 2022). Antenatal education can therefore help translate information into plans concerning transport, costs, birth companionship, place of delivery, and decision-making. In this study, readiness improved by nearly six points on a 25-point scale. The very large standardized effect should, however, be interpreted

conservatively because small sample sizes and measurement limitations can inflate standardized estimates, and a one-group design cannot rule out testing effects, concurrent counseling, or other time-related influences.

Contemporary evidence supports antenatal education more generally, but it also shows that effects vary by intervention type and outcome. Hooper et al. (2025), in a systematic review and meta-analysis of randomized trials, found overall beneficial effects of antenatal education on selected labor and birth outcomes, with considerable heterogeneity across programs. This heterogeneity is important for interpreting educational-game studies: a game that improves factual knowledge may not automatically reduce anxiety, change service use, alter birth mode, or improve neonatal outcomes. Each outcome requires an explicit causal pathway, sufficient intervention dose, and an instrument appropriate to the construct. For the current project, knowledge and readiness are reasonable proximal outcomes; claims about maternal or neonatal safety should be reserved for future studies designed and powered to measure those outcomes.

Engagement with the educational medium should be distinguished from learning outcomes. Game-based approaches can improve attention, motivation, feedback, and persistence, mechanisms emphasized in systematic reviews of gamification in health education (Gentry et al., 2019; Fathi Najafi et al., 2025). In this study, the mean game-use score was high but essentially uncorrelated with post-intervention readiness. Participants may therefore perceive a digital tool positively without necessarily achieving proportionally greater gains in outcomes. Future evaluations should report acceptability as an implementation outcome and, where technically feasible, complement self-report ratings with objective usage indicators such as session completion, time on task, repeated use, and module progression.

Measurement quality is an important methodological consideration in interpreting these findings. Although all knowledge and readiness items showed significant item–total correlations, the reported reliability coefficients were low. Item–total correlation and internal consistency answer different questions, and significant correlations with a total score do not necessarily indicate that all items measure a single underlying construct. The five binary knowledge items intentionally cover diverse domains—labor signs, danger

signs, physical preparation, logistics, and psychological preparation—so a criterion-referenced interpretation may be more appropriate than assuming strict unidimensionality. Future work should therefore include analyses of item difficulty, discrimination, and Kuder–Richardson reliability to strengthen the evidence supporting the knowledge score.

The readiness and game-use scales require additional psychometric refinement because they are intended to summarize broader psychosocial or experiential constructs. Their low internal consistency coefficients suggest that some items may capture distinct dimensions or require review of wording and scoring. Content validity assessment by experts in midwifery, maternal health education, and measurement, followed by cognitive testing with pregnant women, would strengthen the instrument's interpretability. D'Avila et al. (2018) similarly treated construction and validation as a distinct phase in the development of an educational game for pregnant women. Further validation should therefore accompany, rather than follow, larger effectiveness testing.

The digital format should likewise be evaluated in relation to women's information preferences. Pregnant women use multiple information channels and may perceive the quality of these channels differently (Ghiasi, 2021; Vogels-Broeke et al., 2022). An educational game can be advantageous if it makes verified information easier to revisit and remember. However, it can be exclusionary when smartphone access, data costs, visual design, reading level, or digital literacy are ignored. Hughson et al. (2018) emphasized that pregnancy applications may have distinct implications for culturally and linguistically diverse women. For Balikpapan and other Indonesian contexts, future testing should therefore include usability testing across education levels, device types, and data connectivity conditions. The interface should use plain language, clear graphics, and clinically reviewed messages, while the game should provide explicit guidance about when to contact a midwife or emergency service.

Antenatal education is also relational. Evidence from women's experiences shows that group education can provide social connection and opportunities to normalize concerns, exchange experiences, and build confidence (Spiby et al., 2022). Online antenatal education can preserve many informational benefits, but parents report that structure, facilitator accessibility,

interaction, and opportunities for discussion are important design requirements (Wallace et al., 2023). Whitworth et al. (2024) similarly found that digital transformation changes both access to and experience of antenatal education. The educational game should therefore be positioned as a structured supplement to midwife-led counseling, allowing women to identify knowledge gaps, rehearse decisions, and discuss individualized questions with a health professional.

