

REPRODIS: An Innovative Cloud-Based Interactive Platform to Improve Reproductive Health Knowledge of Adolescents with Intellectual Disabilities

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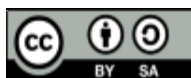
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ABSTRACT

Adolescents with intellectual disabilities are a vulnerable group who often face barriers in accessing comprehensive reproductive health education. Limited communication skills, difficulty understanding abstract concepts, and social stigma hinder their ability to gain adequate knowledge, increasing the risk of sexual exploitation, early pregnancy, and sexually transmitted infections. Digital innovations have shown promise, yet cloud-based platforms tailored to this population remain limited. This study evaluated the effectiveness of the Reproductive Health Interactive System (REPRODIS), a cloud-based, interactive web platform, in improving adolescents with intellectual disabilities' reproductive health knowledge. A quasi-experimental one-group pre-test-post-test design was conducted with 30 adolescents aged 13–18 years with mild to moderate intellectual disabilities in a special needs school in Central Java, Indonesia. Participants completed a validated reproductive health knowledge questionnaire before and after four REPRODIS sessions delivered twice weekly over two weeks. The platform included simplified text, audio-visual animation, voice guidance, interactive quizzes, and parental monitoring features. Data were analyzed using a paired t-test with a significance level of 0.05. The mean knowledge score increased significantly from 46.3 ± 8.2 (pre-test) to 73.5 ± 7.9 (post-test) ($p=0.001$). More than 83% of participants improved by ≥ 20 points. Observations indicated higher engagement during REPRODIS sessions compared to conventional lectures, while parents reported greater confidence in discussing reproductive health at home. REPRODIS significantly improved reproductive health knowledge among adolescents with intellectual disabilities. This innovation demonstrates the potential of cloud-based interactive platforms as inclusive educational tools.



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INTRODUCTION

Adolescence is a critical developmental stage marked by rapid physical, psychological, and social changes, including sexual maturation and the development of reproductive capacity. For adolescents with intellectual disabilities, this transition is often more challenging due to limitations in cognitive function, communication, and adaptive skills. Studies have shown that adolescents with intellectual disabilities usually lack accurate knowledge about reproductive health and are at a higher risk of sexual abuse, unwanted pregnancy, and misinformation compared to their peers without disabilities (Baines et al., 2018; Carter et al., 2022).

Globally, the World Health Organization (Kuumuori et al., 2020; Evans et al., 2024) estimates that more than 1 billion people live with some form of disability. Among them, a significant proportion are adolescents with intellectual or developmental disabilities (Baines et al., 2018). In Indonesia, data on this group remain limited, but evidence suggests that their

reproductive health needs are frequently neglected in school curricula and public health initiatives (Evlyn et al., 2021; Goli et al., 2022).

Traditional teaching methods, such as lectures or printed booklets, often fail to meet the learning needs of adolescents with intellectual disabilities, as they require concrete, simple, and repetitive educational strategies (Haruna et al., 2021; Guo et al., 2025). Recent innovations, such as visual-based media and digital applications, have demonstrated effectiveness in increasing knowledge retention. For instance, (Carter et al., 2022) reported that the use of a sex education pop-up book improved knowledge and attitudes among adolescents with intellectual disabilities. Similarly, Nilasari et al. (2023) developed an online module on sexually transmitted infections that significantly improved adolescent knowledge in Indonesia.

Cloud-based learning platforms offer an opportunity to deliver reproductive health education in an accessible, flexible, and scalable way. These platforms allow integration of multimedia content, interactive assessments, and monitoring features for parents and educators (Alhassan et al., 2025). However, research on cloud-based interventions explicitly tailored to adolescents with intellectual disabilities remains scarce.

One of the digital innovations developed to address these challenges is the Reproductive Health Interactive System (REPRODIS), a cloud-based interactive web platform designed specifically for adolescents with intellectual disabilities. REPRODIS provides accessible reproductive health education through simplified text, animations, voice narration, and interactive quizzes. The platform also includes parental monitoring features that facilitate communication between students, teachers, and families. Despite growing interest in digital health interventions, cloud-based platforms tailored to adolescents with intellectual disabilities' learning characteristics remain limited, underscoring the need for further evaluation and development.

METHOD

This study employed a quasi-experimental one-group pre-test–post-test design. The research was conducted at a special needs school in Magelang, Central Java, Indonesia, in 2025. Ethical approval for this study was granted by the Health Research Ethics Committee Poltekkes Kemenkes Semarang with approval number No. 1385/EA/F.XXIII.38/2025. All procedures conducted in this research adhered to the ethical principles for human subjects research, including informed consent from the parents or legal guardians of all participating adolescents.

