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DEVELOPMENT OF ACARE (ADOLESCENCE CARE): AN ANDROID-BASED REPRODUCTIVE HEALTH EDUCATION APPLICATION FOR ADOLESCENT GIRLS AGED 12–15 YEARS IN INDONESIA

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ABSTRACT

Background: Reproductive health literacy among adolescent girls in Indonesia remains low, compounded by social stigma, limited parent–adolescent communication, and uncurated information access; digital media designed specifically for the 12–15-year age group remain scarce. Objective: To develop and test the feasibility of ACare (Adolescence Care), an Android-based reproductive health education application, based on expert assessment and acceptability among adolescent girls and teachers as target users. Methods: This Research and Development study used the ADDIE model. Feasibility was assessed by one media expert and two content experts across two validation stages separated by a revision cycle. Acceptability was tested through a small-group trial (10 students) and a field trial (30 students) at SMP Negeri 1 Palembang, with assessment by two teachers as field practitioners. Data were analyzed descriptively using percentages. Results: In stage I, ACare scored 73.3% from the media expert and 78.61% from the content experts (feasible). After revision, scores rose to 85.3% and 83.08% (very feasible). Student responses reached 88.32% in the small-group trial and 87.65% in the field trial (very good); teacher responses were 75.47% and 71.94% (good). Conclusion: ACare was feasible in both content and media and was well received by target users. Its effectiveness in improving knowledge and changing reproductive health behavior was not tested and requires further experimental studies with a comparison group.

Keywords: adolescent girls; adolescent reproductive health; android application; digital educational media

INTRODUCTION

Adolescence is a transitional phase marked by rapid biological, psychological, and social changes, making it a period vulnerable to reproductive health problems in the absence of adequate health literacy (World Health Organization (WHO), 2017). Globally, risky sexual behavior among adolescents contributes to unintended pregnancy, unsafe abortion, and an increased incidence of sexually transmitted infections, including HIV/AIDS (Sewak et al., 2023). In low- and middle-income countries, including Indonesia, this vulnerability is compounded by structural barriers, social norms, and limited access to adolescent-friendly reproductive health services (Huang et al., 2022; Onukwugha et al., 2022).

Research findings indicate that Indonesian adolescents' understanding of reproductive health still needs to be improved. An analysis of more than 41,000 unmarried adolescents aged 10–24 years found that average knowledge of reproductive health and modern contraception remained low, particularly among adolescents living in rural areas (Kistiana et al., 2023).

Another study of more than 2,500 Indonesian adolescents found that reproductive health understanding was at a moderate level and was influenced by sex and place of residence. Female adolescents had better understanding than males, yet adolescents in disadvantaged villages showed the lowest understanding (Sukmawati et al., 2023).

This limited understanding cannot be separated from the strong stigma and taboo surrounding sexuality. A qualitative study in Indonesia revealed that many adolescents obtain sexual information from peers and the internet that is partial and inaccurate, while comprehensive sexuality education policy has not been fully implemented in schools (Ayuandini et al., 2023). Health workers' attitudes, perceived as judgmental, constitute an additional barrier for adolescents seeking to access reproductive health services (Situmorang, 2011).

At the same time, adolescents' information-seeking patterns have shifted toward the digital sphere. Research in Indonesia shows that more than half of adolescents have accessed pornographic material through various digital channels, and more intensive social media use increases the likelihood of exposure to such content (Meilani et al., 2023). Exposure to unfiltered media messages is associated with permissive attitudes toward risky sexual behavior, whereas media literacy education has been shown to disrupt the link between pornography consumption and acceptance of inequitable gender norms (Evans-Paulson et al., 2024; Scull et al., 2022). These conditions make the provision of accurate, private, and curated digital information sources an urgent need.

Several systematic reviews have concluded that digital sexual health interventions delivered through websites, short messages, and mobile applications are generally effective in improving adolescents' knowledge and attitudes (Sewak et al., 2023), particularly when the interventions are interactive and allow for two-way communication (Onukwugha et al., 2022; Feroz et al., 2021). A quasi-experimental study in Bangladesh showed that an eight-week short-message-based intervention significantly increased adolescent girls' reproductive health knowledge scores (Ahmed, 2020), and a study in Thailand reported improved sexual health literacy across all domains after 24 weeks of mobile messaging and educational animation (Narkarat et al., 2021). An mHealth review in low- and middle-income countries also noted that phone-based interventions can overcome barriers of stigma and confidentiality concerns by presenting information anonymously and in an easily accessible format (Feroz et al., 2021).