The one-group pretest–posttest design provides useful preliminary evidence but remains vulnerable to alternative explanations. Repeated exposure to the same knowledge items may produce testing effects, and short intervals between pretest and posttest may favor immediate recall. Participants may also improve because of the researcher's attention or concurrent antenatal counseling. Future studies should therefore compare the educational game plus standard education with standard education alone, preferably using random allocation when feasible. Longer follow-up is also needed to determine whether gains are retained and translated into actual birth-preparedness behavior rather than representing only immediate post-intervention change.

The sample size also limits generalizability. Although 35 participants were sufficient to detect the large within-group changes observed in this study, the sample is too small for stable subgroup analyses, multivariable adjustment, or definitive psychometric evaluation. A subsequent controlled study should use an a priori sample-size calculation based on an educationally meaningful difference, expected variance, desired statistical power, and anticipated attrition. With a larger sample, age, education, parity, gestational age, and family support could be examined as covariates or effect modifiers rather than described only as participant characteristics.

Statistical significance should be considered together with educational and clinical relevance. The knowledge gain was statistically robust, but a five-item score cannot capture every competency required for safe childbirth. Future evaluations should therefore complement mean-score changes with competency thresholds and objective preparedness indicators, such as a documented place-of-birth plan, transport arrangements, emergency contact, birth-companion plan, and recognition of referral triggers. The extremely large readiness effect also warrants replication using a more reliable scale and a comparison group

before a stable real-world effect size can be inferred.

The study has a strong applied rationale for maternity care in Indonesia, where geographic and service-access variation can make it difficult to maintain standardized educational support between antenatal contacts. Local evidence demonstrates that app-based interventions can be integrated into pregnancy education (Ariyani et al., 2022; Lisnawati et al., 2022). Internationally, online antenatal care expanded rapidly during the COVID-19 pandemic and highlighted both opportunities and challenges related to access, quality, continuity, and digital readiness (Wu et al., 2020). Tele-education has also been associated with reduced pregnancy-related distress in some settings (Aksoy Derya et al., 2021). These findings support continued development of the educational game, provided that local usability, clinical accuracy, and integration with professional care remain central.

Further research should strengthen both intervention reporting and study design. The game content should be mapped to current maternal health guidance and reviewed by clinical experts; the knowledge and readiness instruments should undergo additional content and construct validation; and feasibility outcomes, such as completion, technical difficulties, adherence, and user experience, should be documented systematically. A controlled study with prespecified primary outcomes and an adequate sample size would provide stronger evidence of effectiveness. These steps would clarify whether the short-term improvements observed here are sustained, attributable to the educational game itself, and meaningful for birth-preparedness behavior.

Several limitations should therefore be acknowledged. First, the one-group design does not control for testing, maturation, concurrent education, or other temporal influences. Second, the sample was small and purposively selected within a single urban setting, which limits external validity. Third, internal-consistency coefficients for the study instruments were low, reducing measurement precision. Fourth, the available data evaluate short-term knowledge and readiness rather than clinical maternal or neonatal outcomes. These limitations do not negate the observed pre–post improvements. However, they require the findings to be interpreted as preliminary evidence that should be confirmed through larger, controlled, and psychometrically stronger studies.

5. CONCLUSIONS

The educational game was associated with significant short-term increases in pregnant women's knowledge and readiness for safe childbirth. Knowledge rose from 2.43 to 3.54 and readiness from 15.46 to 21.31, with both paired t-tests and Wilcoxon sensitivity analyses confirming significant pre–post differences. Participants also reported favorable game-use scores, although game-use ratings were not related to post-intervention readiness. These findings support the educational game as a potentially useful complement to antenatal counseling. Interpretation should remain cautious because the study used a small purposive sample, a one-group design, and instruments with limited internal consistency. Further controlled research with stronger psychometric validation and longer follow-up is recommended before generalizing the effect's magnitude and durability.

