Jurnal Gizi dan Dietetik Indonesia
(Indonesian Journal of Nutrition and Dietetics)
Vol 13, Issue 5, 2025: 352-364

Available online at: https://ejournal.almaata.ac.id/index.php/IJND
p-ISSN 2303-3045 e-ISSN 2503-183X
DOI: https://dx.doi.org/10.21927/ijnd.2025.13(5).352-364

The impact of e-booklets on knowledge and attitudes toward anemia awareness among adolescent girls in Yogyakarta, Indonesia

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ABSTRAK

Latar Belakang: *Menurut Survei Kesehatan Indonesia tahun 2023, sebanyak 15,5% remaja putri menderita anemia, sehingga anemia sebagai suatu masalah kesehatan yang signifikan. Salah satu faktor yang berkaitan dengan anemia remaja adalah rendahnya pengetahuan dan kepatuhan konsumsi Fe.*
Tujuan: *: Mengevaluasi efektivitas edukasi gizi menggunakan e-booklet dibandingkan dengan media slide dalam meningkatkan pengetahuan dan sikap terkait anemia..*
Metode: *Penelitian ini merupakan penelitian quasi eksperimental dengan desain pretest-posttest control group. Penelitian dilakukan pada bulan Maret-April 2024, melibatkan 85 siswi SMP di Yogyakarta, yang dibagi ke dalam kelompok intervensi (e-booklet dan media slide) dan kelompok kontrol (media slide). Data tentang pengetahuan dan sikap dikumpulkan menggunakan kuesioner terstruktur pada tiga tahap: pretest, posttest-1, dan posttest-2. Analisis statistik yang digunakan adalah paired t-test, uji wilcoxon, independent t-test, dan uji mann-whitney.*
Hasil: *Hasil penelitian menunjukkan peningkatan yang signifikan dalam skor pengetahuan pada kedua kelompok, dengan kelompok intervensi mencapai skor post-test yang lebih tinggi (89,1 vs 78,8; p<0,05). Meskipun kedua kelompok menunjukkan sedikit peningkatan dalam hal sikap, perubahan yang diamati tidak mencapai signifikansi secara statistik. Temuan ini menyoroti efektivitas e-booklet sebagai alat pembelajaran digital, yang menawarkan fleksibilitas dan konten mendalam yang mendukung pembelajaran mandiri..*
Kesimpulan: *Penelitian ini menggarisbawahi potensi e-booklet untuk mengatasi kesenjangan pengetahuan tentang anemia di kalangan remaja. Pembuat kebijakan sebaiknya mengintegrasikan e-booklet ke dalam program pendidikan kesehatan nasional dan menggabungkannya dengan metode offline yang interaktif untuk meningkatkan perubahan pengetahuan remaja.*

KATA KUNCI*: anemia; e-booklet; pengetahuan; remaja putri; sikap*

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ABSTRACT

Background: *Based on Indonesia Health Survey 2023, 15,5% female adolescents suffer from anemia, as a significant health problem. This is due to lack of knowledge and low compliance of Fe consumption.*

Objectives: *To evaluate the effectiveness of nutrition education using e-booklets compared to slide media in improving anemia-related knowledge and attitudes.*

Methods: *This was a quasi-experimental design with a pretest-posttest control group, conducted in March–April 2024, involving 85 junior high school girls in Yogyakarta, divided into intervention (e-booklet and slide media) and control (slide media) groups. Data on knowledge and attitudes were collected using structured questionnaires at three points: pretest, posttest-1, and posttest-2. Statistical analyses included paired t-tests, Wilcoxon, independent t-tests, and Mann-Whitney tests.*

Results: *The results showed a significant improvement in knowledge scores in both groups, with the intervention group achieving higher post-test scores (89.1 vs. 78.8; $p<0.05$). Although both groups demonstrated a slight improvement in attitudes, the observed changes did not reach statistical significance. The findings highlight the effectiveness of e-booklets as a digital learning tool, offering flexibility and in-depth content that supports independent learning.*

Conclusions: *This study underscores the potential of e-booklets to address knowledge gaps about anemia among adolescents. Policymakers should integrate e-booklets into national health education programs while combining them with interactive offline methods to enhance attitude changes.*

KEYWORD*: anemia; attitude; adolescent girls; e-booklet; knowledge*

Article info:
Article submitted on December 13, 2024
Articles revised on February 18, 2025
Articles received on June 04, 2025

INTRODUCTION

Anemia is a pressing global health concern, particularly among adolescent girls, who face increased nutritional demands during rapid growth and menstruation. Globally, over 30% of adolescents are affected by anemia, leading to poor health outcomes, hindered development, and reduced quality of life(1). The prevalence of anemia among pregnant women increased from 37.1% in 2013 to 48.9%, with the highest proportion observed in the 15–24 age group, at 84.6%(1). In Yogyakarta Province, a 2018 survey involving 1,500 adolescent girls revealed an anemia prevalence of 19.3%(2). Despite recent efforts, including the distribution of iron supplements, the prevalence of anemia among pregnant women was reduced to 27.7% in 2023(3). This high prevalence is attributed to limited awareness and unfavorable attitudes toward anemia prevention, such as adherence to iron supplementation (3,4). The adolescence phase is a critical window for health interventions, as nutritional habits and health behaviors established during this period can impact long-term health outcomes. Factors such as eating patterns, nutritional intake, and food selection significantly influence anemia prevention and management(5,6).

