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Transforming Antenatal Education in the Digital Era: The Impact of a Hybrid Intervention in Pregnant Women's Behavior

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ABSTRACT

Introduction: Antenatal education is essential to reducing maternal mortality. However, limited access and time constraints reduce participation in conventional pregnancy classes. This study aims to evaluate the effectiveness of a hybrid antenatal education model in improving pregnant women's knowledge, attitudes, and practices (KAP) regarding maternal care.

Methods: A quasi-experimental study with a pretest-posttest control group design was conducted among 60 pregnant women in Magelang, Indonesia, from April to July 2024. Participants were randomly assigned to either a hybrid intervention group or a conventional care group. Data were collected at three time points and analyzed using Paired T-Tests, Independent T-Tests, and GLM-Repeated Measures.

Results: The intervention group showed significant improvements in knowledge, attitudes, and practices ($p < .005$). The effect size was strongest for knowledge (Partial Eta Squared $\eta^2=0.783$). Age was identified as a confounding factor affecting practice ($p=0.008$).

Conclusion: The hybrid antenatal education model significantly enhances maternal health behaviors, particularly knowledge, and provides a sustainable educational strategy. It is recommended for broader implementation in urban healthcare settings to improve antenatal care engagement and outcomes.

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INTRODUCTION

Maternal health is a key indicator of a country's healthcare system quality (1). Indonesia's maternal mortality rate stands at 305 per 100,000 live births—well above the SDG target of fewer than 70 by 2030 (2). The leading causes of maternal death include postpartum hemorrhage, hypertensive disorders in pregnancy, and infections (3,4).

Appropriate antenatal care behavior is a critical determinant in reducing maternal complications and mortality (5,6). This behavior encompasses the domains of knowledge, attitude, and practice concerning maternal health (7). Adequate knowledge of pregnancy danger signs can increase maternal preparedness for obstetric emergencies (8,9).

Traditional antenatal education through pregnancy classes has long been implemented in Indonesia. However, access barriers, time constraints, and limited resources hinder its effectiveness (10,11). Study found that only 54.3% of pregnant women routinely attended conventional classes (12), mainly due to scheduling conflicts and distant locations (13,14). As technology advances and societal behavior shifts post-COVID-19, a hybrid approach that integrates both face-to-face and online methods emerges as a promising alternative to improve participation and educational effectiveness in maternal health (15,16).

In recent years, digital health interventions have significantly developed to improve access and quality of antenatal care (17,18). In Indonesia, the use of digital technology for maternal health has gained increasing attention. Rahmawati's study revealed that 78.4% of pregnant women in urban areas have access to smartphones and the internet—representing a substantial potential for digital-based maternal health education (19). Nonetheless, digital disparities remain a challenge, thus a hybrid model offers a more inclusive solution (20,21).

The hybrid class model combines face-to-face sessions with online education.(22,23) According to Wallace et al. (2023), highlights the need for evidence-based and credible online antenatal courses, grounded in andragogical principles, relevant to educators and policymakers, and responsive to millennials' demand for reliable information and diverse learning needs (24). In the maternal context, Zhou et al. (2021) reported that hybrid interventions led to a 37.5% improvement in antenatal care adherence and an 18.2% reduction in pregnancy complications (25).

Research on the effectiveness of hybrid classes in improving maternal care behavior in Indonesia is still limited. Previous studies, such as those by Kurniasari and Faizah (2020), focused on online education to enhance knowledge (26), but did not evaluate the hybrid model's effect on knowledge, attitude, and practice simultaneously.

This study aims to assess the impact of hybrid antenatal education on pregnant women's behavior—including knowledge, attitude, and practice—in Magelang City. By evaluating the effectiveness of this approach, the study seeks to inform adaptive and effective maternal health education strategies in the digital era.

METHOD

This study employed a quasi-experimental pretest-posttest control group design to evaluate the effect of hybrid antenatal education on maternal behavior (knowledge, attitude, and practice). The study was conducted in three community health centers in Magelang City from April to July 2024. The locations were selected based on their provision of antenatal classes and pregnant women's participation rates.