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AUTHOR CONTRIBUTIONS

All authors contributed to the conception and design of the study. NTY collected the data and drafted the manuscript. HES supervised the study, performed the statistical analysis and critically revised the manuscript. EAH contributed to the methodology and revised the manuscript. All authors read and approved the final version.

CONFLICT OF INTEREST

The authors have no competing interests associated with the material presented in this paper.

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DATA AVAILABILITY

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

DECLARATION OF USE OF AI

During the preparation of this work, the authors used Grammarly to assist with language and grammar editing. The authors

reviewed and edited the content as needed and take full responsibility for the manuscript

REFERENCES

Afaya, A., Azongo, T. B., Dzomeku, V. M., Afaya, R. A., Salia, S. M., Adatara, P., Alhassan, R. K., Amponsah, A. K., Atakro, C. A., Adadem, D., Asiedu, E. O., Amuna, P., & Ayanore, M. A. (2020). Women's knowledge and its associated factors regarding optimum utilisation of antenatal care in rural Ghana: A cross-sectional study. PLOS ONE, 15(7), e0234575. https://doi.org/10.1371/journal.pone.0234575

Aksoy Derya, Y., Altiparmak, S., Akça, E., Gökbulut, N., & Yilmaz, A. N. (2021). Pregnancy and birth planning during COVID-19: The effects of tele-education offered to pregnant women on prenatal distress and pregnancy-related anxiety. Midwifery, 92, 102877. https://doi.org/10.1016/j.midw.2020.102877

Ariyani, N. W., Wirawan, I. M. A., Pinatih, G. N. I., & Kusuma, A. A. N. J. (2022). The effect of an application-based educational intervention with a social cognitive theory model on pregnant women in Denpasar, Bali, Indonesia: A randomized controlled trial. Osong Public Health and Research Perspectives, 13(2), 153–161. https://doi.org/10.24171/j.phrp.2021.0209

Chae, J., & Kim, H. K. (2021). Internet-based prenatal interventions for maternal health among pregnant women: A systematic review and meta-analysis. Children and Youth Services Review, 127, 106079. https://doi.org/10.1016/j.childyouth.2021.106079

D'Avila, C. G., Oliveira, K. L. B. S., Castro, R. M., Pina-Oliveira, A. A., Freitas, N. O., & Fernandes, R. A. Q. (2022). Effectiveness of an educational game for pregnant women: Aggregated knowledge and the women's experience. Escola Anna Nery, 26, e20210078. https://doi.org/10.1590/2177-9465-EAN-2021-0078

D'Avila, C. G., Puggina, A. C., & Fernandes, R. A. Q. (2018). Construction and validation of an educational game for pregnant women. Escola Anna Nery, 22(3), e20170300. https://doi.org/10.1590/2177-9465-EAN-2017-0300

Downer, T., McMurray, A., & Young, J. (2020). The role of antenatal education in promoting maternal and family health literacy. International Journal of Childbirth, 10(1), 52–64. https://doi.org/10.1891/IJCBIRTH-D-20-00012

Fathi Najafi, T., Andaroon, N., Bolghanabadi, N., Sharifi, N., & Dashti, S. (2025). Gamification in midwifery education: A systematic review. BMC Medical Education, 25, 297. https://doi.org/10.1186/s12909-025-06880-x

Gentry, S. V., Gauthier, A., L'Estrade Ehrstrom, B., Wortley, D., Lilienthal, A., Tudor Car, L., Dauwels-Okutsu, S., Nikolaou, C. K., Zary, N., Campbell, J., & Car, J. (2019). Serious gaming and gamification education in health professions: Systematic review. Journal of Medical Internet Research, 21(3), e12994. https://doi.org/10.2196/12994