The effectiveness of anemia prevention programs is frequently hindered by insufficient knowledge and unfavourable attitudes among adolescent girls. Studies in many countries such as Ethiopia and Ghana, have demonstrated that adolescents with limited knowledge about anemia are more likely to experience nutritional problems, underscoring the need for targeted educational interventions in developing countries and specifically in Indonesia (6,7,8).

Innovative educational strategies that enhance knowledge and foster positive attitudes toward nutrition and health are essential to combating anemia among adolescents. Traditional methods, such as lectures and slide presentations, often fail to achieve lasting knowledge retention or behavioral change (9). Adolescents thrive on interactive, flexible, and visually engaging tools that align with their digital

lifestyles. E-booklets offer a promising alternative, combining accessibility with self-paced learning to bridge knowledge gaps and promote healthier attitudes. Without such engaging interventions, poor awareness and adherence to preventive practices will continue to perpetuate the high prevalence of anemia, particularly in vulnerable regions. Research conducted in Yogyakarta revealed that the use of e-booklets resulted in a 12% increase in knowledge and 11 % improvement in attitudes regarding anemia among adolescents (10). However, previous studies have typically focused on one-time assessments without effectively evaluating the impact of e-booklets in high-prevalence regions.

To address these challenges, we created the "Ceria" e-booklet, which is designed specifically as an independent learning tool that offers clear and detailed information on preventing anemia in adolescent girls. By optimizing the use of digital media, we can create more effective educational interventions that foster deeper understanding and sustained behavioral change in combating anemia. By exploring the advantages of digital tools over conventional methods and assessing long-term outcomes, this research seeks to provide actionable insights for developing innovative and scalable health education interventions.

Ultimately, this study aspires to contribute to the global effort to reduce anemia prevalence and improve the well-being of adolescents. This study aims to comprehensively assess the effectiveness of e-booklet media compared to traditional slides in improving adolescent girls' knowledge and attitudes about anemia, making a significant contribution to the development of technology-based nutrition education strategies.

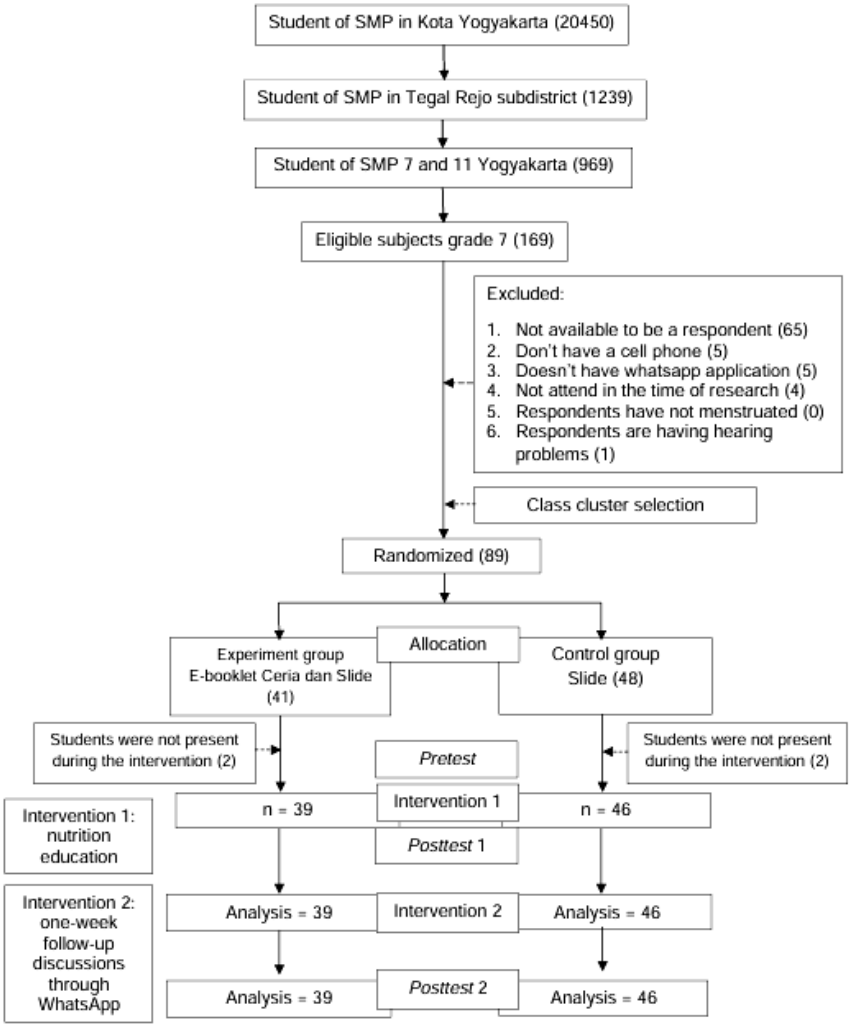


Figure 1. Consort Diagram

MATERIALS AND METHODS

Study design

This study used a quasi-experimental design with a pretest-posttest control group to evaluate the effectiveness of nutrition education using e-booklets compared to traditional slide media in improving knowledge and attitudes about anemia among adolescent girls. The study was conducted in Yogyakarta, Indonesia, during March and April 2024.