The study population comprised 320 pregnant women receiving antenatal care during the study period. The sample size was determined using a two-group hypothesis test formula, with significance level $\alpha = 0.05$, power = 0.80, standard deviation = 4.3, and minimum meaningful mean difference = 2.5. The minimum required sample was 27 participants per group, with a 10% anticipated dropout rate, resulting in 30 participants per group. Thus, a total of 60 respondents were recruited: 30 in the intervention group and 30 in the control group. Random sampling was conducted using Microsoft Excel's RAND) function. Eligibility criteria included gestational age ≥14 weeks, ability to read and write, access to a smartphone and WhatsApp, and participation in facility-organized antenatal classes.

The intervention group received a hybrid class consisting of digital education (videos and modules), WhatsApp group support for 4 weeks (week 2 to week 5), and one initial face-to-face session. Topics included pregnancy, childbirth, postpartum care, and newborn care. The control group attended standard in-person classes provided by healthcare facilities.

Structured questionnaires measured knowledge (15 multiple-choice items), attitude (12 Likert-scale items), and practice (15 frequency-scale items). The instruments were validated by a panel of five experts in maternal health, public health education, and biostatistics, who evaluated item relevance, clarity, and cultural appropriateness. Internal

consistency was confirmed with Cronbach's alpha values indicating good reliability: knowledge (α = .82), attitude (α = .85), and practice (α = .88). These coefficients exceed the recommended minimum threshold of .70, confirming satisfactory reliability for research purposes. Data were collected at three stages: 1st (week 1), 2nd (week 6), and 3rd assessment (week 8) to evaluate sustained impact.

SPSS version 26 was used for data analysis. Paired T-tests assessed within-group changes, Independent T-tests compared groups, and GLM-Repeated Measures examined time effects and group-time interactions. A p-value <0.05 was considered statistically significant.

Ethical Approval

Ethical approval was obtained from the Health Research Ethics Committee of Universitas Jenderal Achmad Yani Yogyakarta (SKep/350/KEPK/XI/2022). Informed consent was secured from all participants, and data confidentiality was strictly maintained

.

RESULTS

Complete description of maternal characteristics is shown in Table 1:

Table 1. Characteristics of Pregnant Women in Magelang City

Variable/Group	Intervention (N=30)		Control (N=30)	
	f	%	f	%
Age				
- High-Risk Pregnancy	4	13	1	3.3
- Not High-Risk Pregnancy	26	86.7	29	96.7
Education				
- Elementary - Secondary	23	76.7	23	76.7
- Higher Education	7	23.3	7	23.3
Occupation				
- Unemployed	7	23.3	11	36.7
- Employed	23	76.7	19	63.3
Income				
- < Minimum Regional Wage	13	43.3	14	46.7
- ≥ Minimum Regional Wage	17	56.7	16	53.3
Number of Pregnancies				
- Primigravida	16	53.3	6	20
- Multigravida	14	46.7	24	80

The study included 60 pregnant women, equally divided into intervention and control groups (30 each), with most participants in the non-risk age category (86.7% vs. 96.7%), having primary to secondary education (76.7% in both), employed (76.7% vs. 63.3%), and reporting an income at or above the regional minimum wage (56.7% vs. 53.3%), while a significant difference was noted in gravidity, as the intervention group was predominantly primigravida (53.3%) and the control group predominantly multigravida (80%).

