



Enhancing antenatal knowledge through gamification: Evaluating the pregnant mother game application, A level 3 research and development

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Abstract

Background: The Pregnant Mother Game application is designed to enhance midwifery services, particularly for online antenatal classes. It is developed by experts in learning media and presented in a game format. The objectives of this research are to develop apps for antenatal classes and to assess how well these applications increase mothers' knowledge.

Methods: It is a level 3 Research and Development, which is developing and refining products. The participants were selected using a purposive sampling technique. Limited trials of the application, which is downloadable on Android devices, were carried out with 10 first-time pregnant women in Cirebon City, Indonesia. Data collection tools included a questionnaire for experts and mothers. Data were analyzed using IBM SPSS Statistics 16, with univariate analysis employing a frequency distribution and bivariate analysis utilizing the Wilcoxon test. The significance level was set at 0.05, with a 95% confidence interval.

Results: The material experts' qualifying test yielded a score of 85% (Very decent), and the media members' score was 84.4% (Very decent). There was a 50% increase in the mean knowledge value. The pretest score ranged between 10 and 25, while the posttest score ranged between 25 and 29. The use of the application was correlated with increased knowledge score, and the correlation coefficient was significant at 0.05.

Conclusion: The program can be used as an effective technology medium for conducting online classes for mothers. The mothers' knowledge significantly improved after taking online classes with the application.

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Highlights

What is current knowledge?

Health information systems are increasingly developing. Ease of accessing accurate and relevant information is a need for the community, including mothers. Antenatal classes are useful for preparing mothers for childbirth, postpartum and newborn care.

What is new here?

This research focuses on the development of health IT products in the form of gaming applications for mothers. These applications can be used as practical, innovative, interesting and evidence-based learning media for antenatal classes.

Introduction

Antenatal class activities are routinely carried out as an effort to promote maternal and child health (1). These activities improve healthy living behaviors during pregnancy, childbirth, and postpartum, and protect mothers. In general, antenatal class activities are conducted face-to-face at 20-37 weeks gestation (2). However, many midwifery service models are now applying technology in an attempt to address potential problems with face-to-face services and meet future needs (3). Studies with prospective trials have shown that attending antenatal classes can reduce childbirth anxiety, depression, and stress in primiparous women (4). Online antenatal classes have become popular as they can be accessed from the comfort of one's home (5).

Antenatal classes provide mothers with knowledge about pregnancy, childbirth, postpartum, and newborn care. These classes are carried out face-to-face depending on the availability of government budgets. They still use conventional educational media such as PowerPoint slides and booklets (6). However, the use of conventional media is becoming less desirable due to the shift toward digital and social media platforms. Alternative educational methods can be used to motivate healthy behaviors in mothers. The reason is that women are increasingly using digital and internet sources to obtain pregnancy information (2,7). Data show that not all mothers can consistently attend face-to-face classes due to distance and time limitations. The effectiveness of these classes depends on the quality of their targets and the context of their delivery (8). Moreover, not all instructors have received training and mastered the skills needed to provide effective education. In face-to-face antenatal classes, the use

of uncomfortable rooms disrupts the concentration of participants (9,10).

The conventional use of media is considered less attractive, thus reducing understanding and interest in attending antenatal classes (11). The search for information about women's health through the internet has increased with the growing number of internet users in the community (12,13). Online antenatal classes make it easy for mothers to obtain health information (14). These classes utilize attractive digital applications and are easily accessible anytime and anywhere (15). The proper use of clear information technology (IT) in antenatal classes can help increase participants' knowledge (16). Women of childbearing age heavily rely on social media, with a usage rate of 93% for women aged 16-24 years and 88% for those aged 24-34 years. Other studies have shown that 95.6% of mothers use the internet as a source of health information (17,18).

Midwives play an important role in providing support and education in antenatal classes. They also enhance the effectiveness of online learning. Therefore, it is necessary to improve knowledge of using IT (19). Antenatal classes should use engaging, effective, and educational media for teaching. This is in line with the theory of health promotion model, which holds that media and other means can influence community members' attitudes, knowledge, and behavior (20,21). Online antenatal classes transcend geographical and physical barriers, allowing access to health information that may be limited by distance, mobility, space, and time (22). These classes make it easy for participants from various backgrounds and locations to access health information (23). Mobile phones have become a widely used medium in the community, including among mothers, for obtaining information (24). Sarpong D (2023) revealed that gamification-based strategies are not only successful in influencing behavior but also outperform alternative behavioral interventions in terms of efficacy. However, she also found that the long-term impact of these interventions, assessed at an average of 14 weeks post-intervention, exhibited diminished effects, ranging from negligible to minor, as indicated by a Hedge's g score of 0.15 and a 95% confidence interval of 0.07 to 0.23 (25).