A total of 30 adolescents aged 13–18 years diagnosed with mild to moderate intellectual disabilities participated. Inclusion criteria included: (1) registered as a student in the school, (2) capable of recognizing basic symbols and pictures, (3) able to follow simple verbal instructions, and (4) parental consent provided. Adolescents with severe sensory impairments or comorbid psychiatric disorders were excluded.

REPRODIS is a cloud-based interactive web platform accessible through computers and tablets. The platform consists of four modules:

1. Introduction to puberty and body changes.
2. Personal hygiene and menstrual health.
3. Prevention of sexual abuse and consent.
4. Healthy relationships and communication.

Each module uses simplified language, colorful animations, voice narration, and interactive quizzes. Parents and teachers can log in to monitor progress and access discussion guides to reinforce learning at home. The REPRODIS platform underwent content validation by three experts in reproductive health, special education, and digital learning technology. Their review assessed accuracy, relevance, language simplification, and suitability for adolescents with intellectual disabilities. Technical validation was performed through usability testing with a small group of nonparticipating students (n=5) to ensure functionality, navigation clarity, audio-visual accuracy, and quiz scoring consistency. Feedback from experts and users was used to refine the interface prior to the intervention. Thus, both content and technical validity were assured before REPRODIS was implemented in the main study.

The intervention was delivered in four sessions (two per week, 45–60 minutes each) under the supervision of teachers and parents. Before the first session, participants completed a pre-test knowledge questionnaire. After the final session, they completed the post-test using the same instrument. Observational notes were taken regarding student engagement, attention, and interaction.

Knowledge was measured using a validated reproductive health questionnaire comprising 20 multiple-choice questions, adapted for individuals with intellectual disabilities (Cronbach's $\alpha=0.82$). The questionnaire covered puberty, hygiene, sexual abuse prevention, and reproductive health rights. Data were analyzed using a statistics app. The Shapiro–Wilk test was used to check normality. Pre-test and post-test scores were compared using a paired t-test at the 0.05 significance level. Descriptive statistics were used to describe participant characteristics and score distributions.

RESULTS

Table 1. Characteristics of respondents

Characteristics	Category	n	%
Age (years)	13–15	19	63.3
	16–18	11	36.7
Sex	Male	16	53.3
	Female	14	46.7
Level of intellectual disability	Mild	21	70.0
	Moderate	9	30.0

This study involved 30 adolescents with mild to moderate intellectual disabilities. The mean age was 14.2 years. Most participants (63.3%) were between 13 and 15 years old, while 36.7% were between 16 and 18 years old. Slightly more than half were male (53.3%), and 70% of the respondents were categorized as having mild intellectual disability, with the remaining 30% classified as moderate.

Knowledge scores (Pre-test vs Post-test)

Table 2. Comparison of knowledge scores before and after intervention

Variable	Mean \pm SD	Min–Max	p-value
Pre-test	46.3 \pm 8.2	30–60	0.001
Post-test	73.5 \pm 7.9	60–90	

The baseline mean knowledge score was 46.3 \pm 8.2 (range 30–60). After the REPRODIS intervention, the mean score significantly increased to 73.5 \pm 7.9 (range 60–90). The paired t-test confirmed a statistically significant improvement (p=0.001). No participants experienced a decrease in their knowledge score after using the REPRODIS platform, indicating that the intervention consistently had a positive effect across all participants.

Knowledge improvement by respondent characteristics

Both age groups (13–15 and 16–18 years) showed significant improvement in knowledge (p=0.001). Younger participants (13–15 years) had a slightly higher post-test average (74.1 \pm 7.2) than older participants (72.3 \pm 8.5). This suggests that younger adolescents may benefit more quickly from interactive learning platforms. Regarding sex, both male and female participants showed significant increases, with female adolescents achieving a slightly higher post-test average (73.8 \pm 7.8) than males (73.2 \pm 8.0).

When comparing disability levels, adolescents with mild intellectual disabilities had higher pre-test and post-test averages than those with moderate disabilities. However, both groups demonstrated statistically significant improvements (p=0.001 for mild; p=0.002 for moderate).

This indicates that REPRODIS was effective across different levels of intellectual disability, though participants with mild disability achieved slightly greater gains.