Table 2. Distribution of Maternal Behavior Variables

Variable/ Assessment	Intervention				Control			
	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
Knowledge								
1st	8.70	1.725	6	12	8.83	1.464	6	12
2nd	11.30	1.208	9	13	9.60	1.133	8	12
3rd	13.40	0.615	12	15	10.03	0.890	9	12
Attitude								
1st	37.50	2.129	34	42	36.83	1.621	34	41
2nd	42.27	2.132	37	45	38.20	1.627	35	41
3rd	45.80	1.349	43	48	40.53	1.634	37	43

Practice								
1st	53.20	4.693	41	60	52.43	3.919	43	58
2nd	57.53	3.277	48	62	54.87	3.037	48	59
3rd	63.47	1.697	59	66	56.90	2.339	53	63

Table 2 shows that the intervention group demonstrated greater improvements in knowledge (8.70 to 13.40), attitude (37.50 to 45.80), and practice (53.20 to 63.47) compared to the control group, which showed only modest gains. Reduced standard deviations (knowledge = 0.615; attitude = 1.349; practice = 1.697) and consistently higher minimum and maximum values at posttest 2 further confirm the effectiveness of the intervention in enhancing maternal health behaviors.

Table 3. Paired T-Test Result

Variable/ Assessment			**Intervention**		**Control**	
			Mean Diff ± SD	**Sig.**	**Mean Diff ± SD**	**Sig.**
Knowledge	1st	2nd	2.600±1.354	.001	0.767±0.898	.001
	2nd	3rd	2.333±1.061	.001	0.433±0.568	.001
Attitude	1st	2nd	4.767±2.161	.001	1.367±1.273	.001
	2nd	3rd	3.533±1.978	.001	2.333±1.470	.001
Practice	1	2nd	4.333±2.073	.001	2.433±1.654	.001
	2nd	3rd	5.933±2.612	.001	2.033±1.691	.001

The statistical analysis presented in Table 3 revealed an upward trend in both groups. Paired t-test results confirmed significant improvements ($p < .005$) across all behavioral variables—knowledge, attitude, and practice—from the first to the second and from the second to the third assessment in both groups. However, the intervention group demonstrated substantially greater mean differences, indicating a more pronounced learning effect of the hybrid method.

Table 4. Independent T-Test Result

Variable/ Assessment		**Intervention**	**Kontrol**	**Mean Diff**	**Sig.**
		Mean±SD	**Mean±SD**		
Knowledge	1st	8.70±1.725	8.83±1.464	0.133	.748
	2nd	11.30±1.208	9.60±1.133	1.700	.001
	3rd	13.63±0.615	10.03±0.890	3600	.001
Attitude	1st	37.50±2.129	36.83±1.621	0.677	.178
	2nd	42.27±2.132	38.20±1.627	4.067	.001
	3rd	45.80±1.349	40.53±1.349	5.267	.001
Practice	1st	53.20±4.693	52.43±3.919	0.767	.495
	2nd	57.53±3.277	54.87±3.037	2.667	.002
	3rd	63.47±1.697	56.90±2.339	6.567	.001

Independent t-test results indicated that although both groups began with comparable first assessment scores ($p > .05$), significant differences emerged at the second assessment and became more pronounced at the third assessment across all variables ($p < .005$ for knowledge and attitude). These findings support the superiority of the hybrid approach in enhancing maternal health behaviors compared to conventional methods.

Table 5. GLM-RM Fixed Model Result

Dependent Variable	**Knowledge**	**Attitude**	**Practice**
Sig.	.004	.026	.001
Confounding	None identified	None identified	Age (p = .008)
Difference in Improvement Between Groups	.001	.001	.001
1st to 2nd Assessment			

Sig.	.001	.001	.002
Partial Eta Squared	.612	.632	.400
2nd t to 3rd Assessment			
Sig.	.001	.001	.001
Partial Eta Squared	.783	.626	.636

The GLM-RM test (Table 5) revealed significant effects of the intervention on maternal knowledge ($p = .004$), attitude ($p = .026$), and practice ($p < .001$). No significant confounders were found for knowledge and attitude, whereas age emerged as a significant confounder for practice ($p = .008$). Effect size estimates (Partial Eta Squared) indicated strong impacts, particularly for knowledge ($\eta^2 = .783$), followed by practice ($\eta^2 = .636$) and attitude ($\eta^2 = .626$).