This article introduced IT products in the form of game applications for pregnant women as a fun and educational medium for online antenatal classes based on evidence.

Methods

The research was carried out from June to October 2022 in Cirebon City, West Java Indonesia. It used level 3 product research and development, which is to develop and perfect products (25,26). The population included material experts, namely coordinating midwives for antenatal classes and IT experts, and pregnant women. The participant were five media experts, five material experts, and 10

mothers selected using purposive sampling according to level 3 research and development guidelines. The inclusion criteria were first pregnancy, age 20-35 years, never having attended antenatal classes, first trimester of pregnancy, and owning an Android cellphone. There may be potential biases due to the limited sample size. This can be overcome by continuing the research at level 4, main field testing, and product dissemination. Data were collected using a questionnaire for material experts, media experts, and mothers. Data analysis was performed using IBM SPSS Statistics 16, with univariate analysis employing a frequency distribution and bivariate analysis utilizing the Wilcoxon test. The significance level was set at 0.05, with a 95% confidence interval (25,27).

The application was developed based on materials in the antenatal classes guide created by lecturers who are IT experts. The application then underwent an internal product test by material and media experts using a product feasibility test questionnaire adopted from Widiyastuti's research (28). The questionnaire comprises nine questions, each with a maximum value of 4; thus, the maximum total value obtained is 36. Results are presented in the form of percentages across categories: < 21% (Very unfit), 21-40% (Not feasible), 41-60% (Fairly decent), 61-80% (Decent), and 81-100% (Very decent). The application was tested for validity and reliability, yielding a Cronbach's alpha of 0.981. The results of the initial internal test showed that the application was very decent and thus received limited product testing. An ethical review was carried out; the respondents provided informed consent, and their data was kept confidential. Subsequently, 10 participants completed a pretest with 30 questions. Next, a WhatsApp group was created and the application link was shared within the group so that all participants could download it on their Android phones.

The application had a data size of 120 MB on Android devices, including the space acquired after installation. Videos and materials are stored within the application and thus they can be viewed offline at any time. The internet was only used when the pregnancy class started as it was run through the WhatsApp group. The application contained instructions on how to use it, videos about pregnancy, childbirth, postpartum, and newborn care, quizzes and games, and settings. The users first required to log into the application. In the first meeting, the participants accessed a 10-minute pregnancy video, followed by a discussion guided by a midwife on the WhatsApp group. Next, an evaluation of the video was carried out using a quiz in the form of a game in the application. In the second meeting, the participants accessed another 10-minute video about childbirth. Afterward, a discussion was held, followed by a quiz game within the application. In the third meeting, the participants accessed a third 10-minute video about postpartum and newborn care. Then, the content was discussed, concluding with another quiz game. The winner of the game was the mother who answered the questions correctly in the fastest time. The quizzes contained questions presented in the form of interesting and educational games using animation. Midwives, as operators, could determine which participant won the quiz. At the third meeting, a posttest with 30 questions was carried out.

Results

Figure 1 displays the application after it was successfully installed.

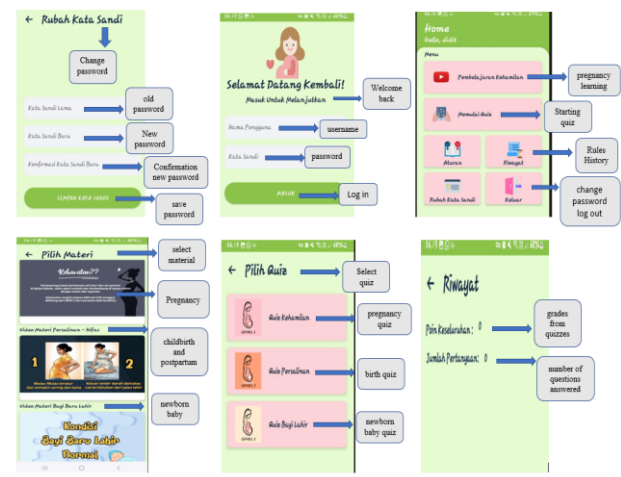


Figure 1. Application screenshot

The application has several additional features, including usage rules, material choices, quiz choices, with each quiz having 10 questions (Total of 30 questions), usage history to see what has been opened with time description, and an option to change the password if desired.