Nevertheless, most of these digital interventions were developed in different sociocultural contexts and target a broad adolescent age range. Available Indonesian-language reproductive health applications are generally one-directional, presenting material without a consultation channel, and are not specifically designed for early-adolescent girls. Yet the 12–15-year age range marks the onset of menarche, the formation of self-concept, and initial exposure to gender norms and romantic relationships, making it the most strategic period for preventive intervention (Soetjiningsih, 2004; Kusmiran, 2011). A gap therefore exists between advances in digital technology and the availability of contextually appropriate sexuality education media for this age group.

The novelty of this study lies in three aspects. First, ACare is an Android application that specifically targets adolescent girls aged 12–15 years in Indonesia, with age and sex verification at the registration stage so that content can be curated according to their developmental stage. Second, ACare integrates three functions that are typically separate in similar applications: game-based content delivery (gamification), a private consultation service with a counselor, and an anonymous question-and-answer archive that serves as a collective knowledge base. Third, the development of ACare follows an adolescent application design framework that emphasizes technical quality, engagement, support, autonomy, and privacy and security (Huang et al., 2022), and was validated in multiple layers by a media expert, content experts, target users, and field practitioners.

This study aimed to develop the ACare Android-based reproductive health education application for adolescent girls aged 12–15 years using the ADDIE model, to test the application's feasibility based on assessments by a media expert and content experts, and to measure the level of user acceptability among adolescent girls and teachers as field practitioners. This study was not designed to test the application's effectiveness in changing knowledge or behavior.

MATERIALS AND METHODS

Research Design

This study used a Research and Development (R&D) approach, a scientific procedure oriented toward creating a specific product and testing its quality within a specific context of use (Sugiyono, 2019). The resulting product was an Android-based reproductive health education application for adolescent girls called ACare. The development framework used was the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. ADDIE was chosen because it is iterative and outcome-oriented, allowing the product to be refined based on feedback at each stage (Branch, 2009).

Research Location and Time

The study was conducted at SMP Negeri 1 Palembang, South Sumatra, Indonesia. The entire research process, from needs analysis, design, development, and validation to revision and field testing, was carried out from July to November 2022.

Sample

The study sample was divided into three groups. The first group consisted of expert validators, comprising one media expert and two content experts. The media expert was an academic with a master's degree in information technology and an active lecturer at a technology-based higher education institution, while the content experts were academics with master's degrees in midwifery and active lecturers in midwifery study programs. The second group comprised target users, namely 10 female students in the small-group trial and 30 female students in the field trial, all aged 12–15 years. The third group consisted of field practitioners, namely two teachers who assessed the application at both trial stages.

Female students were selected using purposive sampling. The inclusion criteria were: aged 12–15 years, actively enrolled at SMP Negeri 1 Palembang, owning or having access to an Android device, willing to follow the entire procedure, obtaining written parental/guardian consent, and providing assent. Students who were absent during testing, did not complete the questionnaire, or withdrew were excluded from the analysis. The sample sizes of 10 students for the small-group trial and 30 students for the field trial were set for staged formative evaluation: the small group was used to identify initial usability problems, while the field group was used to assess acceptability among a broader range of users. Validators were purposively selected based on a minimum of a master's degree, relevance of their field of expertise, and active teaching or work experience in information technology/instructional media or in midwifery and reproductive health.

Development Procedure

1. **Analysis.** The researchers conducted a preliminary observation at SMP Negeri 1 Palembang to identify needs, gaps in students' knowledge of reproductive health, and the availability of digital educational media already familiar to students. The technical requirements for application development were also reviewed at this stage.
2. **Design.** The results of the needs analysis were translated into a product blueprint covering the determination of key features, navigation flow, content scope, color scheme selection, and language style adapted to the literacy level of adolescents aged 12–15 years.
3. **Development.** The application was constructed based on the blueprint, involving a professional software developer to ensure that technical aspects were met. The initial product was then validated by the media expert and content experts (stage I validation) and revised based on the input obtained (stage I revision).
4. **Implementation.** The product resulting from the stage I revision was trialed with a small group to obtain user feedback, then revalidated by the media expert and content experts (stage II validation) and revised again (stage II revision).
5. **Evaluation.** The final product was trialed with a larger group (field trial) to measure the level of acceptability among target users and field practitioners.