DISCUSSION

The findings confirm that the hybrid model—combining face-to-face sessions with online modules and videos—significantly improved maternal behaviors in Magelang City. These results are consistent with studies by Nurmala and Ahsan (2020), who emphasized the flexibility and broader reach of hybrid education, particularly for employed urban mothers (27). The intervention group in this study, which included a majority of working women (76.7%), demonstrated substantial improvements in knowledge. This highlights the need for online antenatal courses that are credible, evidence-based, and grounded in andragogical principles, while remaining relevant to stakeholders and responsive to millennials' demand for reliable information and diverse learning needs (28).

The significant increase in knowledge in the intervention group (from 8.70 to 13.40), compared to the control group (from 8.83 to 10.03), underscores the effectiveness of the hybrid model. A Partial Eta Squared of 0.783 indicates a very large effect size, meaning that approximately 78% of the variance in knowledge acquisition can be attributed to the hybrid intervention, which highlights its substantial educational impact. This result is supported by Widiastuti et al. (2021), who found that hybrid educational interventions provide continuous access to learning materials through modules and videos that can be revisited after face-to-face sessions, facilitating deeper learning and longer knowledge retention (29). The combination of in-person meetings and digital resources enables pregnant women in Magelang City to acquire knowledge through multiple learning modalities tailored to their preferences and learning styles. Similarly, Mulyani et al. (2023) demonstrated that the use of Augmented Reality (AR) in health education significantly enhanced knowledge of healthy lifestyles among pregnant women (30).

The greater change in attitude observed in the intervention group (from 37.50 to 45.80) compared to the control group (from 36.83 to 40.53) reflects the success of the hybrid model in fostering positive perspectives toward antenatal care. According to Puspitasari and Rahmadhani (2022), the combination of social interaction during face-to-face sessions and self-reflection through digital materials creates a conducive environment for attitudinal transformation related to pregnancy care (31). In Magelang City, the integration of group discussions with reinforcement through educational videos provided a more comprehensive learning experience than conventional approaches.

In terms of practice, the intervention group demonstrated substantial improvement (from 53.20 to 63.47) compared to the control group (from 52.43 to 56.90), indicating the effectiveness of the hybrid approach in translating knowledge into real-life actions. Setiawati and Mulyono (2023) highlighted that online-accessible video demonstrations of antenatal care enable pregnant women to revisit techniques taught during face-to-face sessions, thereby enhancing procedural understanding and confidence (32). The modules and educational videos provided during the intervention allowed participants to repeatedly review the materials, strengthening both comprehension and practical skills (33). Setyaningrum et al. (2023) also reported that Android-based pregnancy education applications effectively improve maternal health behavior (34).

Results of the General Linear Model–Repeated Measures (GLM-RM) test demonstrated significant effects of the intervention on all three behavioral aspects—knowledge ($p = .004$), attitude ($p = .026$), and practice ($p < .001$)—confirming the superiority of the hybrid model over conventional approaches. Hernawati et al. (2021) noted that hybrid interventions address the limitations of traditional educational models by applying blended learning principles, which leverage the strengths of both face-to-face and digital modalities, resulting in more sustained behavioral changes (35). The reduction in standard deviation values within the intervention group further indicates

the effectiveness of the hybrid model in equalizing understanding and practice among pregnant women from diverse backgrounds.

The finding that age was a significant confounder for practice ($p = .008$) highlights the importance of considering this variable in implementing hybrid programs. Consistent with Putri and Handayani (2020), age influences adaptability to technology and digital learning modalities, with younger pregnant women generally adapting more readily to the online components of hybrid interventions (36). This underscores the need for tailored strategies in designing hybrid antenatal programs to accommodate the varying needs of women across age groups.

The continued improvement from posttest 1 to posttest 2 in the intervention group indicates the long-term effects of the hybrid approach. Ardianti and Sulistiani (2022) observed that the availability of digital materials following face-to-face sessions provides ongoing reinforcement, supporting long-term retention of healthy behavior (37).

Digital health interventions, therefore, have the potential to enhance the effectiveness of antenatal care, particularly in resource-limited settings.(38) The integration of face-to-face classes with digital content in Magelang City demonstrates potential to reach a broader and more diverse population of pregnant women, including those with time constraints due to employment or limited mobility during pregnancy.