Ghiasi, A. (2021). Health information needs, sources of information, and barriers to accessing health information among pregnant women: A systematic review of research. Journal of Maternal-Fetal & Neonatal Medicine, 34(8), 1320–1330. https://doi.org/10.1080/14767058.2019.1634685

Girma, D., Waleligne, A., & Dejene, H. (2022). Birth preparedness and complication readiness practice and associated factors among pregnant women in Central Ethiopia, 2021: A cross-sectional study. PLOS ONE, 17(10), e0276496. https://doi.org/10.1371/journal.pone.0276496

Graseck, A., & Leitner, K. (2021). Prenatal education in the digital age. Clinical Obstetrics and Gynecology, 64(2), 345–351. https://doi.org/10.1097/GRF.0000000000000608

Hooper, E., Mechkaroff, O., Upitis, A., Schofield, E., Carland, J. E., & Henry, A. (2025). The effectiveness of antenatal education on improving labour and birth outcomes - A systematic review and meta-analysis. Women and Birth, 38(1), 101843. https://doi.org/10.1016/j.wombi.2024.101843

Hughson, J. A. P., Daly, J. O., Woodward-Kron, R., Hajek, J., & Story, D. (2018). The rise of pregnancy apps and the implications for culturally and linguistically diverse women: Narrative

review. JMIR mHealth and uHealth, 6(11), e189. https://doi.org/10.2196/mhealth.9119

Lisnawati, L., Widiyanti, R., & Hapitria, P. (2022). Gembil (Game Ibu Hamil) application based on Android in increasing knowledge of primigravida during the COVID-19 pandemic in 2022. Jurnal Kebidanan Kestra, 5(1), 142–148. https://doi.org/10.35451/jkk.v5i1.1369

Mohamed, H., Ismail, A., Sutan, R., Rahman, R. A., & Juval, K. (2025). A scoping review of digital technologies in antenatal care: Recent progress and applications of digital technologies. BMC Pregnancy and Childbirth, 25, 153. https://doi.org/10.1186/s12884-025-07209-8

Spiby, H., Stewart, J., Watts, K., Hughes, A. J., & Slade, P. (2022). The importance of face to face, group antenatal education classes for first time mothers: A qualitative study. Midwifery, 109, 103295. https://doi.org/10.1016/j.midw.2022.103295

van den Heuvel, J. F. M., Groenhof, T. K., Veerbeek, J. H. W., van Solinge, W. W., Lely, A. T., Franx, A., & Bekker, M. N. (2018). eHealth as the next-generation perinatal care: An overview of the literature. Journal of Medical Internet Research, 20(6), e202. https://doi.org/10.2196/jmir.9262

Vogels-Broeke, M., Daemers, D., Budé, L., de Vries, R., & Nieuwenhuijze, M. (2022). Sources of information used by women during pregnancy and the perceived quality. BMC Pregnancy and Childbirth, 22, 109. https://doi.org/10.1186/s12884-022-04422-7

Wallace, H. J., Bayes, S., Davenport, C., & Grant, M. (2023). How should online antenatal and parenting education be structured according to parents? Qualitative findings from a mixed-methods retrospective study. Women's Health, 19, 17455057221150098. https://doi.org/10.1177/17455057221150098

Whitworth, K., Donnellan-Fernandez, R., & Fleet, J. A. (2024). Digital transformation of antenatal education: A descriptive exploratory study of women's experiences of online antenatal education. Women and Birth, 37(1), 188–196. https://doi.org/10.1016/j.wombi.2023.08.008

Wu, H., Sun, W., Huang, X., Yu, S., Wang, H., Bi, X., Sheng, J., Chen, S., Akinwunmi, B., Zhang, C. J. P., & Ming, W.-K. (2020). Online antenatal care during the COVID-19 pandemic: Opportunities and challenges. Journal of Medical Internet Research, 22(7), e19916. https://doi.org/10.2196/19916