Study participants

The selection was conducted using a purposive sampling technique based on specific criteria: 1) the high prevalence of anemia in Yogyakarta City, which is 20.58%, 2) the sub-district with a high prevalence, namely Tegalrejo District (30.17%), 3) Junior High School in Tegalrejo District with similar characteristics, namely SMP 7 and SMP 11), 4) Determination of class samples by considering the school schedule and permission given by teachers, 5) determination of students with the criterias: female, student enrolled in 7th grade, willingness to participate as a respondent, ownership of a mobile phone with WhatsApp installed, attendance during the study period, and having experienced menstruation. Based on this criterias, 85 female randomly assigned into two groups: the intervention group/SMP 7 Yogyakarta (n=46), who received nutrition education using e-booklets combined with slide media, and the control group/SMP 11 Yogyakarta (n=39), who received education using only slide media. Both of the two schools have a considerable distance, so there is no cross-information between the intervention and control groups. Study participant's tree is depicted in **Figure 1**.

Intervention

The intervention provided is an e-booklet which includes information about the definition of anemia, signs and symptoms of anemia, causes of anemia, the impact of anemia, how to prevent and manage anemia, and a list of foods that are sources of iron, how to consume Fe supplementation, and side effects of Fe consumption. The description of the booklet is detailed as in **Figure 2**.

The intervention consisted of a 120-minute nutrition education session delivered through WhatsApp group communication. The content covered the definition, causes, symptoms, impact, prevention, food sources of iron, and proper use of iron supplementation and its side effects. The intervention group received additional educational content in the form of a visually engaging e-booklet. The e-booklet used in this study was developed based on the research objectives and tailored to the characteristics of adolescent respondents. The content, language, and visual presentation were designed to be engaging and easily understood by junior high school students. Prior to implementation, the e-booklet underwent expert validation by media and nutrition education specialists to ensure its effectiveness as an educational tool. While the control group was given the same content through slide presentations. Both groups participated in one-week follow-up discussions through WhatsApp groups for reinforcement and clarification.

Outcome measures

The primary outcome variables were knowledge and attitudes toward anemia, assessed at three-time points: pretest, posttest-1 (immediately after the intervention), and posttest-2 (one week after the intervention). Knowledge was assessed using a structured questionnaire with scores ranging from 0 to 100, while attitudes were evaluated using a Likert scale. The questionnaire was developed with 20 knowledge questions and 20 attitude statements and has been tested for validity by the researcher, the validity test score is 0.361, the reliability test score for knowledge and attitude is 0.839 and 0.763 respectively.

Data analysis

Data analysis was performed using SPSS software version 25. Descriptive statistics were employed to summarize participant characteristics, knowledge, and attitude score. The Shapiro-Wilk test was used to assess data normality. Comparisons of pretest, posttest-1, and posttest-2 scores within groups were conducted using paired t-tests and Wilcoxon signed-rank tests.

cover of e-booklet

definition of anemia

sign and symtoms of anemia

determinant of anemia

impact of anemia

initiatives of anemia prevention

food sources of fe

how to consume fe supplementation

side effect of fe

Figure 2. E-booklet media

Independent t-tests and Mann-Whitney U tests were utilized to evaluate the effectiveness of the intervention between groups. A p-value of less than 0.05 was considered statistically significant.

Ethical considerations

This study was approved by the Health Research Ethics Committee of the Health Polytechnic of the Ministry of Health Yogyakarta (No.DP.04.03/e-KEPK.1/032/2024). The researchers obtained informed consent from all participants' parents or legal guardians before initiating the study.

RESLTS AND DISCUSSIONS

Subject characteristics

A total of 85 adolescent girls participated in the study, with 46 assigned to the intervention group and 39 to the control group. The age distribution was similar across both groups, with most participants being 13 years old. The remaining participants were aged 14 and 15, with no significant differences between the two groups (p=0.154), indicating comparability at baseline. As detailed in **Table 1.**

Table 1. Subject characteristic

Variable	Group				Total (n = 85)		*p*
	E-booklet+slide (n = 46)		Slide (n = 39)				
	n	%	n	%	n	%	
Age (year)							
12	7	15.22	2	5.13	9	10.59	0.154
13	33	71.74	27	69.23	60	70.59	
14	5	10.87	9	23.08	14	16.47	
15	1	2.17	1	2.56	2	2.35	

This age group is particularly vulnerable to nutritional deficiencies, including iron deficiency anemia, which affects over 30% of adolescents globally (11) and remains a significant public health concern in Indonesia (6,7,8). The vulnerability stems from rapid growth and increased nutritional demands during adolescence, further exacerbated by poor dietary habits and limited health literacy (12,13).

