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Impact of Android-Based Reproductive Health Education on Knowledge Improvement Among Adolescent Girls in Takalar, Indonesia: A Quasi-Experimental Study in a Senior High School

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Abstract

Background: Adolescent girls are particularly vulnerable to reproductive health problems due to limited knowledge and inadequate access to reliable information. Innovative educational strategies are needed to improve their understanding of reproductive health.
Objective: This study aimed to evaluate the effectiveness of Android-based reproductive health education in improving knowledge among adolescent girls.
Methods: A quasi-experimental study with a pretest–posttest control group design was conducted among 100 female students at a senior high school in Takalar, Indonesia. Participants were divided into an intervention group (n = 50) and a control group (n = 50). The intervention group received reproductive health education through an Android-based application, while the control group continued routine school activities. Knowledge was assessed using a structured questionnaire administered before and after the intervention. Data were analyzed using descriptive statistics and the Mann–Whitney U test.
Results: The intervention group showed a substantial increase in mean knowledge scores from pre-test to post-test (11.52 ± 3.04 to 17.54 ± 2.29), while the control group demonstrated only a slight change (12.86 ± 3.74 to 13.24 ± 4.22), indicating greater short-term knowledge improvement in the intervention group.
Conclusion: Android-based reproductive health education effectively improves knowledge among adolescent girls and represents a promising digital approach for school-based health promotion.

Keywords: **:** Adolescent girls, android application, knowledge, mHealth, reproductive health education

INTRODUCTION

Adolescence is a critical transitional stage characterized by rapid physical, cognitive, emotional, and social development (1-3). This period requires appropriate guidance and support to promote optimal growth and development. However, insufficient knowledge and limited access to accurate reproductive health information remain significant challenges among adolescents, particularly girls. This gap often leads to various reproductive health issues, including a poor understanding of menstruation, early pregnancy, and increased vulnerability to sexually transmitted infections.

Adolescent girls experience substantial physiological and psychological changes, including the onset of menarche (4, 5) and the development of secondary sexual characteristics (6, 7). These biological changes are accompanied by evolving cognitive abilities, emotional fluctuations, and shifts in social relationships (8-10). Without adequate knowledge and support, these transitions may negatively impact their reproductive health and overall well-being. In Indonesia, adolescents represent a substantial proportion of the population. National statistics indicate that adolescents account for nearly a quarter of the total population, highlighting the importance of targeted health education interventions. At the regional level, data from South Sulawesi and Takalar Regency also demonstrate a considerable number of adolescents aged 15–19 years, emphasizing the urgency of addressing their reproductive health needs.

Despite its importance, reproductive health education among adolescents remains limited. Many young individuals lack adequate understanding of essential topics such as menstrual health, prevention of early pregnancy, and sexually transmitted diseases (11-13). This lack of knowledge is often associated with risky sexual behaviors and increased incidence of unplanned pregnancies and infections. Previous studies have shown that adolescents who lack comprehensive reproductive health education are more likely to engage in unsafe practices (14).

The rapid advancement of digital technology provides new opportunities for delivering health education (15). Mobile applications, particularly Android-based platforms, offer flexible, accessible, and interactive learning environments (16-18). These applications enable users to access information anytime and anywhere, incorporate multimedia elements such as videos and animations, and facilitate self-paced learning. Evidence suggests that digital learning tools enhance knowledge retention and engagement, especially among technology-oriented adolescents.

Although previous studies have demonstrated the potential of digital reproductive health education, several gaps remain. Existing research has primarily focused on general digital or web-based interventions, with limited evidence on Android-based applications in real-world school settings, particularly in resource-limited contexts. In addition, few studies have focused exclusively on adolescent girls or included a no-intervention control group, limiting the ability to clearly assess the added value of such interventions.

Therefore, this study aims to examine the impact of Android-based reproductive health education on knowledge among adolescent girls in Takalar, Indonesia. This study contributes by providing context-specific evidence from a resource-limited school setting, focusing on a female adolescent population, and applying a quasi-experimental design with a no-intervention control group.

METHODS

Study Design, Population, Sample, and Sampling

This study employed a quantitative quasi-experimental design using a pretest–post-test control group approach. The research was conducted among female students at Senior High School SMAN 8 Takalar. The population of this study consisted of all female students enrolled at Senior High School 8 Takalar, Indonesia. These students were within the adolescent age range, predominantly between 15 and 18 years, representing a critical developmental stage for reproductive health education.

