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Integrating Behavioral Theory and Educational Innovation to Improve Adolescent Sexual and Reproductive Health: A Systematic Review

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ABSTRACT: **Background**: Educational interventions have become a cornerstone of adolescent SRH promotion, with increasing emphasis on theory-based approaches and innovative educational strategies. However, evidence regarding their comparative effectiveness across different SRH outcomes remains fragmented. This systematic review synthesized experimental evidence on the effectiveness of theory-based and innovative educational interventions for improving adolescent SRH outcomes and preventing risky sexual behaviors.

Methods: A systematic literature review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. Six electronic databases (PubMed, Cochrane Library, ERIC, ScienceDirect, JSTOR, and Wiley Online Library) were searched for English-language studies published between January 2000 and December 2025. Randomized controlled trials (RCTs), cluster RCTs, and quasi-experimental studies evaluating educational interventions among adolescents aged 10–19 years were included. Methodological quality was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools, while risk of bias was evaluated using RoB 2 for randomized studies and ROBINS-I for quasi-experimental studies. Due to methodological heterogeneity, findings were synthesized narratively.

Results: Forty studies met the eligibility criteria, comprising 28 randomized or cluster randomized controlled trials and 12 quasi-experimental studies. Educational interventions were categorized as theory-based, innovative, or combined approaches. Across the included studies, interventions consistently improved SRH knowledge, attitudes, self-efficacy, behavioral intentions, and communication skills. Evidence for behavioral outcomes including condom use, contraceptive behaviors, delayed sexual initiation, abstinence, and reductions in risky sexual behaviors was generally positive but less consistent. Combined approaches were promising, but heterogeneous indirect comparisons did not establish their superiority or sustained behavioral effectiveness.

Conclusions: Educational interventions can improve knowledge and selected psychosocial outcomes, while evidence for sustained behavioral change remains mixed. Cultural context, intervention dose and fidelity, service access, and methodological limitations should guide interpretation. Stronger comparative studies with longer behavioral follow-up are needed.

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1. INTRODUCTION

Adolescence represents a critical developmental period characterized by profound physical, psychological, cognitive, and social changes that shape health behaviors across the life course (Uktamovna, 2025). During this transition, adolescents begin exploring intimate relationships and developing sexual identities, making them particularly vulnerable to sexual and reproductive health (SRH) risks (Janighorban et al., 2022; Lynch et al., 2025). According to the World Health Organization (WHO), adolescents account for a substantial proportion of new sexually transmitted infections (STIs), unintended pregnancies, and other adverse reproductive health outcomes worldwide (World Health Organization, 2026). Unsafe sexual practices during adolescence are associated with increased risks of HIV infection, early pregnancy, unsafe abortion, school dropout, psychosocial problems, and long-term reproductive health complications (Millanzi, 2022; Musindo et al., 2023). These challenges are particularly pronounced in low- and middle-income countries, where limited access to accurate SRH information and youth-friendly health services remains a significant public health concern (Crooks et al., 2022; Jing et al., 2023; Leung et al., 2024; Pozuelo et al., 2022).

Education has long been recognized as one of the most effective strategies for promoting healthy sexual behaviors among adolescents (Wilkins et al., 2022). School-based sexuality education (Myat et al., 2024), community education programs (Bekele et al., 2022), peer education (Elisa et al., 2022), and digital health education (Borji-Navan et al., 2024) have been widely implemented to improve adolescents' knowledge, attitudes, communication skills, and decision-making regarding sexual and reproductive health. Beyond providing factual information, contemporary educational interventions increasingly aim to strengthen psychosocial determinants of behavior, including self-efficacy, behavioral intentions, and interpersonal communication, which are essential for translating knowledge into healthier sexual practices (Burgermaster & Rodriguez, 2022). Consequently, educational interventions have become central components of national and international strategies for preventing HIV infection, sexually transmitted infections, and unintended adolescent pregnancy (Singh et al., 2025).