Knowledge scores

Both groups showed significant improvements in knowledge. The intervention group had a notable increase in mean scores from 62.7 (pretest) to 89.1 (posttest-2), while the control group's scores increased from 64.6 (pretest) to 78.8 (posttest-2). The difference in the intervention group was statistically significant ($p < 0.05$), while the control group's improvement was not significant ($p = 0.210$) (**Figure 3 (a)**).

In this study, addressing these issues through innovative and effective educational strategies can significantly improve adolescents' current health and positively impact future maternal and child health outcomes, particularly as many adolescent girls transition to motherhood. Other study intervention that tailored in Yogyakarta, Indonesia, demonstrated that well-structured education programs could reduce anemia prevalence among adolescents by up to 11% (14).

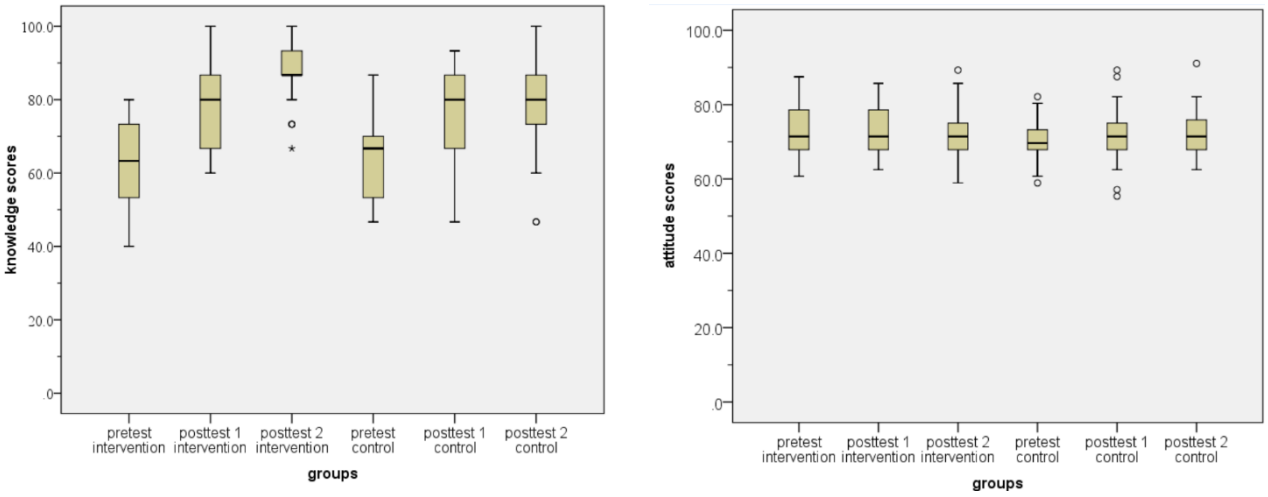
Educating adolescents about anemia is essential not only for fostering healthier future generations but also for addressing the broader prevalence of anemia in vulnerable populations. Public health strategies that combine efforts to reduce malnutrition with initiatives to improve health literacy align closely with this goal (15). Digital resources such as e-booklets offer a transformative solution by providing flexible, engaging, and accessible educational tools. These tools are particularly beneficial in areas with limited access to traditional health education methods (10,16,17). Integrating e-booklets into school curricula or community health programs can empower adolescents to make informed decisions about their health and nutrition, fostering lifelong healthy behaviors (15,18,19).

Attitude scores

Both groups exhibited minor improvements in attitude scores; however, these changes were not statistically significant. In the intervention

group, scores shifted from 72.2 at pretest to 71.9 at posttest-2, while the control group's scores increased from 70.5 at pretest to 72.2 at posttest-2. No significant differences were observed, $p > 0.05$. (**Figure 3 (b)**).

The findings of this study reveal that while both educational methods effectively increased attitude scores, e-booklets outperformed slide media due to their interactive and comprehensive nature. Although e-booklets facilitated a 22% greater improvement in knowledge retention compared to slides, however the impact on attitudes was limited, with no statistically significant differences observed between the groups. This suggests that attitude changes may require reinforcement strategies, such as peer discussions or interactive workshops.