These findings align with the global paradigm of digital health education (39,40), which emphasizes accessibility, learner-centered approaches, and multimodal reinforcement to improve health literacy and behavioral outcomes (41). By situating hybrid antenatal education within this broader framework, the study contributes not only empirical evidence but also theoretical insights into how blended learning strategies can address maternal health challenges in the digital era.(18,42)

Recommendations for Future Research

Future studies should prioritize longitudinal designs with extended follow-up periods and larger randomized controlled trials to establish stronger causal relationships and assess sustained behavioral changes resulting from hybrid antenatal education. Key priorities include developing age-stratified interventions to address confounding effects, optimizing combinations of digital platforms, evaluating cost-effectiveness and scalability across diverse healthcare settings, and examining effectiveness among high-risk pregnancies and rural populations.

CONCLUSION

Hybrid antenatal education interventions significantly improved all aspects of maternal health behavior (knowledge, attitude, and practice), with the greatest impact observed in the knowledge domain. Behavioral changes were progressive and sustained, as reflected by consistent improvements from pretest to posttest 2 and reduced variance, which indicated increased uniformity. Age emerged as the only significant confounding factor, particularly influencing practice. The hybrid model—combining face-to-face sessions with digital modules and videos—provides superior accessibility, continuity of learning, and multimodal reinforcement, making it especially suitable for urban pregnant women.

This study affirms that integrating conventional and digital methods results in more substantial and sustained improvements in maternal health behaviors in the digital era. Health facilities and primary healthcare providers are encouraged to adopt the hybrid education model in antenatal programs. Implementation should be supported by locally adapted digital platforms, age-stratified intervention strategies, enhanced digital competence among healthcare workers, and regular updates of comprehensive educational content. Program sustainability further requires adequate funding and the active involvement of community health workers and local organizations to expand outreach among pregnant women across the region.

AUTHOR'S CONTRIBUTION STATEMENT

Sri Widatiningsih (Corresponding Author): Conceived and designed the study; developed the hybrid intervention methodology; supervised data collection and analysis; interpreted the results; drafted the initial manuscript; coordinated the research team; critically reviewed and revised the manuscript for important intellectual content; approved the final version for submission.

Mundarti: Contributed to study design and methodology development; participated in data collection and field implementation of the intervention; assisted in data analysis and interpretation; contributed to manuscript writing and literature review; provided critical feedback on the manuscript; approved the final version for submission.

Christin Hiyana TD: Participated in study design and planning; assisted in the development of educational materials for the hybrid intervention; contributed to data collection and participant recruitment; performed statistical analysis; contributed to manuscript writing and editing; reviewed and approved the final manuscript.

Esti Handayani: Contributed to study conceptualization and research design; participated in the development and validation of data collection instruments; assisted in field data collection and intervention implementation; contributed to statistical analysis and results interpretation; participated in manuscript drafting and critical revision; provided expertise in digital health education approaches.

All authors have read and agreed to the published version of the manuscript and take responsibility for the integrity of the work as a whole.

CONFLICTS OF INTEREST

The authors declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The research was conducted with complete independence and objectivity, ensuring the integrity and credibility of the study findings.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors acknowledge the use of AI-assisted technologies during the manuscript preparation process. Specifically, Claude and Deep-L were utilized to enhance language clarity, improve grammatical accuracy, and refine the overall readability of the manuscript. The AI tools were employed solely for language enhancement and editorial assistance, and did not contribute to the conceptualization, methodology, data analysis, or interpretation of research findings. All scientific content, research design, data collection, analysis, and conclusions remain entirely the intellectual work of the authors. The authors take full responsibility for the accuracy and integrity of all content presented in this manuscript.