The application was developed for the Android platform. The application content was developed with reference to WHO adolescent health guidelines, national adolescent reproductive health sources, and textbooks on adolescent reproductive health and adolescent growth and development listed in the references. The content was then reviewed by two midwifery/reproductive health experts before being used in the user trials.

Research Instruments

Data were collected using two types of instruments. The expert validation sheet was used to assess product feasibility, covering the aspects of instructional media principles, operational procedures, and application media (media expert only), and content relevance to the subject matter (content experts only). The

response questionnaire was used to measure user acceptability among students and teachers, with equivalent assessment aspects. Both instruments used a Likert scale and included an open column for suggestions and qualitative comments.

The instruments used a five-point Likert scale (1–5). The media expert sheet consisted of 23 items (12 items on instructional media principles, 6 on operational procedures, and 5 on application media); the content expert sheet consisted of 22 items (8 items on instructional media principles, 6 on operational procedures, and 8 on content relevance); the student questionnaire consisted of 26 items (9 items on instructional media principles, 9 on application media, and 8 on content relevance); while the teacher questionnaire consisted of 31 items (12 items on instructional media principles, 6 on operational procedures, 5 on application media, and 8 on content relevance). The instruments were developed based on the instructional media evaluation and formative evaluation principles of Akbar (2013) and Tessmer (1993).

Data Analysis

Quantitative data from the validation sheets and response questionnaires were analyzed descriptively using a percentage technique, namely the score obtained divided by the maximum score multiplied by 100%. The results were interpreted using criteria adapted from Akbar (2013), as presented in Table 1. A score above 80% indicates that the product falls into the very feasible category and does not require fundamental revision, whereas a score of 80% or below requires improvement of the relevant aspect in accordance with formative evaluation procedures (Tessmer, 1993). Qualitative data in the form of suggestions and comments from validators and users were analyzed thematically and used as the basis for product refinement at each revision cycle.

Table 1 Interpretation criteria for product feasibility and user response

Score range (%)	Feasibility criteria (expert validators)	Response criteria (users)
0–20	Very unfeasible	Very poor
21–40	Unfeasible	Poor
41–60	Fairly feasible	Fairly good
61–80	Feasible	Good
81–100	Very feasible	Very good

Source: adapted from Akbar (2013).

Ethical Considerations

The research protocol received ethical approval from the Health Research Ethics Committee of Politeknik Kesehatan Kementerian Kesehatan Palembang, under number 777/KEPK/Adm2/XI/2022. Before data collection, the researchers obtained official permission from SMP Negeri 1 Palembang. Parents or guardians received a written explanation of the study's purpose, procedures, benefits, potential discomforts, confidentiality, and voluntary nature, and then provided written informed consent. Students received an age-appropriate explanation and provided assent before participating. Every participant had the right to refuse or withdraw at any time without academic consequences. Questionnaires used participant codes and did not include identifying information in the analysis database. Results were reported in aggregate, access to data was restricted to the research team, and consultation information was not used to identify participants.

RESULTS AND DISCUSSION

RESULTS

Analysis Stage

Preliminary observation at SMP Negeri 1 Palembang found that some students aged 12–15 years did not yet understand the basic concepts of adolescent girls' reproductive health. At the time the study was conducted, none of the students knew of or had ever used an Android application specifically addressing adolescent girls' reproductive health. This finding formed the basis for developing ACare as an educational medium that could be accessed independently and privately.

The initial needs analysis involved 20 students aged 12–15 years. Preliminary observation and interviews indicated a need for basic information on reproductive health, and no participant reported having previously used an Android application dedicated to adolescent girls' reproductive health.

Design Stage

In the design stage, an interface design was developed with a color scheme appealing to adolescent girls, a simplified navigation flow, and content written in language easily understood by students. The user instructions were designed to be brief and clear. The design comprised three main features: a consultation service, a question-and-answer archive, and a content feature packaged in a game format.

Development and Implementation Stage

The ACare application was built according to the blueprint that had been developed. The usage mechanism begins with the selection of a user role, either as a member or an administrator. Users are then directed to the registration menu, where they enter their name, email address, and age. Prospective members must meet the entry criteria of being female and aged 12–15 years. Once verified, users can access all features of the application.