(b) Knowledge score

(a) Attitude score

Figure 3. Adolescents' knowledge (a) and attitude (b) scores between two groups in different time

Subject's Knowledge and Attitude Scores Between Groups

Table 2 presents a comparison of knowledge and attitude scores between the intervention group (e-booklet and slide media) and the control group (slide media only) at three-time points: pretest, posttest-1, and posttest-2. The intervention group showed a significant improvement in knowledge, with a notable increase from pretest (62.7) to posttest-2 (89.1) and statistically significant($p < 0.05$). In contrast, while the control group also improved, the difference was not statistically significant, indicating that the e-booklet enhanced knowledge about anemia compared to slide media. In the attitude section, both groups exhibited slight improvements in attitude scores. However, these changes were not statistically significant ($p > 0.05$). This suggests that while both media formats contributed to a slight shift in attitudes, neither was particularly effective in driving significant attitude changes, highlighting the need for more interactive or reinforcement-based strategies to influence behavior. Based on **Table 2**, the pretest comparison of the knowledge of the two groups shows no significant difference in the average pretest score between the intervention and control groups. The results of the posttest 1 knowledge of the two groups showed no significant difference in the average posttest 1 score between the intervention group and the control group. The results of posttest 2 knowledge of both groups showed a significant difference between the intervention and control groups.

The results indicated that the knowledge pretest in both groups before the intervention was similar with a difference in knowledge pretest scores of 1.9 higher in the control group and a

difference in attitude pretest scores of 1.7 higher in the intervention group.

Based on **Table 2**, the pretest comparison of the attitudes of the two groups shows no significant difference in the average pretest score between the intervention and control groups. The results of the two groups' posttest 1 and posttest 2 attitudes showed no significant difference in the average posttest 1 and posttest 2 scores between the intervention and control groups. The significant improvement in knowledge scores among the intervention group highlights the effectiveness of e-booklets as a modern digital educational tool. Unlike traditional slide presentations, e-booklets provide a richer, more comprehensive learning experience by offering detailed content supported by visually appealing designs. This combination not only aids in conveying complex information but also supports independent learning(20).

Participants in the intervention group could access the material at their convenience, allowing them to revisit and reflect on the content as needed. This flexibility likely played a crucial role in improving knowledge retention, making the e-booklets a superior tool for delivering health education. These findings are consistent with research by Nikmah (2022) (21) and Pardosi (2019) (22), which revealed that e-booklets enhance comprehension and long-term knowledge retention more effectively than conventional teaching methods(23,24,25).

Table 2. Subject's knowledge and attitude scores between groups

Variables	E-booklet+slide	Slide	*p-value*
	Mean ± SD	**Mean ± SD**	
Knowledge			
Pretest	62.7 ± 11.1	64.6 ± 10.9	0.563
Posttest 1	78.7 ± 11.0	75.6 ± 11.0	0.268
Posttest 2	89.1 ± 8.7	78.8 ± 12.6	0.000*
Attitude			
Pretest	72.2 ± 6.5	70.5 ± 5.2	0.202
Posttest 1	73.2 ± 6.3	71.8 ± 7.3	0.333
Posttest 2	71.9 ± 6.4	72.2 ± 6.0	0.828

**p-value <0.05*

Subject Knowledge and Attitude Scores between Time and Group

Table 3 compares knowledge and attitude scores within two group at different time points (pretest, posttest-1, and posttest-2). The intervention group showed significant improvements in knowledge, with all posttest scores significantly higher than pretest scores ($p < 0.05$). However, no significant changes in attitude scores were observed within the two group. Similarly, the control group exhibited a significant increase in knowledge between pretest and posttest-1 ($p < 0.05$), but no significant changes in attitude scores were found. The results suggest that while both groups gained knowledge, the intervention group demonstrated a more notable improvement, especially in terms of knowledge retention

Table 3. Adolescent knowledge and attitude scores between time and group

Variabel	*Pretest*	*Posttest 1*	*Posttest 2*	*pretest vs posttest 1*	*pretest vs posttest 2*	*posttest 1 vs posttest 2*
E-booklet+slide						
Knowledge	62.7±11.1	78.7±11.0	89.1±8.7	0.000*	0.000*	0.000*
Attitude	72.2±6.5	73.2±63	71.9±6.4	0.231	0.822	0.204
Slide						
Knowledge	64.6±10.9	75.6±11.0	78.8±12.6	0.000*	0.000*	0.210
Attitude	70.5±5.2	71.8±7.3	72.2±6.0	0.287	0.114	0.644

**p-value <0.05*

The significant differences between the intervention and control group occurred in posttest-2 showed that e-booklets were more effective in improving knowledge than media slides. This increase is likely due to the flexibility of the e-booklet that allows participants to access the material independently, the interactive design that strengthens information retention, and the longer duration of the learning effect than conventional methods (20). While both groups experienced an increase in knowledge scores, only the intervention group showed a significant difference on posttest-2 ($p = 0.000$), indicating that the e-booklet had a stronger impact on long-term comprehension(10,21) However, despite the increase in knowledge, the change in attitudes was not significant, suggesting that increased understanding was not enough to change behavior and may require additional strategies such as group discussions, role-playing, or community-based reinforcement(26,27) Therefore, the integration of e-booklets with other interactive methods as well as long-term research is needed to ensure their effectiveness in encouraging change in attitudes and behaviors(16).