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BIBLIOGRAPHY

1. Kazemi K, Ryhtä I, Azimi I, Niela-Vilen H, Axelin A, Rahmani AM, et al. Impact of Physical Activity on Quality of Life During Pregnancy: A Causal ML Approach. 2024; Available from: http://arxiv.org/abs/2402.16909
2. Kementerian Kesehatan RI. Profil Kesehatan Indonesia Tahun 2022. Jakarta; 2023.Available from: https://kemkes.go.id/id/profil-kesehatan-indonesia-2022.

3. UNFPA. UNFPA calls for action on Indonesia's maternal mortality [Internet]. 2024. Available from: https://en.antaranews.com/news/322251/unfpa-calls-for-action-on-indonesias-maternal-mortalityANTARA News
4. Syairaji M, Nurdiati DS, Wiratama BS, Prüst ZD, Bloemenkamp KWM, Verschueren KJC. Trends and causes of maternal mortality in Indonesia: a systematic review. BMC Pregnancy Childbirth. 2024;24(1):1–14. doi: 10.1186/s12884-024-06687-6.
5. Battulga B, Benjamin MR, Chen H, Bat-Enkh E. The impact of social support and pregnancy on subjective well-being: A systematic review. Front Psychol. 2021;12:710858. doi: 10.3389/fpsyg.2021.710858.
6. Jeong J, Sullivan EF, Mccann JK. Effectiveness of father-inclusive interventions on maternal, paternal, couples, and early child outcomes in low- and middle-income countries: a systematic review. 2024;1–30. doi: 10.1016/j.socscimed.2023.115971. doi: 10.1016/j.socscimed.2023.115971.Effectiveness.
7. Alhamedi NM, Alshoaibi NF, Alamri RMS, Alamri SA, Alsulami SS, Ghulam E SS. Knowledge, attitude, and practice of breastfeeding among mothers attending King Abdulaziz University Hospital,Jeddah, Saudi Arabia. J Fam Med Prim Care. 2025;14(4):1295–306. doi: 10.4103/jfmpc.
8. Shrateh ON, Al Khateeb J, Habib A, Kateeb S, Khdour H, Said T, et al. Awareness and knowledge of preeclampsia among women in Palestine. Pregnancy Hypertens. 2025;41(April 2024). doi: 10.1016/j.preghy.2025.101238.
9. Alsabi FA, Orabi AM, Bajamal EZ. Knowledge and attitude of pregnant women about preeclampsia in King Abdulaziz Medical City, Western Region: A cross-sectional study. PLoS One [Internet]. 2025;20(5 May):1–13. Available from: https://doi.org/10.1371/journal.pone.0312304
10. Rahmadhani W, Novyriana E. The Husband's Social Support on Participation in Pregnant Woman Class Program During the Covid-19 Pandemic in Kebumen. Proc 3rd Borobudur Int Symp Humanit Soc Sci 2021 (BIS-HSS 2021). 2023;203–7. doi: 10.2991/978-2-494069-49-7_35.
11. Isye Fadmiyanor, Yeni Aryani OV. Partisipasi suami dalam pelaksanaan kelas ibu hamil. 2022;3(1):29–32. doi: https://doi.org/10.36929/ebima.v3i1.514
12. Patriajati S, Sriatmi A. Determinants of Mothers' Participation in Antenatal Classes. J Adm Kesehat Indones. 2019;7(2):139. doi: 10.20473/jaki.v7i2.2019.139-146.
13. AlDughaishi MY, Seshan V, Matua GA. Challenges and Strategies for Providing Effective Antenatal Education Services in Oman's Public Healthcare System. Sultan Qaboos Univ Med J. 2023;23(November):510–8. https://doi.org/10.18295/squmj.5.2023.032.
14. Wahyuningsih E, Wahyuningsih A, Ambarsari L. Analysis of Antenatal Care (ANC) Visits and Prenatal Classes for High-Risk Pregnancy : Compliance and Involvement of Couples. Gaster. 2025;23(1):38–50. doi: 10.30787/gaster.v23i1.1666.
15. Dashraath P, Wong JLJ, Lim MXK, Lim LM, Li S, Biswas A, et al. Coronavirus disease 2019 (COVID-19) pandemic and pregnancy. Am J Obstet Gynecol. 2020 Jun 1;222(6):521–31. doi: 10.1016/J.AJOG.2020.03.021.
16. Bahasoan AN, Wulan Ayuandiani, Muhammad Mukhram, Aswar Rahmat. Effectiveness of Online Learning In Pandemic Covid-19. Int J Sci Technol Manag. 2020;1(2):100–6. doi: 10.46729/ijstm.v1i2.30.
17. Gunawan, Ni Made Yeni Suranti F. Variations of Models and Learning Platforms for Prospective Teachers During the COVID-19 Pandemic Period. Indones Teach Educ [Internet]. 2020;1(2):61–70. Available from: https://journal.publication-center.com/index.php/ijte/article/view/95/48
18. Whitworth K, Donnellan-Fernandez R, Fleet JA. Digital transformation of antenatal education: A descriptive exploratory study of women's experiences of online antenatal education. Women and Birth [Internet]. 2024;37(1):188–96. Available from: https://doi.org/10.1016/j.wombi.2023.08.008
19. Rahmawati, E., Willison, S., Dwirahmadi, F., & Wulandari RD. Digital health literacy among Indonesian pregnant women: opportunities and challenges. J Public Health Africa. 2021;12(1):1982. doi: https://doi.org/10.4081/jphia.2021.1982.
20. Susilawati S, Supriyatno T. Online Learning Through WhatsApp Group in Improving Learning Motivation in the Era and Post Pandemic COVID -19. J Pendidik Teor Penelitian, dan Pengemb. 2020;5(6):852. doi: 10.17977/jptpp.v5i6.13670.