The sample consisted of 100 female students from Senior High School 8 Takalar, Indonesia. A non-probability sampling technique, specifically purposive sampling, was employed to select participants who met the inclusion criteria. The inclusion criteria were: (1) female students enrolled in grade X or XI, (2) aged between 15 and 18 years, (3) willing to participate in the study, and (4) able to access and use an Android-based application. Students who were absent during

data collection or did not complete both pre-test and post-test assessments were excluded from the study.

The allocation of participants into intervention and control groups was conducted based on existing class groupings to minimize contamination between groups and ensure the feasibility of the intervention.

Sample Size

The power analysis was conducted using G*Power software (version 3.1) to determine the minimum required sample size for detecting differences in knowledge outcomes between the intervention and control groups. Power analysis is an essential step in quantitative research to ensure that the study has a sufficient probability of detecting a true effect while minimizing Type I and Type II errors. The calculation was based on a two-tailed test with a significance level (α) of 0.05 and a desired statistical power (1 − β) of 0.80, which are commonly accepted standards in health and behavioral research. A medium effect size (Cohen's d = 0.5) was assumed, following conventional recommendations for experimental and quasi-experimental studies when prior effect size estimates are limited.

Using these parameters (α = 0.05, power = 0.80, effect size = 0.5, allocation ratio = 1:1), the minimum required sample size was estimated to be approximately 64 participants (32 per group). However, this study included a total of 100 participants (50 per group), exceeding the minimum requirement. This larger sample size enhances the statistical reliability, increases power, and improves the precision of the estimated effects.

Android-Based Reproductive Health Education

The Android-based reproductive health education intervention was delivered over a period of two weeks**.** Participants in the intervention group were instructed to use the application at least 3–4 times per week, with each session lasting approximately 15–20 minutes**.**

At the beginning of the intervention, participants attended a brief orientation session conducted by the researcher, which included instructions on how to install, navigate, and use the application effectively. During the intervention period, participants primarily used the application independently, allowing for self-paced learning.

To support engagement, participants were periodically reminded by the researcher through classroom communication to access the application according to the recommended frequency. Although direct monitoring of application usage (e.g., log data) was not available, adherence was encouraged through regular follow-up and supervision during school hours.

The educational content was standardized for all participants and included topics such as puberty, menstrual health, prevention of early pregnancy, and sexually transmitted infections. All participants in the intervention group received the same version of the application and were exposed to identical learning materials.

Data Collection Instruments

The study measured participant characteristics and Reproductive Health knowledge.

1. Participant Characteristics

Participant characteristics were collected using a demographic questionnaire developed by the researchers, which included items on age, prior exposure to reproductive health information, and parents' occupation. These variables were used to describe the baseline profile of respondents and to assess group comparability.

Reproductive Health knowledge

Reproductive health knowledge was assessed using a structured self-administered questionnaire developed based on relevant literature. The instrument consisted of 20 items covering domains such as puberty, menstrual health, prevention of early pregnancy, and sexually transmitted infections. Content validity was evaluated by two experts in nursing, and necessary revisions were made. Reliability testing using Cronbach's alpha yielded a coefficient of 0.78, indicating acceptable internal consistency.

Each item had one correct answer, and responses were scored as "1" for correct and "0" for incorrect answers. The total knowledge score was calculated by summing all item scores, with higher scores indicating better knowledge.

Data Collection

At the initial stage, respondents in both the intervention and control groups completed a pre-test using a structured questionnaire to assess baseline knowledge of reproductive health. Following the pre-test, the intervention group received reproductive health education through an Android-based application. Participants were

guided on how to install and use the application and were instructed to access the educational materials over the designated intervention period. The content included topics on puberty, menstrual health, prevention of early pregnancy, and sexually transmitted infections, presented in an interactive multimedia format.

Meanwhile, the control group did not receive the Android-based intervention and continued with routine school activities based on the standard curriculum. They did not receive any structured reproductive health education comparable to the intervention. Although exposure to general health or biology topics and informal sources (e.g., peers or media) may have occurred, these were not specifically designed as comprehensive reproductive health education and were not controlled during the study period.

Data Analysis

Data analysis was performed using SPSS version 23 for Windows. Descriptive statistics, including mean, standard deviation, minimum, and maximum values, were used to summarize participants' characteristics and knowledge scores.

Inferential analysis was performed using the Mann–Whitney U test to compare differences in knowledge scores between the intervention and control groups. This non-parametric test was selected because the data did not meet the assumptions of normal distribution and was appropriate for comparing two independent groups. The level of statistical significance was set at $p < 0.05$. The Mann–Whitney test was applied to evaluate whether there were differences in knowledge scores between groups before and after the intervention. The results were interpreted based on p-values, where values less than 0.05 indicated statistically significant differences.