E-booklets have proven to be effective in increasing adolescents' knowledge about anemia, particularly due to their interactive and flexible design, which aligns with adolescents' learning preferences and allows for self-paced exploration. This effectiveness was evident in posttest-2, conducted one week after the intervention, demonstrating that the material provided in the e-booklet could be well understood and retained in the short to medium term. Studies by Nikmah et al. (2022) (21) and Wijaya et al. (2024) (10) also indicate that e-booklet-based learning enhances comprehension better than conventional methods, as it allows participants to revisit the material as needed. Moreover, research by Pardosi (2019) (28) and Alves et al. (2023) confirms that combining text with illustrations, infographics, and interactive media strengthens memory retention and improves knowledge acquisition. However, to assess long-term impact, further research is needed to evaluate knowledge retention over several months and its influence on attitude and behavior change. Smits et al. (2022) (20) and Ghadam et al. (2023) (16) emphasize that digital learning interventions can have longer-lasting effects compared to conventional methods if supported by periodic reinforcement, such as group discussions or curriculum-integrated follow-ups. Therefore, while e-booklets are effective in enhancing short- to medium-term knowledge, integrating them with other interactive strategies is essential to ensure sustainable behavioral change.

In contrast, while delivering concise summaries effectively, slide presentations have inherent limitations in their ability to support in-depth learning. Slides are typically designed for quick overviews and rely heavily on the presence of an instructor to elaborate on key points. This format may leave gaps in understanding, particularly for topics requiring more comprehensive exploration. The lack of interactivity and limited visual engagement in slides further reduces their appeal and effectiveness, especially among adolescents who value engaging and interactive educational experiences. These limitations likely contributed to the smaller improvements in knowledge scores observed in the control group, as participants had fewer opportunities to engage with the material thoroughly (29).

Although knowledge scores significantly improved, the attitude changes were minimal and statistically insignificant. The slight decline in attitude scores observed in posttest 2 suggests that reinforcement is key to sustaining positive attitudes. The relatively short duration of the intervention and the absence of interactive or participatory elements, such as discussions, group activities, or role-playing, may have limited the intervention's ability to influence attitudes significantly. Previous research emphasizes that face-to-face interactions often foster stronger emotional connections, which are crucial for depth understanding and attitude change (30,31) As such, offline methods, such as workshops or counseling sessions, could complement digital interventions like e-booklets to create a more profound and lasting impact on attitudes. Moreover, changes in attitudes are likely shaped by broader cultural and social factors. Peer norms, family values, and societal expectations often

influence adolescents' beliefs about health and nutrition. To enhance attitude change, future interventions should consider incorporating peer-led discussions, which can strengthen emotional and social engagement, thus fostering a more supportive environment for shifting attitudes (27,32, 33).

In this case, continuous increase in knowledge is higher than attitude score, this can be explained that firstly, knowledge retention tends to occur more quickly than attitude change, as attitudes are influenced by deeply ingrained beliefs and experiences. Secondly, the intervention's duration and format, which primarily focused on delivering educational content through e-booklets and slides, were effective in enhancing knowledge but may not have been sufficient to instill lasting attitude changes. Third, the lack of reinforcement or interactive approaches tend to have limited the intervention's impact on attitudes. Lastly, external environmental and social factors played a role in shaping attitudes, making them less responsive to short-term educational interventions.

The Effectiveness of the Use of Ceria E-Booklet to Increase Knowledge and Attitudes

Table 4 compares the mean rank of knowledge and attitude score changes between the intervention and control groups. The intervention group showed a significantly greater improvement in knowledge scores from pretest to posttest-2 ($p = 0.000$), indicating the effectiveness of the e-booklet media. However, there was no significant difference between the two groups in attitude scores across all time points ($p > 0.05$), suggesting that both media types had a similar effect on attitude changes.

Table 4. Average difference in attitude score of intervention group and control group

	Mean Rank		
	Δposttest 1 – pretest	***Δposttest 2 – pretest***	***Δposttest 2 – posttest 1***
Knowledge			
E-booklet+slide	45.6	51.6	49.8
Control	40.0	32.9	35.0
p-value	0.297	0.000*	0.005*
Attitude			
Slide	1.0	-0.3	-1.3
Control	1.2	1.7	0.4
p-value	0.891	0.232	0.215

**p-value <0.05*

This study demonstrates the effectiveness of e-booklets in improving adolescents' knowledge about anemia. However, educational interventions should incorporate interactive components such as peer discussions, group activities, or community-based projects to achieve lasting changes in attitudes. Combining digital tools like e-booklets with offline methods can enhance engagement and foster more profound understanding. For policymakers and educators, the findings stress the importance of integrating e-booklets into health education programs while ensuring the content is tailored to the specific needs of adolescents. While e-booklets are effective for enhancing knowledge, addressing the psychosocial factors influencing health behaviors is equally important. Additionally, integrating e-booklets with other educational strategies, such as gamified apps or group activities, can further engage adolescents and improve learning outcomes. A blended approach, combining digital resources with face-to-face interactions, ensures better retention and understanding while also allowing for real-time clarification of misconceptions.