The consultation service feature is the main feature designed to address adolescent girls' reluctance to ask about their reproductive health concerns. Members select the topic they wish to discuss and then submit questions privately to a counselor. The archive feature displays questions that the counselor has answered anonymously, complete with a comment column and like/dislike buttons, so that it functions as both a collective knowledge base and a feedback channel. The content feature is packaged into two menus: a school menu containing adolescent girls' reproductive health material, and a garden menu presenting an interactive quiz.

Figures 1 and 2 present the application's initial display before and after revision, Figure 3 shows the main menu, Figures 4 and 5 show the private consultation feature and the anonymous question-and-answer archive, while Figures 6 and 7 show the game, content, and interactive quiz features.

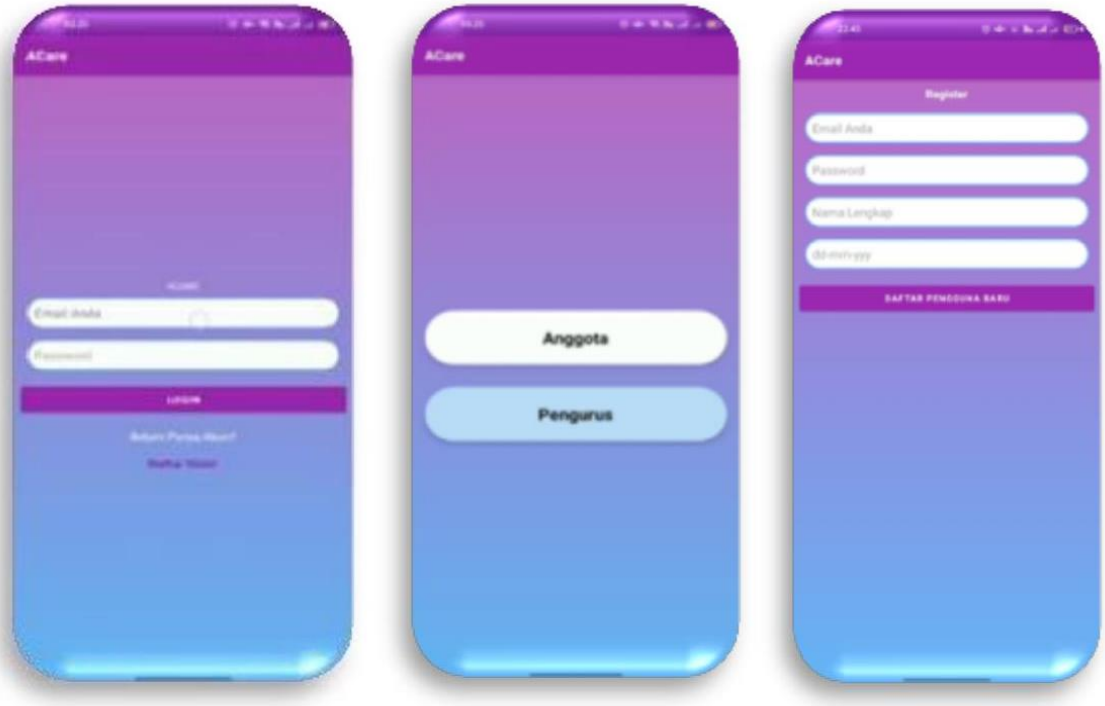


Figure 1 Initial display of the ACare application before revision



Figure 2 Initial display of the ACare application after revision

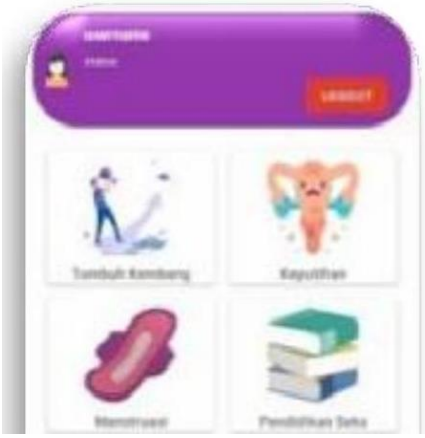


Figure 3 Main menu of the ACare application



Figure 4 Private consultation feature in the ACare application

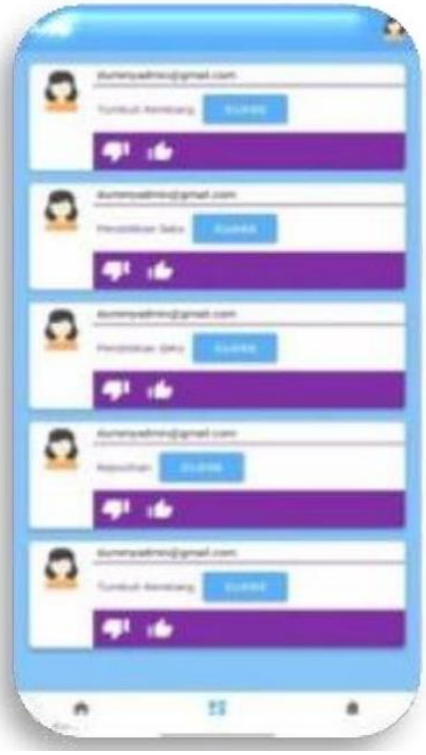


Figure 5 Anonymous question-and-answer archive feature



Figure 6 Game, content, and school menu feature