Ethical Considerations

This study was conducted in accordance with established ethical principles for research involving human participants. Ethical approval was obtained from the Tanawali Persada Ethics Committee (Approval No. 0.15/LPPM/TPT/VI/2025) prior to data collection. Permission to conduct the study was also obtained from the school authorities of Senior High School 8 Takalar. All participants were provided with clear information regarding the purpose, procedures, potential benefits, and risks of the study. Participation was entirely voluntary, and written informed consent was obtained from all respondents. For participants under the age of 18 years, consent was also obtained from parents or legal guardians.

Confidentiality and anonymity were strictly maintained throughout the study. Participants' identities were not recorded, and all data were coded and used solely for research purposes. Respondents were informed of their right to withdraw from the study at any time without any consequences. In addition, the study ensured that the intervention posed no harm to participants. The educational content delivered through the Android-based application was designed to be appropriate, accurate, and aligned with reproductive health guidelines for adolescents.

RESULTS

Table 1 presents the baseline characteristics of respondents in both groups. The mean age in the intervention group was 15 years (SD = 0.51), while the control group had a slightly higher mean age of 16 years (SD = 0.72), indicating comparable age distribution. The majority of respondents in both groups had previously received information on reproductive health, with 86% in the intervention group and 90% in the control group.

Regarding parental occupation, most respondents in both groups were from farming families, representing 70% in the intervention group and 96% in the control group. These findings indicate that the study participants were predominantly from similar demographic and socioeconomic backgrounds, supporting the comparability between the intervention and control groups.

Table 2 shows a notable increase in knowledge scores in the intervention group, where the mean score rose from 11.52 ± 3.04 at pre-test to 17.54 ± 2.29 at post-test. In contrast, the control group exhibited only a slight increase (12.86 ± 3.74 to 13.24 ± 4.22). The range of scores also shifted upward in the intervention group after the intervention, while the control group remained relatively stable. These findings indicate a more pronounced improvement in knowledge levels among participants who received the Android-based reproductive health education compared to those who did not.

Table1. Descriptive Statistics of Study Variables by Group (n=100)

Variable	Intervention (n=50)	Control (n=50)
Age (years), mean ± SD	15.00 ± 0.51	16.00 ± 0.72
Previous information about reproductive health		
Ever	43 (86%)	45 (90%)
Never	7 (14%)	5 (10%)
Parents' occupation		
Labor	4 (8%)	1 (2%)
Entrepreneur	9 (18%)	0 (0%)
Farmer	35 (70%)	48 (96%)
Civil servant	2 (4%)	1 (2%)

Notes: Values are presented as mean ± standard deviation or frequency (%)

Table 2. Descriptive statistics outcome measure between groups (n=100)

Group	Variable	Minimum	Maximum	Mean ± SD	SE Mean
Intervention	Knowledge pre-test	5	20	11.52 ± 3.04	0.43
	Knowledge post-test	10	20	17.54 ± 2.29	0.32
Control	Knowledge pre-test	6	20	12.86 ± 3.74	0.52
	Knowledge post-test	6	19	13.24 ± 4.22	0.59

Table 3. Pre–Post Outcomes in Intervention and Control Groups (n=100)

Group	Variable	Mean ± SD	SE Mean	p	Effect size (r)
Intervention	Knowledge pre-test	11.52 ± 3.04	0.43	0.00	0.65
	Knowledge post-test	17.54 ± 2.29	0.32		
Control	Knowledge pre-test	12.86 ± 3.74	0.52	0.61	0.08
	Knowledge post-test	13.24 ± 4.22	0.59		

Mann-Whitney U test

Table 3 shows a significant improvement in knowledge scores in the intervention group (p = 0.00; large effect size), whereas the control group showed no significant change (p = 0.61; small effect size). These findings highlight the dominant effect of the Android-based educational intervention in enhancing adolescents' knowledge compared to no intervention.

DISCUSSION

The findings of this study indicate that Android-based reproductive health education is associated with a significant improvement in knowledge among adolescent girls. The marked increase in post-test scores in the intervention group indicates that mobile-based learning platforms can effectively enhance adolescents' understanding of reproductive health topics. This finding supports previous evidence that digital health education interventions are effective for adolescents, who are highly engaged with mobile technology. The observed improvement in knowledge among participants who received the intervention may be explained by the inherent advantages of mobile-based learning platforms. In this study, the use of an Android-based application enabled adolescents to access educational content in a flexible and continuous manner, allowing them to engage with the material at their own pace and revisit information as needed. Such accessibility is particularly important for adolescent learners, as it supports self-directed learning and accommodates individual differences in comprehension (17, 19, 20).