CONCLUSION AND RECOMMENDATION

E-booklets are a promising educational tool for improving anemia knowledge among adolescent girls. However, their impact on attitudes remains limited. To achieve more comprehensive behavioral changes, future programs should incorporate interactive elements such as group discussions, role-playing, and continuous reinforcement through digital and offline methods. Policymakers should consider

integrating e-booklets into school curricula and national health programs. Long-term research is needed to evaluate the sustained impact of digital health education interventions on behavior change. Longer implementation periods may potentially improve learning retention, provide opportunities for habit development, and facilitate better adoption. Embedding these tools in ongoing adolescent health programs will also help reinforce consistent advancement in knowledge, attitudes, and practices.

ACKNOWLEDGEMENT

We would like to express our gratitude to the Head of SMP 7 and 11 Yogyakarta City, along with all the teachers, for their support and facilitation in this research. We also extend our sincere appreciation to all respondents who participated in this study.

REFERENCES

1. Kemenkes RI. Riset Kesehatan Dasar Nasional 2018. Jakarta, Indonesia; 2018.
2. Kemenkes RI. Laporan Provinsi DI Yogyakarta Riskesdas 2018. Jakarta, Indonesia; 2019.
3. Kemenkes RI. Survei Kesehatan Indonesia (SKI) tahun 2023. Jakarta, Indonesia; 2023.
4. Silitonga HTH, Salim LA, Nurmala I, Wartiningsih M. Compliance of Iron Supplementation and Determinants among Adolescent Girls: A Systematic Review. Iran J Public Health. 2023 Jan;52(1):37–48. https://doi.org/10.18502/ijph.v52i1.11664
5. Pareek P, Kuwari S, Thakur H. Determinants of Anemia Among Adolescents Girls. Curr Dev Nutr. 2022;6:154. https://doi.org/10.1093/cdn/nzac051.070
6. Wiafe MA, Ayenu J, Eli-Cophie D. A Review of the Risk Factors for Iron Deficiency Anaemia among Adolescents in Developing Countries. Anemia. 2023;2023:6406286. https:// doi:10.1155/2023/6406286
7. Van Zutphen KG, Kraemer K, Melse-Boonstra A. Knowledge Gaps in Understanding the Etiology of Anemia in Indonesian Adolescents. Food Nutr Bull. 2021;42(1_suppl):S39–58. https://doi.org/10.1177/0379572120979241
8. Agustina R, Wirawan F, Sadariskar AA, Setianingsing AA, Nadiya K, Prafiantini E, et al. Associations of Knowledge, Attitude, and Practices toward Anemia with Anemia Prevalence and Height-for-Age Z-Score among Indonesian Adolescent Girls. Food Nutr Bull. 2021;42(1_suppl):S92–108. https://doi.org/10.1177/03795721211011136
9. Rachmi CN. Hidup Sehat Sejak Sekarang Untuk Remaja Kekinian [Internet]. 2019. 1–224 p. Available from: https://ayosehat.kemkes.go.id/buku-modul-pendidikan-gizi downloaded at 25 January 2025.
10. Wijaya LR, Utami SB, Rialihanto MP, Siswati T. Implementation of an e-pocket book to improve knowledge and perceive anemia in adolescents. J Gizi dan Diet Indones.2024;12(1):10–8. https://dx.doi.org/10.21927/ijnd.2024.12(1).10-18
11. WHO. Anemia. 2024; Available from: https://www.who.int/health-topics/anaemia#tab=tab_1 downloaded at 05 January 2025.
12. Norris SA, Frongillo EA, Black MM, Dong Y, Fall C, Lampl M, et al. Nutrition in adolescent growth and development. Lancet. 2022 Jan 8;399(10320):172–84.
13. Deivita Y, Syafruddin S, Andi Nilawati U, Aminuddin A, Burhanuddin B, Zahir Z. Overview of Anemia; risk factors and solution offering. Gac Sanit. 2021;35 Suppl 2:S235-S241. doi:10.1016/j.gaceta.2021.07.034
14. Siswati T, Olfah Y, Kasjono HS, Paramashanti BA. Improving Adolescent Knowledge and Attitude toward the Intergenerational Cycle of Undernutrition through Audiovisual Education: Findings from RESEPIN Study in Yogyakarta, Indonesia. Indian J Community Med. 2022;47(2):196-201. https://doi:10.4103/ijcm.ijcm_1229_21
15. Hargreaves D, Mates E, Menon P, Alderman H, Devakumar D, Fawzi W, et al. Strategies and interventions for healthy adolescent growth, nutrition, and development. Lancet. 2022 Jan 8;399(10320):198–210. https://doi.org/10.1016/S01406736(21)01593-2