The online antenatal class lasted for one hour during which the participants could access 10-minute learning videos. The materials in the application were validated by media and material experts. Coordinating midwives, who hold advanced diploma in midwifery and had 16-30 years of work experience, acted as material experts. They implemented antenatal classes and conducted activities for pregnant women. They also provided an assessment score for the application as follows Table 1.

Table 1. Results of material experts' assessment

No	Due diligence	Subject				
		One	Two	Three	Four	Five
Aspects of material suitability						
1	Facilitating interaction	4	4	4	4	4
2	Material clarity on pregnancy, childbirth, puerperium, and newborn	3	4	3	3	4
3	Accurate material claims	3	3	3	3	3
4	Proper coverage of materials	3	4	3	3	4
5	Material completeness	3	3	3	4	3
6	The relevance of the image to the material	3	3	3	3	3
Aspects of ease in absorbing information						
1	Midwives' ease in understanding the materials through the application	4	3	4	4	3
2	Compatibility between the app design and the level of thinking	3	3	3	3	3
3	Midwives' ease of using the app	4	4	4	4	4
Sum		30	31	30	31	31
Average of grades		30.6 ÷ 36 = 0.85				
Percentage		0.85 × 100 = 85 %				
Qualification category		Very decent				

The next validation was performed by the media experts. They were lecturers and practitioner's expert in creating learning animation media, with undergraduate degrees in informatics engineering and postgraduate degrees in information systems (Table 2).

Table 2. Media experts' assessment results

No	Due diligence	Subject				
		One	Two	Three	Four	Five
Display aspect						
1	Background color accuracy	3	3	3	3	4
2	Alignment of writing colors with the background	4	3	4	3	3
3	Clarity of narrative	3	4	3	4	3
4	Accuracy of choosing text	3	4	3	4	4
5	Accuracy type selection	4	3	4	3	3
6	Accuracy size selection	3	3	3	4	3
Programming aspects						
1	Clarity of Programming indicators	4	4	4	3	3
2	Clarity of navigation structure	3	4	3	4	4
3	Text efficiency	3	3	3	3	3
Sum		30	31	30	31	30
Average of grades		30.4 ÷ 36 = 0.844				
Percentage		0.844 × 100 = 84.4%				
Qualification category		Very decent				

As indicated in Table 3, most mothers were aged 20-35 years (70%) and were mostly senior high school graduates (90%), housewives (60%), and at a gestational age of 9-12 weeks (50%).

As indicated in Table 4, the use of apps for antenatal classes significantly increases mothers' knowledge scores for pretest value (18.50 ± 5.44) and Post-test value (27.63 ± 1.07).

Table 3. Characteristics of the participants (n=10)

No.	Characteristics	Frequency	Percentage
1	Age (20-35 years old)		
	a. 20-25	7	70
	b. 26-30	2	20
	c. 31-35	1	10
2	Education		
	a. Senior high school	9	90
	b. College	1	10
3	Work		
	a. Yes	4	40
	b. No	6	60
4	Gestational age (until 12 weeks)		
	a. < 4 weeks	2	20
	b. 4-8 weeks	3	30
	c. 9-12 weeks	5	50

Table 4. The application impact on maternal knowledge (n=10)

Knowledge	Median (IQR*)	Mean (SD)	Min-Max	P-value
Pretest value	19.5 (10)	18.50 (5.442)	10-25	0.005
Post-test value	28 (1)	27.63 (1.075)	25-29	

* Interquartile Range

This research was conducted at the level 3 product research and development stage. Therefore, the application was revised based on feedback from the material and media experts. Accordingly, animated moving images were added to the application to make it more attractive. The sample size was modest as it was still at the limited product testing stage. The knowledge assessment can be further

expanded by conducting main field tests with larger samples. This application can be used as an alternative media tool for future classes for pregnant women as it is educational, engaging, and easy to use. It can also be used online, thereby addressing the challenges of distance and time limitations associated with face-to-face antenatal classes. This application can compete with other educational media tools due to its ease of access and content that meets government standards.