Table 3. Pre-test and post-test scores by age, sex, and disability level

Characteristics	n	Pre-test Mean \pm SD	Post-test Mean \pm SD	p-value
Age 13–15	19	45.8 \pm 7.5	74.1 \pm 7.2	0.001
Age 16–18	11	47.2 \pm 9.1	72.3 \pm 8.5	0.001
Male	16	46.0 \pm 8.4	73.2 \pm 8.0	0.001
Female	14	46.6 \pm 8.1	73.8 \pm 7.8	0.001
Mild disability	21	47.0 \pm 7.9	74.5 \pm 7.5	0.001
Moderate disability	9	45.0 \pm 8.7	71.6 \pm 8.3	0.002

Observational findings

Classroom observations supported the quantitative findings. Adolescents were more attentive and motivated during REPRODIS sessions compared to conventional lectures. They responded eagerly to quizzes, often showing excitement when animations or voice guidance were presented. Teachers noted reduced classroom distractions and improved focus, while parents expressed greater confidence in initiating reproductive health discussions at home thanks to the platform's monitoring features.

DISCUSSION

This study demonstrated that REPRODIS, a cloud-based interactive web platform, was effective in significantly improving reproductive health knowledge among adolescents with intellectual disabilities. The overall increase in scores, along with positive feedback from both teachers and parents, underscores the importance of using inclusive, interactive digital tools to address reproductive health education gaps in this population.

Effectiveness of REPRODIS

The mean knowledge scores increased from 46.3 to 73.5 after the intervention, confirming that adolescents with intellectual disabilities can learn effectively when educational content is adapted to their cognitive abilities. Similar results were reported by Çöl et al. (2020), who showed that visual and tangible media, such as pop-up books, enhanced comprehension and attitudes towards sexual health. Likewise, Nilasari et al. (2023) found that online reproductive health modules improved adolescent knowledge about sexually transmitted infections, suggesting that digital interventions have broad applicability. REPRODIS extends these findings by demonstrating the added value of explicitly tailored cloud-based interactivity for adolescents with intellectual disabilities.

In addition, the interactive quiz feature in REPRODIS likely played a crucial role in consolidating memory. Prior research has shown that immediate feedback and gamified learning elements stimulate reward pathways, thereby enhancing intrinsic motivation among adolescents with intellectual disabilities (Haruna et al., 2021; Guo et al., 2025). The cloud-based architecture also enables learners to access materials repeatedly, which aligns with the evidence that repeated exposure improves mastery for students who need more time to absorb conceptual information (Guo et al., 2025; Schmidt et al., 2020).

These findings highlight that REPRODIS is more than a teaching tool; it functions as an inclusive learning environment. By reducing cognitive load and providing structured guidance, REPRODIS addresses common barriers faced by this group, including limited attention span, difficulty processing abstract information, and reliance on repetitive instruction. The platform's success provides empirical support for integrating cloud-based adaptive tools in school curricula for special education.

Differences by age

The analysis revealed that younger adolescents (13–15 years) had slightly higher post-test scores than older adolescents (16–18 years). Cognitive developmental stages may explain this, as younger adolescents are often more receptive to visual and game-like learning formats (Azizah et al., 2022). Older participants may already have prior misconceptions or reduced motivation towards structured interventions, as found in previous studies on adolescent learning behaviors (Patel et al., 2023). This indicates that early intervention during younger adolescence is critical for maximizing educational outcomes.

Another explanation is that younger students often display higher curiosity and lower embarrassment when discussing sensitive topics such as puberty and sexuality. Research by Guo et al. (2025) and Schmidt et al. (2020) found that early-adolescent learners with mild intellectual disabilities tend to be more enthusiastic and less self-conscious during interactive reproductive health lessons compared with older adolescents. This developmental openness can enhance engagement with digital modules like REPRODIS.

These results point to the importance of introducing reproductive health education earlier in adolescence. Early exposure not only improves knowledge but also strengthens self-protective behaviors, which are crucial in preventing exploitation, unsafe relationships, and misinformation (Patel et al., 2023). Therefore, educational policies should emphasize early, repeated, and developmentally tailored instruction for adolescents with intellectual disabilities.

Differences by sex

Both male and female adolescents benefited significantly, with females achieving slightly higher post-test scores. This aligns with research by Ali et al. (2021), which reported that female adolescents with intellectual disabilities often demonstrate greater engagement in reproductive health sessions, possibly due to heightened relevance of topics such as menstruation and personal hygiene. However, gender-sensitive strategies remain important, as male adolescents may face distinct challenges in discussing sensitive topics openly (Pownall et al., 2012; Powell et al., 2019). Integrating male-focused modules within platforms like REPRODIS could further balance outcomes across sexes.

