



Volume 16 Nomor 1 (2026) 49-57

JURNAL KEBIDANAN

p-ISSN: 2089-7669 ; e-ISSN: 2621-2870

<https://doi.org/10.31983/jkb.v16i1.13817>



Thirty Years of Digital-Based Reproductive Health Education: A Bibliometric Perspective

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Received: September 10, 2025; Revised: October 14, 2025; Accepted: February 27, 2026

ABSTRACT

Background: Reproductive health education is essential for improving individual quality of life and sexual well-being. Advances in digital technology have transformed educational approaches in this field over the past decades.

Objective: To analyze global scientific publication trends on digital-based reproductive health education over the past 30 years (1994–2024).

Methods: A bibliometric approach was employed. Articles were retrieved using the keywords “sexual health education” OR “reproductive health education” AND “mobile technology”, along with 33 additional digital-related terms. Data were collected from the Scopus database (retrieval date: May 10, 2025). A total of 308 records were identified, and after applying relevance and inclusion criteria, 272 articles were retained for analysis. VOSviewer software was used to examine keyword co-occurrence, co-authorship networks, productive journals, institutions, and countries.

Results: The VOSviewer visualization revealed sparse networks with limited interconnecting lines, indicating low levels of collaboration among researchers in this field. The most frequent keyword was “human”. Mustanski B emerged as the most prolific author, *Sex Education* as the leading journal, and the University of Toronto as the most productive institution. The United States dominated overall publication output. Indonesia appeared in the network with a relatively small cluster, reflecting modest publication volume.

Conclusion: Research on digital-based reproductive health education remains limited, with low collaboration intensity across authors and institutions. These findings highlight substantial opportunities for future research expansion, particularly in underexplored keyword clusters.

Keywords: Bibliometrics; Digital; Reproductive health education; Sexual health education; VOSviewer

Introduction

Reproductive health is part of an indicator of individual well-being that involves many aspects. Since 1994, the world has discussed the importance of reproductive health education. The discussion became a core topic in the implementation of the International Conference Population and Development (ICPD) which took place in Cairo Egypt. This education aims to create healthy reproductive behavior. The impact of the lack of reproductive health education is the emergence of various reproductive problems in the form of physical, psychological, socio-cultural, and economic [1]–[4].

Some information based on World Health Organization (WHO) data in 2024 shows that reproductive health education is worth reviewing. The birth rate of adolescents aged 10-14 years is 1.5 per 1000 females. This birth rate is higher in African countries at 4.4 per woman. Throughout human life about 3 to 4 billion

people in the world do not get access to proper sexual and reproductive health services. This reflects the low access to education and adequate reproductive health services. Therefore, innovative and inclusive education and communication methods and strategies are needed [5]–[8].

At the national level, data from BKKBN (2021) shows that only about 35% of adolescents in Indonesia have adequate knowledge about reproductive health. One in four adolescents obtain information from unreliable sources. This problem is exacerbated by the limited formal curriculum and lack of evidence-based education in schools. This problem is exacerbated by the limited number of valid and youth-friendly sources of information. Therefore, there is a need to provide reproductive health information through media that is more accessible to the younger generation. Teenage pregnancy (10-14 years old) in Indonesia is 0.297 live births per 1000 women. This figure compares favorably with the global birth rate of [9]–[11].

The results of the ICPD and the data above reinforce the importance of reproductive health education. Many countries have adopted an educational approach in this field. Along with the development of information technology, the delivery of reproductive health materials has also undergone a transformation towards digital. Digital-based reproductive health education is a strategic alternative in reaching the wider community, especially the digital-native generation. The digital-native generation is a generation that has been accustomed to the use of technology since birth. This generation starts from the millennial generation, which began in 1981 [12].

Several foreign and domestic studies on the theme of reproductive health education and digitalization have been published. This is the basis that technology in the field of reproductive health education deserves to be raised and developed. Amiruddin's research results state that there is a significant influence between social media exposure on reproductive health knowledge in women with various educational backgrounds, occupations and economic levels. Digital-based sexual health education can significantly improve adolescents' sexual literacy, increase openness to sensitive topics, and encourage healthy behaviors related to sexual and reproductive health. Studies conducted in Indonesia provide similar results, namely digital applications have an impact in increasing positive behavior on adolescent reproductive health. [13]–[20].