Discussion

Our analysis revealed that the application performed exceptionally well, with high success rates across different metrics. User feedback suggested that incorporating animated graphics could enhance the application's visual appeal. Similar research, conducted qualitatively and exploratively, has shown that the use of communication technology and social media can be significant when there are limitations of distance and time (29). Digital health solutions have the potential to be used as monitoring tools during pregnancy. However, the key to their success is high user engagement. Prospective cohort studies on the challenges of accepting digital monitoring devices and complying with digital health assessments during pregnancy suggest that maintaining high engagement with digital monitoring devices over long periods remains challenging. Since cultural and socio-economic factors have the strongest influence on engagement with these devices, more efforts are needed to address the needs of mothers from different demographic backgrounds (30).

A significant impact on knowledge acquisition was observed following the use of the application in antenatal classes. There was a substantial improvement in knowledge levels, with notable increase in both the lowest and highest scores recorded. This finding is in line with Brusniak's research, indicating that distance education can have a positive impact on maternal physical and mental health, marking a shift toward a new era of smart and connected health services, referred to as Health Services 4.0 (31).

While the study has shown promising results, it is important to acknowledge its limitations posed by the small sample size and limited trial scope. Future research should focus on further product development, including revisions and broader field trials, to fully realize the potential of the application.

The trend of mothers utilizing digital platforms for health information is on the rise. Mobile apps, chatbots, and digital models like HoPE (Healthcare Obstetric in PrEgnancy) are becoming popular tools for accessing health information during pregnancy. Research on the HoPE Model Architecture, a novel approach to pregnancy information retrieval based on conversational agents, shows that the digital model is proven to be able to provide information quickly and accurately compared to other models (32). The design of these tools is crucial; they should be engaging, with clear messaging and the use of images, while ensuring that the information provided is comprehensive and aligns with existing health norms. Furthermore, research on infographic media shows that the credibility and trustworthiness of the media in conveying messages are crucial for gaining acceptance and increasing health literacy (33). Therefore, it is necessary to present health materials in a way that is easy to understand and use for pregnant women.

The shift toward online antenatal classes is gaining momentum, driven by their convenience and accessibility. This trend is supported by findings showing that a significant number of women are turning to the internet for health information. The results of a cohort study revealed that 90.5% of mothers use the internet at home to obtain general information about health and seek information related to their obstetrics, emphasizing the role of the internet as a potential tool to improve health information access (34). Nguyen's research shows that the use of online social media contributes to the conceptual framework and practical experience of health utilization behavior models among mothers (35).

The application is user-friendly and entertaining, and its educational interface is well-suited for both educators and learners. It effectively addresses the limitations of traditional in-person classes, and its positive impact on women's health through online social support is evident. Using applications has become a necessity nowadays. The results of Mulyani's research showed that the use of augmented reality media in health education significantly increases knowledge scores for healthy lifestyle (5.0 ± 10.9 ; $p < .05$) and behavior (9.7 ± 17.5 ; $p < 0.05$) (36). In online antenatal classes, social and environmental support is highly important, enabling participants to interact actively and understand materials well (37). Similar research on the effects of WhatsApp-based and pamphlet-based learning on mothers' awareness and attitude showed that online media use and clinical interventions during pregnancy can be beneficial for women. In fact, sharing health information among mothers through social networks is associated with better pregnancy management. Online health information access also increases mothers' health awareness and enhances their attitudes and behaviors (38). Online antenatal care, including the use of telehealth, is developing rapidly and widely (39).

In conclusion, the design of the application, which combines entertainment and education, is key to encouraging mothers to seek health information, thereby enhancing their knowledge.

Conclusion

The use of the application is recommended as an alternative to in-person antenatal classes. Participating in online antenatal classes using the application increases

knowledge. This study provides alternative solutions using IT to implement online antenatal classes. These classes improve the health of mothers and children and prevent increased morbidity and mortality rates among them. The next stage of research needs to be carried out in the form of product revisions and extensive trials to enable the application to be disseminated and used in all antenatal classes.

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Ethical statement

This study was approved by the Ethics Committee of the Tasikmalaya Health Polytechnic (Ethical approval code: No.KP-KEPK/0016/2022). The respondents signed written informed consent and participated in the study voluntarily.

Conflicts of interest

The authors declare no conflicts of interest for the publication of this study.

Author contributions

All authors have actively contributed to designing and conducting the study and preparing the draft and final version of the manuscript for publication.

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