Over the past two decades, educational interventions have evolved considerably in both theoretical foundation and delivery approach. Many programs are explicitly grounded in behavioral theories such as the Theory of Planned Behavior (TPB) (Ranaei et al., 2025), Health Belief Model (HBM) (Aisah et al., 2022), Social Cognitive Theory (SCT) (Rezvani et al., 2024), Information–Motivation–Behavioral Skills (IMB) model (Taştekin Ouyaba et al., 2023), Protection Motivation Theory (PMT) (Borhani et al., 2023), Extended Parallel Process Model (EPPM) (Sharifi et al., 2025), and Fuzzy-Trace Theory (Reyna et al., 2022). These theories provide structured frameworks for understanding and modifying behavioral determinants, thereby enhancing the effectiveness of educational interventions. At the same time, advances in educational technology have facilitated the development of innovative learning approaches, including mobile health (mHealth) (Isaacs et al., 2024), web-based education (Guo et al., 2025), gamification, serious games (Sierra-Yagüe et al., 2026), peer-led learning (Mason-Jones et al., 2023), multimedia education (Scull et al., 2022), theater-based interventions (Mohandespour et al., 2023), and other learner-centered strategies that increase adolescents' engagement and accessibility to SRH information.

A growing body of experimental research has evaluated the effectiveness of both theory-based and innovative educational interventions, reporting improvements in various SRH outcomes. Nevertheless, findings remain heterogeneous across studies. While many interventions demonstrate substantial improvements in knowledge, attitudes, self-efficacy, and behavioral intentions, evidence regarding sustained behavioral outcomes—including consistent condom use, delayed sexual initiation, abstinence, and reductions in risky sexual behaviors—remains inconsistent. Variations in theoretical frameworks, intervention content, educational settings, delivery methods, intervention duration, follow-up periods, and outcome measurements further complicate comparisons across studies (Akande et al., 2024; Haruna et al., 2018; Li et al., 2011; Ma et al., 2022; Mbizvo et al., 2023; Michielsen et al., 2012; Pinandari et al., 2023; Thammaraksa et al., 2025; Villa-Rueda et al., 2022). Moreover, the relative contribution of behavioral theory versus innovative educational delivery to intervention effectiveness has not been comprehensively synthesized.

Previous systematic reviews have primarily examined comprehensive sexuality education, digital health interventions (Sewak et al., 2023), school-based educational programs (dos Santos et al., 2026), or specific behavioral interventions separately. Although these reviews have contributed valuable evidence regarding particular educational approaches, they generally focused on a single intervention modality or a limited range of outcomes. Consequently, current evidence remains fragmented, making it difficult to determine whether theory-based interventions, innovative educational approaches, or their integration provides

greater benefits for improving adolescent sexual and reproductive health. Furthermore, few reviews have restricted their synthesis to experimental studies, which provide the highest level of evidence for evaluating intervention effectiveness.

To address these gaps, the present systematic review synthesizes evidence exclusively from randomized controlled trials, cluster randomized controlled trials, and quasi-experimental studies evaluating theory-based and innovative educational interventions for adolescents. Unlike previous reviews, this study integrates these educational approaches within a single analytical framework while synthesizing evidence according to key sexual and reproductive health outcomes, including knowledge, attitudes, self-efficacy, behavioral intentions, communication and negotiation skills, condom use and contraceptive behaviors, sexual initiation, abstinence, and risky sexual behaviors. By comparing the effectiveness of different educational strategies across these outcome domains, this review provides a comprehensive understanding of how educational content, behavioral theory, and delivery methods collectively influence adolescent sexual and reproductive health.

Accordingly, the objective of this systematic review was to synthesize and critically evaluate the effectiveness of theory-based educational interventions and innovative educational interventions in improving sexual and reproductive health outcomes and preventing risky sexual behaviors among adolescents.

This review was guided by the following review questions:

1. How effective are theory-based educational interventions in improving adolescents' sexual and reproductive health outcomes?

2. How effective are innovative educational interventions in improving adolescents' sexual and reproductive health outcomes?

3. Which sexual and reproductive health outcomes are most consistently improved by educational interventions, and which outcomes remain challenging to influence?