The effectiveness of the intervention can be attributed to several key factors. First, mobile applications provide flexible and continuous access to information, allowing users to learn at their own pace and revisit content as needed.

Second, the integration of multimedia elements such as videos, animations, and interactive quizzes enhances engagement and knowledge retention. Recent studies have highlighted that digital and mobile health (mHealth) interventions significantly improve health literacy and knowledge outcomes among adolescents due to their interactive and user-centered design (21, 22). These findings align with the current study, where the intervention group exhibited a substantial improvement compared to the control group.

Furthermore, the results are consistent with previous research demonstrating that technology-based reproductive health education is more effective than traditional methods (23). For instance, a study by Widman et al. (2021) found that digital sexual health interventions significantly increased knowledge and awareness among adolescents across diverse settings (24). Similarly, a systematic review by Feroz et al. (2022) concluded that mobile health interventions improve adolescents' knowledge and attitudes toward reproductive health, particularly in low- and middle-income countries (25). These studies support the notion that digital platforms are not only accessible but also capable of delivering sensitive health information in a more acceptable and engaging manner.

The minimal improvement observed in the control group further highlights the limitations of conventional learning approaches. Without structured and engaging educational strategies, adolescents may rely on informal or unreliable sources of information, resulting in only marginal knowledge gains. This finding is consistent with previous studies showing that traditional lecture-based methods are less effective in enhancing learning outcomes compared to interactive and technology-supported approaches, which provide greater engagement and flexibility (26)

In addition, the demographic similarity between the intervention and control groups strengthens the validity of the findings, suggesting that the observed differences in knowledge outcomes are primarily attributable to the intervention rather than external factors. The predominance of respondents from similar socioeconomic backgrounds also indicates that the effectiveness of the Android-based application is applicable across relatively homogeneous populations, particularly in school-based settings.

The contribution of this study lies not only in confirming the potential of digital reproductive health education but also in its implementation within a school-based setting in a resource-limited context. By focusing on adolescent girls and comparing the intervention with a no-intervention control group, this study provides context-specific evidence that may inform practical applications in similar educational settings.

While the findings show improved knowledge, several factors should be considered. The lower baseline score in the intervention group may have allowed greater room for improvement, and the novelty of the Android-based application may have enhanced short-term engagement. In addition, outcomes were measured shortly after the intervention, reflecting short-term gains rather than long-term retention.

It is also important to note that this study focused solely on knowledge outcomes. As knowledge improvement does not necessarily translate into sustained behavioral change, broader implications for attitudes, self-efficacy, and health practices remain uncertain. Future studies should include longer follow-up periods and additional outcome measures to better assess these aspects.

Limitations

Despite these promising findings, this study has several limitations. First, the study was conducted in a single school with a relatively small sample size, which may limit the generalizability of the results to broader populations. Second, the study focused solely on knowledge outcomes and did not assess changes in attitudes or behavioral practices related to reproductive health. Third, the short duration of the intervention may not fully capture the long-term impact and sustainability of knowledge retention. Future research should consider larger, multi-center studies, incorporate longitudinal designs, and include behavioural and attitudinal outcomes to provide a more comprehensive evaluation of the effectiveness of digital reproductive health education interventions.

CONCLUSION

The findings of this study indicate that Android-based reproductive health education is associated with improved knowledge among adolescent girls. These findings suggest that mobile-based educational tools may serve as a practical approach for delivering reproductive

health information, particularly in resource-limited contexts. However, further research is needed to examine their impact on broader outcomes, including attitudes and health-related behaviors. Integrating digital health education into school programs may offer a scalable strategy to enhance adolescent reproductive health education in similar settings.

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Author Contributions

SS conceptualized and designed the study, supervised data collection, and drafted the original manuscript.
WH contributed to the study design, conducted data collection, and assisted in data interpretation.
EE performed data analysis, interpreted the results, and contributed to manuscript drafting.
SA contributed to the development of the educational intervention and conducted data collection
AA contributed to data collection, manuscript drafting, and assisted in data interpretation
RRM contributed to the literature review, provided methodological guidance, and manuscript revision

Conflict of Interest

There is no conflict of interest for this research.

Data Availability Statement

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

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