A bibliometric analysis was conducted with the keyword "reproductive health" and found that there are great opportunities for digital reproductive health education research. One of them is to find out what digital reproductive health education media have been widely developed or vice versa. Several digital media platforms have been used in reproductive health education, but topics based on digital types have not appeared in the landscape. Based on that, this research includes more specific keywords in digitalization such as internet, website, mobile phone and others. It is expected that keywords from one of these types of digitalization will appear.

The increase in digital technology and the world's attention to reproductive health education from 1994 to 2024 is the basis for this study to examine in a period of 3 decades. The timing of 1994 was based on ICPD activities which was the first world conference to discuss reproductive health and from that year technological advances continued to increase gradually. The year 2024 is the last year that has passed for 12 months. There has been no research that discusses trends in topics, authors, journals, publishers or organizations or institutions and countries regarding digital-based reproductive health. Based on this, a bibliometric approach is needed to understand the dynamics of research in the field of digital reproductive health education. This study includes databases taken are articles with international standardized quality, one of which is the Scopus database.

The formulation of the problem of this research "How is the visualization of topics, authors, journals, institutions and countries in the world that dominantly publish digital reproductive health education themes for 3 decades using bibliometric analysis?" The purpose of this study is to analyze bibliometrics so as to determine the trend of digital-based reproductive health education research publications over three decades. The theoretical benefit of the research is to add literacy to the development of world publications on digital reproductive health education. The practical benefits of this research as one of the inspirations to find novelty research related to digital reproductive health education.

There have been studies using bibliometric analysis, such as several titles Gestational diabetes mellitus Cardiovascular disease by Yanxi Jia [21], *Tren dan Titik Panas Penelitian tentang Kehamilan Remaja: Analisis Bibliometrik oleh Pehlivanoglu* [22] dan *Tren Penelitian Global tentang Infertilitas dan Psikologi dari Dua Dekade Terakhir: Sebuah Studi Bibliometrik dan Visualisasi oleh Hongkun Zhu* [23]. All use the Vosviewer Application to analyze visualizations. The difference is the theme raised, namely digital-based reproductive health education, the database used in previous studies Web of Science (WoS) and Web of Science Core Collection (WoSCC), while in this study the data source used is Scopus. The

purpose of this study is to analyze bibliometrics so as to determine the trend of digital-based reproductive health education research publications over three decades.

Methods

This study employed a quantitative descriptive design using bibliometric statistical analysis and visualization. Data collection, processing, and interpretation were conducted in May 2025, with literature searching initiated on 10 May 2025. The Scopus database was used as the primary source, and publications were filtered based on a 30-year time frame (1994–2024) as the inclusion criterion.

Article retrieval applied the terms “sexual health education” OR “reproductive health education” AND “mobile technology”, complemented by 33 digital-related keywords. Retrieved documents were exported in RIS format and processed in Mendeley for data cleaning, including duplicate removal and verification of bibliographic completeness (title, authors, journal name, abstract, and DOI). Incomplete records were excluded. Additional Scopus data in CSV format were analyzed in VOSviewer.

Bibliometric analysis comprised network, overlay, and density visualizations. Network visualization identified co-authorship, institutional and country collaboration, keyword co-occurrence, and journal linkages. Overlay visualization displayed temporal trends, while density visualization mapped publication concentration and thematic depth. Further analyses included citation network mapping, keyword evolution analysis, bibliographic analysis of influential publications, and co-citation analysis to identify intellectual linkages and thematic clusters.

The synthesis of findings involved identifying the ten most productive authors, journals, institutions, and countries, along with mapping collaboration intensity and the complexity of publication patterns within the field of digital reproductive health education. As the study utilized publicly accessible bibliographic metadata without involving human participants, ethical approval was not required.

Results and Discussion

The results of this finding, relevant articles from the Scopus database as many as 308, after filtering based on time 1994-2024 and cleaning data, 272 documents were obtained. Based on the publication time, there were no articles in 1994 but starting from 1995. In addition to the time range, we did not make restrictions on language, document type, age and others.