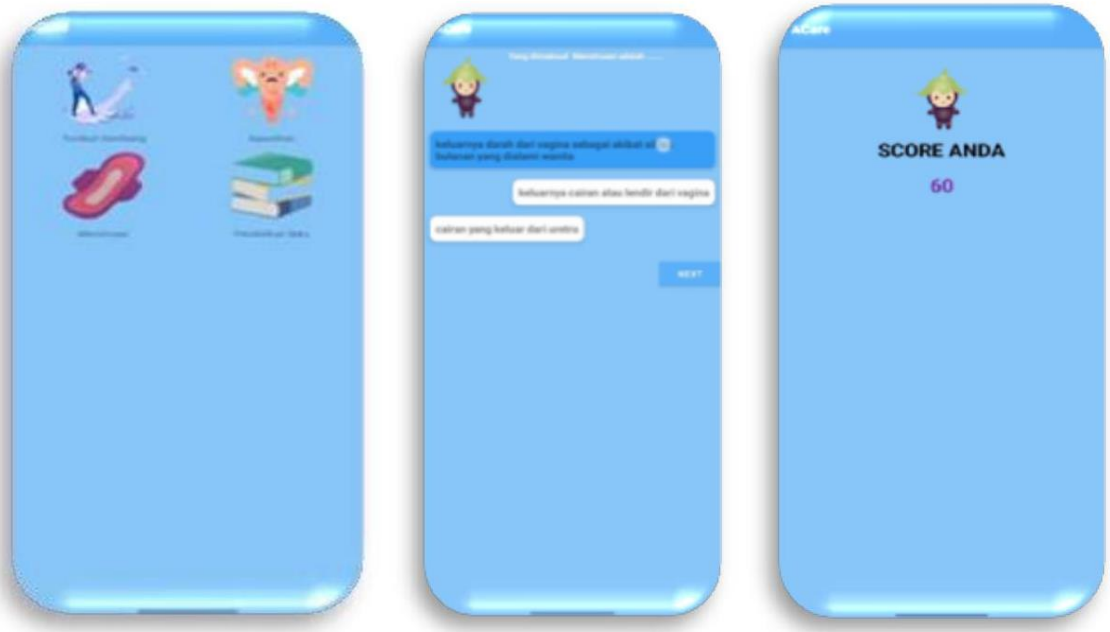


Figure 7 Garden menu and interactive quiz featuring the Kessi mascot

Stage I Expert Validation

The initial ACare product was assessed by one media expert and two content experts. The stage I validation results are presented in Table 2. The media expert gave an average score of 73.3% and the content experts 78.61%, both falling into the feasible category but not yet reaching the very feasible threshold. The media expert recommended improving error handling and enhancing the visual appeal of the interface so that it would not appear rigid. The content experts recommended simplifying the language of the material to make it easier for adolescent girls aged 12–15 years to understand.

Table 2 Media and content expert validation results in stage I

Assessment aspect	Score obtained	Maximum score	Percentage (%)	Criterion
Media expert (n = 1)				
Instructional media principles	45	60	75.0	Feasible

Operational procedures	22	30	73.0	Feasible
Application media	18	25	72.0	Feasible
Media expert average	–	–	73.3	Feasible
Content experts (n = 2, combined score)				
Instructional media principles	36; 30	40; 40	82.50	Very feasible
Operational procedures	26; 21	30; 30	78.33	Feasible
Content relevance to topic	35; 25	40; 40	75.00	Feasible
Content expert average	–	–	78.61	Feasible

Note: Content expert scores are presented as Validator 1; Validator 2. The percentage represents the average of both validators.