21. Skouteris H, Savaglio M. The use of social media for preconception information and pregnancy planning among young women. J Clin Med. 2021;10(9). doi: 10.3390/jcm10091892.
22. Hamid R. Exploring the Effectiveness of Hybrid Learning Models in Higher Education Post-Pandemic. Int J Post Axial Futur Teach Learn [Internet]. 2024;2(3):177–91. Available from: https://journal.amorfati.id/index.php/postaxial/article/view/386
23. Rum EP, Baso FA, Musoyeva A. Hybrid Learning Model in Post-Pandemic Education: Lecturers Attitude in Indonesian and Uzbekistan Higher Education. APTISI Trans Technopreneursh. 2025;7(1):169–79. doi: 10.34306/att.v7i1.516.
24. Wallace HJ, Bayes S, Davenport C, Grant M. How should online antenatal and parenting education be structured according to parents? Qualitative findings from a mixed-methods retrospective study. Women's Heal. 2023;19. doi: 10.1177/17455057221150098.
25. Zhou, Y., Zhang, Q., Li, H., Wang, T., & Wang Y. Effects of a hybrid intervention model on women's antenatal care utilization, knowledge of danger signs, birth preparedness and pregnancy outcomes in rural China. Midwifery. 2021;100. doi: https://doi.org/10.1016/j.midw.2021.103062.
26. Kurniasari, D., & Faizah I. Edukasi berbasis daring sebagai upaya pencegahan dan pengendalian anemia dalam kehamilan di masa pandemi Covid-19. J Ilm Kesehat. 2020;5(2):106–15. doi: https://doi.org/10.30604/jika.v5i2.321.
27. Nurmala, S., & Ahsan K. Efektivitas Model Edukasi Hybrid pada Perilaku Perawatan Kehamilan di Wilayah Perkotaan. J Midwifery. 2020;5(1):257–70. https://doi.org/10.33560/jmidwifery.v5i1.257.
28. Kim HK, Jeong GH, Min HY. Pregnant women's experiences of online prenatal education in Korea during COVID-19: a phenomenological study. Women's Heal Nurs. 2024;30(3):192–202. doi: 10.4069/whn.2024.09.09.
29. Widiastuti, T., Purwanti, E., & Sumarni S. Pemanfaatan Teknologi Digital dalam Edukasi Kesehatan Maternal: Studi Kasus Implementasi Model Hybrid di Jawa Tengah. Caring Midwifery Sci J. 2021;6(1):24638–50. https://doi.org/10.20473/cmsnj.v6i1.24638.
30. Mulyani, E. Y., Jus'at, I., & Sumaedi S. The effect of Augmented-Reality media-based health education on healthy lifestyle knowledge, attitude, and healthy lifestyle behaviors among pregnant women during COVID-19 pandemic in Jakarta,Indonesia. Digit Heal. 2023;9. https://doi.org/10.1177/20552076231167255.
31. Puspitasari, D., & Rahmadhani K. Transformasi Sikap Ibu Hamil melalui Edukasi Kesehatan Hybrid di Era Digital. J Matern dan Kebidanan Indones. 2022;10(2):576–90. https://doi.org/10.31596/jmki.v10i2.576.