Table 1.

Top Ten Ranking Order of Journal Authors, Institutions and Countries

Ranking	Author	Journal	Institution	Country
1	Mustanki, B.	Sex Education	Universitas of Toronto	United States
2	Shegog, R.	Frontiers in Public Health	University of California San Francisco	Canada
3	Colton, Z.A.	Bmc Public Health	The University of British Columbia	United Kingdom
4	Decker, M.J.	Archives of Sexual Behavior	Northwestern University Feinberg School of Medicine	Australia
5	Gutmann-Gonzales, A.	Canadian Journal of Human Sexuality	UCSF School of Medicine	China
6	Johns, M.M.	Sexual Health	Northwestern University	Iran
7	Liles, S.M.	American Journal of Sexuality Education	Brown University	Indonesia
8	Macapagal, K.	Plos One	The University of North Carolina at Chapel Hill	Germany
9	Marcantonio, T.L	Health Promotion Practice	University of Melbourne	Turkey
10	Markham, C.M	Jmir Formative Research	University of Texas Health	Hongkong

In Figure 2, 164 journals are recorded, but the journal names that appear in the visualization are 12 journals. This number is based on the frequency of occurrence of the journal name more than 4 times. The visualization in Figure 4.4 informs the collaboration between journals at the international level. Frontiers in Public Health is a journal that publishes in the latest years. The journal has collaborated with 7 other journals. Of all the circles, there is no dominant circle or the largest one.

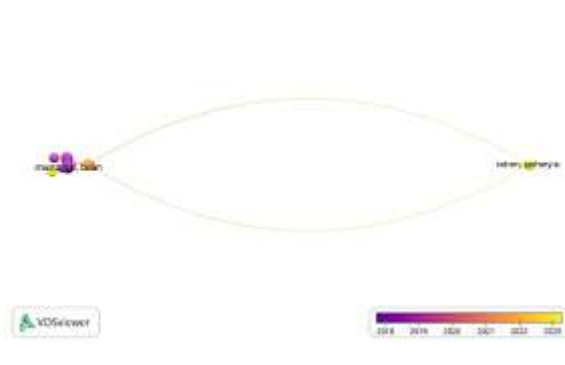


Figure 3 Visualization of Overlays by Author



Figure 4 Visualization of Overlays by Institution

Figure 3 is a visualization of the world's authors. VOSviewer recorded 1,206 authors. Of the total number of researchers around the world, only 27 are productive in writing according to the theme of this study. This figure comes from the frequency of authors who have published articles based on the theme 3 times. Collaboration is still lacking, only 2 clusters of authors have collaborated. The theme of digital reproductive health education is not yet in great demand by researchers in the world.

Figure 4 visualizes institution names that appear more than twice. The total number of institution names is 793. As with authors and journals, collaboration between institutions is still very low, there is no dominant circle and there are still few institutions that publish articles according to the theme. The productivity of institutions in studying this theme is still limited.

Figure 5 captures the 55 countries that were most productive in publishing on this research theme. In Figure 4, the 10 most productive countries appear. It is said to be productive based on 5 times the frequency of the country publishing articles based on the theme. The United States is the dominant country when compared to the other 9 countries. Still in line with institutions, journals and authors, this theme has not been studied much and there is not much collaboration.