Females have also been shown to demonstrate stronger verbal comprehension and higher participation in structured health education sessions, which may enhance their ability to process simplified narratives and voice-guided modules (Pownall et al., 2012; Powell et al., 2019). In contrast, male adolescents may experience greater social discomfort discussing sexual health, potentially limiting engagement during some sessions (Haruna et al., 2021; Guo et al., 2025). Still, the observed gains in both groups affirm that REPRODIS is effective irrespective of gender differences.

These findings support the implementation of gender-sensitive enhancements to the platform—for instance, by including additional male-specific examples, such as wet dreams or personal boundaries, in male peer interactions. By integrating such modules, platforms like REPRODIS can further minimize gender gaps in future interventions.

Differences by disability level

Adolescents with mild intellectual disabilities achieved higher average knowledge gains compared to those with moderate disabilities, though both groups improved significantly. This finding is consistent with Jalanidhi & Azizah (2021), who reported that intellectual functioning levels influence the extent of knowledge acquisition in reproductive health education. Nevertheless, the fact that participants with moderate disabilities also improved demonstrates the adaptability of REPRODIS, which uses simplified language, voice narration, and visual cues to enhance accessibility. This suggests that with further refinement, such platforms could be expanded to reach adolescents with more severe disabilities as well.

The voice-narrated, visually supported, and chunked content design of REPRODIS reduces the cognitive demands often associated with digital learning. Similar results were reported by Fischer et al. (2023), who found that simplified visual narratives enhanced comprehension in

adolescents with varying levels of cognitive functioning. For students with moderate disabilities, the platform's repetition and audio prompts likely provided additional scaffolding that sustained their learning.

These findings underline the need for future versions of REPRODIS to incorporate customizable difficulty settings. Adjustable pacing, more concrete examples, and increased repetition may further enhance comprehension among adolescents with more severe cognitive limitations.

Role of parental involvement

An important aspect of REPRODIS is its parental monitoring feature. Parents reported greater confidence in discussing reproductive health at home after participating (Powell et al., 2019). This aligns with the findings of Goli et al. (2021, who emphasized the critical role of family involvement in sustaining reproductive health education for adolescents with disabilities. By bridging the gap between school- and home-based learning, REPRODIS strengthens support systems and reinforces messages beyond the classroom. (Ballan, 2012)

Implications for policy and practice

The positive results of REPRODIS highlight the potential of cloud-based platforms in inclusive health education. Policymakers should consider integrating such digital innovations into special education curricula and community health programs (Sala et al., 2019). The scalability of cloud technology enables a broader reach, especially in resource-limited areas where specialized teachers are scarce. Furthermore, integration with mobile applications could increase accessibility and ensure continuous learning outside the classroom (Haruna et al., 2021; Patel et al., 2023).

Moreover, parental engagement strengthens knowledge transfer beyond the classroom. Studies in Indonesia and globally suggest that adolescents with disabilities are more likely to engage in healthy behaviors when parents actively monitor and reinforce learning activities (Evlyn et al., 2021; Goli et al., 2022). Therefore, the REPRODIS approach addresses both the learner and their support system, improving overall educational effectiveness.

Limitations and future research

This study had limitations, including a relatively small sample size and a lack of long-term follow-up to assess retention and behavioral changes. Future studies should expand to include larger, more diverse populations, incorporate randomized controlled trials, and examine long-term outcomes, such as changes in attitudes, behaviors, and protective practices. Research should also explore the cost-effectiveness and scalability of cloud-based platforms like REPRODIS for nationwide use.

CONCLUSION

This study demonstrated that REPRODIS, a cloud-based interactive web platform, was effective in significantly improving reproductive health knowledge among adolescents with intellectual disabilities. The intervention not only resulted in a substantial increase in overall knowledge scores but also demonstrated consistent effectiveness across participant subgroups. Younger adolescents (13–15 years) tended to achieve slightly greater improvements than older peers; female adolescents scored marginally higher than males, and those.

AUTHOR'S DECLARATION

Authors' contributions and responsibilities

AL: was responsible for conceptualizing the research, designing the methodology, and drafting the initial manuscript; **AF:** carried out data collection, curation, and formal analysis; **MD:** developed and validated the REPRODIS platform and contributed to data visualization; **RS:** provided resources, supervised the research process, and critically reviewed and edited the manuscript; **MT, YA:** managed project administration, secured ethical approval and funding, and gave final approval for the version to be published.

Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interests.

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