Stage I Revision and Stage II Expert Validation

Improvements were made in accordance with the validators' input, including refining the system's error handling, refreshing the interface display, and simplifying the language of the material. The stage II validation results are presented in Table 3. The media expert's score increased from 73.3% to 85.3%, and the content experts' score increased from 78.61% to 83.08%; both reached the very feasible category. The media expert judged the application to be ready for use, with the recommendation to add a completion indicator to each menu.

Table 3 Media and content expert validation results in stage II

Assessment aspect	Score obtained	Maximum score	Percentage (%)	Criterion
Media expert (n = 1)				
Instructional media principles	51	60	85.0	Very feasible
Operational procedures	25	30	83.0	Very feasible
Application media	22	25	88.0	Very feasible
Media expert average	–	–	85.3	Very feasible
Content experts (n = 2, combined score)				
Instructional media principles	37; 29	40; 40	82.50	Very feasible
Operational procedures	28; 22	30; 30	83.00	Very feasible
Content relevance to topic	35; 32	40; 40	83.75	Very feasible
Content expert average	–	–	83.08	Very feasible

User Responses in the Small-Group Trial and Field Trial

The small-group trial involved 10 female students, and the field trial involved 30 female students. At both stages, two teachers also provided assessments as field practitioners. The complete results are presented in Table 4. Student responses fell into the very good category, at 88.32% in the small-group trial and 87.65% in the field trial. Teacher responses fell into the good category, at 75.47% in the small-group trial and 71.94% in the field trial. The teachers recommended that socialization of the ACare application continue to be carried out within the school and community.

Table 4 Responses of target users and field practitioners in the small-group trial and field trial

Rater group	Small-group trial (%)	Criterion	Field trial (%)	Criterion
Students (n = 10 / n = 30)	88.32	Very good	87.65	Very good
Teachers (n = 2)	75.47	Good	71.94	Good

A breakdown of student responses by assessment aspect is presented in Table 5. The content relevance to subject matter aspect obtained the highest score in the small-group trial (90.75%), while in the field trial, the highest score was obtained by the application media aspect (88.33%).

Table 5 Student responses by assessment aspect

Assessment aspect	Small-group trial, n = 10 (%)	Field trial, n = 30 (%)
Instructional media principles	86.40	87.16
Application media	87.80	88.33

Content relevance to subject matter	90.75	87.46
Overall average	**88.32**	**87.65**

Table 6 summarizes the product changes made in each revision cycle together with the basis for the input, so that the trail of product refinement can be traced.

Table 6 Summary of validator input and product revision follow-up

Cycle	Source of input	Content of input	Follow-up action
Stage I revision	Media expert	System error handling needed improvement; interface still appeared rigid	Improved error handling and refreshed interface design
Stage I revision	Content experts	Language of the material needed to be simplified for easier understanding by adolescents aged 12–15 years	Content rewritten with simpler wording
Stage II revision	Media expert	A completion indicator/button was needed for each menu	Added menu completion indicators
Stage II revision	Field practitioners	Ongoing socialization of the application was needed	Developed a dissemination plan for schools

Open-ended comments from students in the small-group trial mainly highlighted the need for simpler language, clearer usage instructions, a more appealing display, and easily recognizable navigation. This input was consolidated with the experts' suggestions and used in the revision of the interface, content, and menu completion indicators, as summarized in Table 6.

DISCUSSION

This study produced ACare, an Android-based reproductive health education application for adolescent girls aged 12–15 years, which was judged very feasible by both the media expert (85.3%) and the content experts (83.08%) after two revision cycles, and received a very good response from target users (87.65–88.32%). The main finding of this study is formative in nature: the application was shown to be acceptable and feasible, not shown to be effective in improving knowledge or changing behavior.

The pattern of score improvement from stage I to stage II across both groups of validators indicates that the formative evaluation mechanism functioned effectively. The media expert's score increased by 12 percentage points, and the content experts' score increased by 4.47 percentage points. The largest improvement in the media expert's assessment occurred in the application media aspect (from 72% to 88%), consistent with the focus of improvements on error handling and interface display. This finding confirms the importance of repeated feedback cycles in instructional media development, as proposed by Tessmer (1993) and accommodated within the iterative structure of the ADDIE model (Branch, 2009).