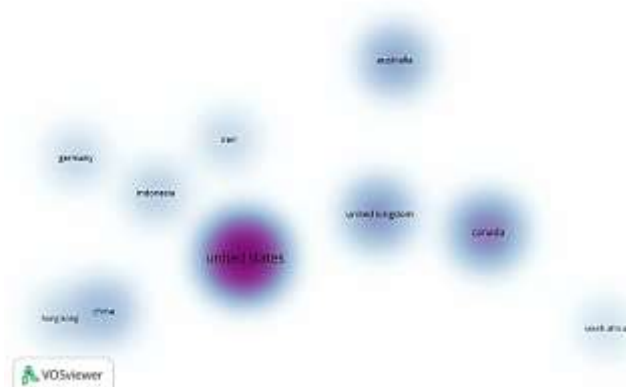


Figure 5 Visualization of Density by Country

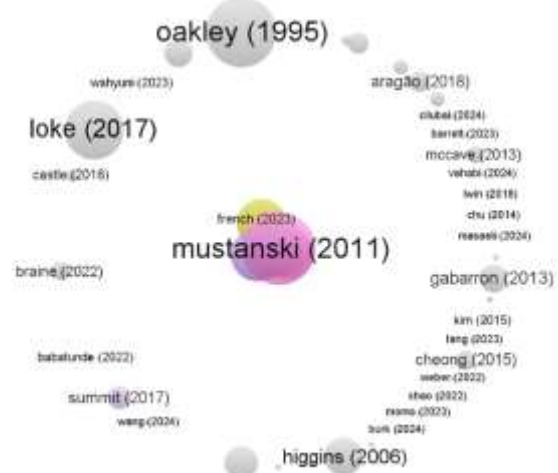


Figure 6 Network Visualization by Document

Figure 6 informs that 272 documents were recorded in the VOSviewer application. The three most documents discuss according to the research theme can be seen from the size of the largest circle, the year

of publication of the latest document is still very limited. There is no visible collaboration based on documents.

Keywords such as human, sexual health, and adolescent appeared most frequently, illustrating the general focus on the adolescent population and the importance of sexual health. This is in line with Audrey Azoulay's (2018) opinion that reproductive health education should start early to promote healthy decision-making. Technology-related keywords such as AI, mhealth, and digital technology have emerged, but have not yet become a dominant center theme, indicating great potential for development, research, and publication [24].

The findings of this study have high significance in several aspects, first, the visualization shows that this topic has not been much of a main focus by the global academic community. This opens up a great opportunity for researchers from developing countries like Indonesia to fill the literature gap, especially in the local context. Secondly, with the finding that most publications appeared in the last five years, this confirms the statements of Furizal et al and Goodyear about the increasing attention to digital platforms in the delivery of sexual education. This suggests that the shift from conventional to digital approaches is underway, albeit not globally. Third, the consistency of the results with previous studies in Indonesia corroborates that the use of digital media is effective in reaching adolescents, especially in the context of sensitive education such as reproductive health [20], [25]–[27].

This research makes a useful contribution to the field of midwifery and public health. Through a bibliometric approach, this study provides an empirical basis for global trends and patterns in digital reproductive health education. Bibliometric analysis is still rarely applied in the field of midwifery. Using VOSviewer and Scopus data, this study introduces a quantitative approach that can enrich research methods in this field. The identification of trends and low collaboration suggests that there are great opportunities for cross-disciplinary, cross-country, and cross-institutional research, both in terms of intervention and theory development.

The implications of this study strengthen the Health Belief Model (HBM) and Theory of Planned Behavior (TPB) theories in digitalization. Factors, risk perception and behavioral intention are now also influenced by exposure to digital media, as suggested by Alyafei (2024) and Purwanto (2022). Similarly, the adoption of digital technology in education supports Rogers' Diffusion of Innovation Theory showing that digitalization is an innovation that is entering the early stages of advancement in the field of reproductive health [28]–[30].

The practical implication of this research is the development of Digital Intervention. These results can be used as a basis for developing reproductive health education applications that are more contextual and responsive to the needs of adolescents, especially in developing countries. Increased international collaboration institutions and researchers in Indonesia can establish cooperation with countries and institutions that are already active in this field such as UCSF or the University of Toronto to accelerate technological development in the reproductive health sector. The government and educational institutions can use this data to formulate digital-based reproductive health education policies that are more inclusive and equitable, especially to reach areas with limited access to conventional health services.

Although it provides useful results, this study has limited data sources on Scopus. Although Scopus is one of the largest scientific databases, it does not cover all publications from various countries, especially from journals originating from developing countries that have limitations in journal indexation. This research is quantitative with a bibliometric approach. This data does not provide an in-depth understanding of the content or quality of interventions in digital-based reproductive health education. Indonesia is included in the 10 countries that publish on this topic, but the analysis does not specifically explain local dynamics such as culture, norms, or regulations that affect digital reproductive health education in Indonesia. This study did not assess the direct effectiveness of the digital interventions used. Further evaluation is needed to determine how much impact the digital approach has on changes in knowledge, attitudes, or behaviors related to reproductive health.