16. Ghadam OS, Sohrabi Z, Mehrabi M, et al. Evaluating the effect of digital game-based nutrition education on anemia indicators in adolescent girls: A randomized clinical trial. Food Sci Nutr. 2022;11(2):863-871. https://doi:10.1002/fsn3.3120
17. Khizar M, Ruel-Bergeron J, Zavala E, et al. Delivery platforms for reaching adolescents with nutrition interventions in low- and middle-income countries. Ann N Y Acad Sci. 2024;1538(1):71-84. https://doi:10.1111/nyas.15196
18. Ruiz LD, Radtke MD, Scherr RE. Development and Pilot Testing of a Food Literacy Curriculum for High School-Aged Adolescents. Nutrients. 2021;13(5):1532. https://doi:10.3390/nu13051532
19. Omar Amahmid Youssef El Guamri YRMYBRKKRSEBOI, Belghyti D. Nutrition education in school curriculum: impact on adolescents' attitudes and dietary behaviours. Int J Heal Promot Educ. 2020;58(5):242–58. https://doi.org/10.1080/14635240.2019.1685399
20. Smits M, Kim CM, van Goor H, Ludden GDS. From Digital Health to Digital Well-being: Systematic Scoping Review. J Med Internet Res. 2022;24(4):e33787. https:// doi:10.2196/33787
21. Nikmah A, Supadi J, Setiadi Y. The Effect of Nutrition Education with E-Booklet Media on Knowledge and Attitude About Anemia in Adolescent Girls at SMP N 1 Gemuh, Kendal Regency. Journal of NutritionVol. 3, No. 1, May, 2022 doi: https://doi.org/10.35308/jns.v3i1.5242
22. Pardosi M. The Effectiveness of Booklet of Anemia on the Behaviors of Adolescent. Glob J Health Sci. 2019;Vol. 11(10). https://doi.org/10.5539/gjhs.v11n10p111
23. Alves SAA, Silva KND, Machado MFAS, et al. Digital booklet on sustainable practices for promoting adolescent health. Cartilha digital sobre práticas sustentáveis para a promoção da saúde do adolescente. Cien Saude Colet. 2023;28(8):2215-2226.
24. Lewis CC, Taba M, Allen TB, Caldwell PHY, Skinner SR, Kang M, et al. Developing an Educational Resource Aimed at Improving Adolescent Digital Health Literacy: Using Co-Design as Research Methodology. J Med Internet Res. 2024 Aug;26:e49453. https://doi.org/10.2196/49453
25. Caillaud C, Ledger S, Diaz C, Clerc G, Galy O, Yacef K. iEngage: A digital health education program designed to enhance physical activity in young adolescents. PLoS One. 2022;17(10):1–18. https://doi.org/10.1371/journal.pone.0274644
26. Tang Y, Diao H, Jin F, Pu Y, Wang H. The effect of peer education based on adolescent health education on the resilience of children and adolescents: A cluster randomized controlled trial. PLoS One. 2022;17(2):e0263012. https:// doi:10.1371/journal.pone.0263012
27. Diao H, Pu Y, Yang L, Li T, Jin F, Wang H. The impacts of peer education based on adolescent health education on the quality of life in adolescents: a randomized controlled trial. Qual Life Res. 2020;29(1):153–61. https://doi.org/10.1007/s11136-019-02309-3
28. Jansen BJ, Jung S, Salminen J, Guan KW, Nielsen L. Strengths and Weaknesses of Persona Creation Methods: Guidelines and Opportunities for Digital Innovations. Conference: Proceedings of the 54th Hawaii International Conference on System Sciences. January 2021. DOI: 10.24251/HICSS.2021.604
29. Siswati T, Iskandar S, Pramestuti N, et al. Effect of a Short Course on Improving the Cadres' Knowledge in the Context of Reducing Stunting through Home Visits in Yogyakarta, Indonesia. Int J Environ Res Public Health. 2022;19(16):9843. Published 2022 Aug 10. doi:10.3390/ijerph19169843
30. Jiang Y, Chen Y, Lu J, Wang Y. The Effect of the Online and Offline Blended Teaching Mode on English as a Foreign Language Learners' Listening Performance in a Chinese Context. Front Psychol. 2021;12:742742. doi:10.3389/fpsyg.2021.742742
31. Ruzek EA, Hafen CA, Allen JP, Gregory A, Mikami AY, Pianta RC. How teacher emotional support motivates students: The mediating roles of perceived peer

relatedness, autonomy support, and competence. Learn Instr. 2016;42:95-103. doi:10.1016/j.learninstruc.2016.01.004

32. Tang Y, Diao H, Jin F, Pu Y, Wang H. The effect of peer education based on adolescent health education on the resilience of children and adolescents: A cluster randomized controlled trial. PLoS One. 2022;17(2 February):1–18. http://dx.doi.org/10.1371/journal.pone.0263012
33. Ragelienė T, Grønhøj A. The influence of peers' and siblings' on children's and adolescents' healthy eating behavior. A systematic literature review. Appetite. 2020;148:104592. doi:10.1016/j.appet.2020.104592.