A consistent gap was found between student responses (87.65–88.32%, very good category) and teacher responses (71.94–75.47%, good category). It should be emphasized that the teacher assessment came from only two field practitioners (n = 2), so this gap of approximately 13–16 percentage points cannot be treated as a statistically tested finding, but rather as a hypothesis-generating observation that needs to be examined with a more adequate number of raters. Several explanations may be relevant: teachers assessed the application from the perspective of integration into the formal learning process and the need for facilitation, whereas students assessed it from the perspective of ease of use and visual appeal. Intergenerational differences in digital literacy may also contribute. If this pattern is confirmed in studies with a larger number of teachers, the implication is that implementing ACare in the school environment requires training and mentoring for teachers, not merely distributing the application to students.

Teachers' open-ended comments indicated that the application needs to be accompanied by ongoing socialization, implementation guidance for schools, and mentoring so that it can be used consistently as an educational medium. This input supports the interpretation that the lower teacher scores do not simply indicate rejection of the application, but rather reflect concern for implementation readiness, facilitation needs, and the sustainability of use within the school environment.

The high level of acceptability found in this study is consistent with systematic review findings that digital sexual health interventions are generally well received by adolescents (Sewak et al., 2023; Onukwugha

et al., 2022). ACare's private consultation and anonymous archive features conceptually address the barriers most frequently reported in the mHealth literature, namely stigma, embarrassment, and confidentiality concerns when adolescents access reproductive health services (Feroz et al., 2021; Situmorang, 2011). ACare's characteristics are also consistent with adolescent preferences identified in the adolescent application design framework, namely an appealing display, easy navigation, interactivity through quizzes and gamification, and privacy assurance (Huang et al., 2022).

In the Indonesian context, these results complement the development of similar applications reported previously. The Lawan Roma application was reported to increase adolescents' access to reproductive health services through an electronic consultation feature (Indriyani et al., 2019), while the Immunecare application, developed for basic immunization services, achieved a feasibility level of 79.6% (Wahyuni et al., 2021). ACare's feasibility score of 83.08–85.3% is above this range, although direct comparison should be made with caution given differences in instruments, number of validators, and content domains. ACare's specific contribution lies in narrowing the target to the 12–15-year age range with age and sex verification at registration, and in combining three functions—gamified content, private consultation, and an anonymous archive—within a single platform.

For health workers and schools, ACare has the potential to serve as a complementary educational channel that adolescent girls can access independently and privately, thereby reducing reliance on face-to-face counseling sessions, which are limited in frequency. For developers of health education media, the finding regarding the student–teacher perception gap underscores the importance of involving field practitioners from the design stage onward, not only at the evaluation stage.

This study has two main limitations. First, it measured feasibility and user acceptability rather than effectiveness: no pre- and post-use knowledge measurements were taken and no comparison group was used, so it cannot be concluded that ACare improves knowledge or changes reproductive health behavior. Second, the number of participants was relatively small (10 students in the small-group trial, 30 students in the field trial) and drawn from a single public school in an urban area, so the results cannot be generalized to the broader population of Indonesian adolescent girls, particularly those in rural areas.

Future studies need to test ACare's effectiveness through a quasi-experimental design or a randomized controlled trial with pre- and post-intervention knowledge measurements and a control group, as carried out in mHealth studies in Bangladesh (Ahmed, 2020) and Thailand (Narkarat et al., 2021); expanding the research location to rural areas is likewise needed to test the application's applicability in contexts with different levels of internet access and digital literacy. In addition, a medium-term evaluation of continued use and a data security audit should be conducted before the application is disseminated widely.

CONCLUSION

The ACare (Adolescence Care) Android-based reproductive health education application was successfully developed through the ADDIE model with three main features, gamified content, a private consultation service, and an anonymous question and answer archive, specifically designed for adolescent girls aged 12–15 years. After two revision cycles based on validator input, the application was judged very feasible by the media expert (85.3%) and content experts (83.08%). The level of acceptability among target users fell into the very good category (87.65–88.32%), while acceptability among field practitioners fell into the good category (71.94–75.47%). The perception gap between students and teachers indicates a need for mentoring support for teachers in implementing the application within the school environment. This study did not test the application's effectiveness in improving knowledge or changing behavior; claims regarding ACare's effectiveness require verification through further experimental research with a comparison group.

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