Finally, this study shows that although attention to digital-based reproductive health education has increased in the last decade, collaboration and research distribution are still focused on a few countries and institutions. This study serves as an initial foundation to encourage more inclusive, collaborative, and contextualized research, especially in an effort to address the challenges of reproductive health education in the digital era. Using a bibliometric approach, this study not only reflects global scientific developments, but also serves as a mirror to local readiness in adapting to technological innovations in the field of reproductive health. In the future, further research that explores the effectiveness of interventions and cross-

country collaboration is needed to ensure that all adolescents, without exception, can access comprehensive and quality reproductive health information and education.

The limitation of this study is that the articles come from a single database. This research only describes the landscape that records the words that appear and illustrates them in images, so this research is limited to quantitative analysis based on frequency and does not analyze relationships or influences.

Conclusion

The ten most frequently occurring keywords in digital-based reproductive health education-themed publications over three decades are: human, humans, female, male, sexual health, article, adolescent, adult, sexual behavior, and sexual education. These keywords indicate that the main focus of research still revolves around biological aspects, gender, and sexual health in general, with great attention to adolescents and adults.

The most prolific authors by number of publications are Mustanski B., Shegog R., Colton Z.A., Decker M.J., Gutmann-Gonzales A., Johns M.M., Liles S.M., Macapagal K., Marcantonio T.L., and Markham C.M. They come from various reputable institutions and actively publish research around sexual health education in various digital formats.

Journals that most frequently cover this topic include: Sex Education, Frontiers in Public Health, BMC Public Health, Archives of Sexual Behavior, Canadian Journal of Human Sexuality, Sexual Health, American Journal of Sexuality Education, PLOS ONE, Health Promotion Practice, and JMIR Formative Research. These journals have a strong focus on public health, sexuality, and digital innovation in education.

The institution most involved in publications on this topic is the University of Toronto, University of California San Francisco (UCSF), The University of British Columbia, Northwestern University Feinberg School of Medicine, UCSF School of Medicine, Northwestern University, Brown University, The University of North Carolina di Chapel Hill, University of Melbourne, dan University of Texas Health. Keterlibatan institusi-institusi ini menandakan tingginya kontribusi akademik dari negara-negara dengan infrastruktur riset yang kuat.

The country with the highest number of publications is the United States, followed by Canada, the United Kingdom, Australia, China, Iran, Indonesia, Germany, Turkey, and Hong Kong. The dominance of developed countries indicates that they have higher attention to the development of reproductive health education through digital media. However, the emergence of Indonesia in this list shows an increase in contributions from developing countries.

Digital-based reproductive health themes are still rarely researched, so it is recommended for researchers to conduct research and publish research on digital-based reproductive health themes. Encourage cross-country and cross-institutional collaboration to enrich perspectives, expand thematic reach, and increase methodological strength in the development of digital-based reproductive health education. Although Indonesia is included in the top 10 most productive countries, there are not many studies that raise digital approaches in the local socio-cultural context in depth. Future research can focus more on developing and evaluating digital reproductive health education intervention models that are locally based, according to the cultural values and characteristics of adolescents in various regions in Indonesia. Bibliometric research provides a general mapping quantitatively. Therefore, for future research, it is recommended that research that looks for influences or relationships between variables, qualitative research or research that combines several methods. Digital transformation in reproductive health education brings new risks such as misuse of personal data, cyberbullying, or invalid content. Future research needs to explore the dimensions of digital ethics and privacy in the context of sexual education, so that the interventions developed remain safe, credible and user-friendly. Future research is expected to start reaching special populations such as people with disabilities, LGBTQIA+ groups, or adolescents in remote areas, so that digital reproductive health education is truly inclusive and equitable.

Acknowledgements

I would like to thank 'Aisyiyah University in Surakarta for giving us the opportunity to study. Furthermore, STIKes Karsa Husada Garut which has given us permission for further study.

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