32. Setiawati, A., & Mulyono S. Peran Video Edukasi dalam Meningkatkan Keterampilan Perawatan Mandiri pada Ibu Hamil di Wilayah Urban. J Kesehat Masy. 2023;8(1):553–68. doi: https://doi.org/10.33087/jkm.v8i1.921.
33. Lucas CJ, Lyell E, Koch B, Elder V, Cummins L, Lambert S, et al. Feasibility of face-to-face and online learning methods to provide nutrition education to midwives, general practice nurses and student nurses. BMJ Nutr Prev Heal. 2019;2(2):80–5. doi: 10.1136/bmjnph-2019-000031.
34. Setyaningrum, I. S., Pipitcahyani, T. I., Pratami, E., & Harumi AM. The Effect of Android-based Pregnancy Education and Care on Improving The Behavior of Pregnant Women. Int J Adv Heal Sci Technol. 2023;3(5). doi: https://doi.org/10.35882/ijahst.v3i5.273.
35. Hernawati, P., Suherman, A., & Nugroho H. Komparasi Efektivitas Model Edukasi Konvensional dan Hybrid pada Program Kesehatan Maternal di Indonesia. Heal J. 2021;9(2):553–68. doi: https://doi.org/10.29238/health.v9i2.553.
36. Putri, R. A., & Handayani S. Faktor Demografis yang Mempengaruhi Adaptasi terhadap Model Pembelajaran Hybrid pada Ibu Hamil. J Kesehat Reproduksi. 2020;5(2):327–41. doi: https://doi.org/10.22146/jkr.v5i2.327.
37. Ardianti, F., & Sulistiani D. Evaluasi Dampak Jangka Panjang dari Intervensi Edukasi Hybrid pada Perilaku Kesehatan Maternal. J Manaj Matern. 2022;7(3):985–1000. doi: https://doi.org/10.35473/jmm.v7i3.985.
38. Endehabtu BF, Tilahun B, Gelaye KA, Mengiste SA. Mapping the Role of Digital Health Interventions to Enhance Effective Coverage of Antenatal Care: A Scoping Review. J Multidiscip Healthc. 2024;17(December 2023):71–82. doi: 10.2147/JMDH.S438097.

39. Pang TY, Lee TK, Murshed M. Towards a New Paradigm for Digital Health Training and Education in Australia: Exploring the Implication of the Fifth Industrial Revolution. Appl Sci. 2023;13(11). doi: 10.3390/app13116854.
40. Simanjuntak R, Padua SA, Sicat A, Yunus R. Transformation of Health Education in The Digital Era : Innovative Approaches for Developing 21 ST -Century Competence. 2025;3(3).
41. Redican KJ. Health Literacy and Health Education: Research and Practical Applications. Am J Heal Educ [Internet]. 2021;52(6):321–2. Available from: https://doi.org/10.1080/19325037.2021.1985021
42. Larkai E, Davies A, Toolan M, Lynch M, Plachcinski R, Larkin M, et al. What Do Antenatal Women Want From Their Antenatal Education? A National Survey. Matern Child Health J [Internet]. 2025;29(3):324–37. Available from: https://doi.org/10.1007/s10995-025-04048-z