4. What methodological characteristics, theoretical frameworks, and educational delivery strategies appear to contribute to the effectiveness of educational interventions for adolescents?

The findings of this review are expected to provide evidence to support educators, healthcare professionals, policymakers, and researchers in developing theory-informed, innovative, and evidence-based educational interventions that promote sustainable improvements in adolescent sexual and reproductive health.

2. MATERIALS AND METHODS

Study Design

This systematic literature review was conducted to synthesize evidence regarding the effectiveness of theory-based and innovative educational interventions in preventing risky sexual behavior among adolescents. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (Page et al., 2021) to ensure transparent identification, selection, appraisal, and reporting of the available evidence. Because substantial heterogeneity was anticipated in intervention characteristics, theoretical frameworks, outcome measures, and follow-up durations, a narrative synthesis was undertaken rather than a quantitative meta-analysis.

The review focused exclusively on experimental evidence to provide a robust evaluation of intervention effectiveness. Accordingly, randomized controlled trials (RCTs), cluster randomized controlled trials (cluster RCTs), and quasi-experimental studies were considered eligible. Restricting inclusion to intervention studies strengthened the overall level of evidence and allowed direct assessment of the effectiveness of educational programs in improving adolescent sexual and reproductive health outcomes.

Eligibility Criteria

Studies were included if they met the following criteria: (1) involved adolescents aged 10–19 years; (2) evaluated educational interventions designed to improve sexual and reproductive health or prevent risky sexual behaviors; (3) implemented theory-based educational approaches, innovative educational strategies, or combinations of both; (4) included a comparison group

receiving standard education, usual care, another intervention, or no intervention; (5) reported at least one relevant behavioral or psychosocial outcome; (6) employed randomized controlled trial, cluster randomized controlled trial, or quasi-experimental designs; and (7) were published in peer-reviewed journals in English. Studies involving mixed-age samples were included only when outcome data for adolescents aged 10–19 years could be extracted separately. Eligible quasi-experimental studies required a concurrent comparison group. Psychosocial outcomes included knowledge, attitudes, self-efficacy, behavioral intentions, and communication skills; studies reporting these outcomes were eligible even when actual sexual behavior was not assessed.

Studies were excluded if they were observational studies, qualitative studies, case reports, conference abstracts, editorials, reviews, protocols, dissertations, or grey literature. Uncontrolled before–after studies were also excluded. Studies focusing exclusively on adults or university students, interventions unrelated to sexual and reproductive health education, duplicate publications, and studies lacking sufficient outcome data were also excluded.

Table 1. Eligibility Criteria Based on PICOS

Component	Eligibility Criteria
Population	Adolescents aged 10–19 years
Intervention	Theory-based educational interventions, innovative educational interventions, or combined approaches
Comparator	Standard education, usual care, no intervention, or alternative educational intervention
Outcomes	Knowledge, attitudes, self-efficacy, behavioral intentions, communication skills, condom use, contraceptive behaviors, sexual initiation, abstinence, risky sexual behaviors
Study Design	Randomized controlled trials, cluster randomized controlled trials, quasi-experimental studies

Information Sources

A comprehensive literature search was conducted using six electronic databases: PubMed, Cochrane Library, Education Resources Information Center (ERIC), ScienceDirect, JSTOR, and Wiley Online Library. These databases were selected to ensure broad coverage of biomedical, public health, nursing, educational, and behavioral science literature relevant to adolescent sexual and reproductive health interventions. Searches were performed independently across all databases using predefined search strategies tailored to the indexing terms and search functionalities of each database.

To maximize retrieval of relevant studies, database-specific controlled vocabulary (Medical Subject Headings [MeSH] in PubMed) was combined with free-text keywords and Boolean operators. Reference lists of eligible studies were also manually screened to identify additional relevant articles that might not have been captured through the electronic database search. Only studies published in English were considered for inclusion.

Search Strategy

The literature search was designed to identify experimental studies evaluating the effectiveness of theory-based and innovative educational interventions for improving adolescent sexual and reproductive health and preventing risky sexual behaviors. The search strategy combined controlled vocabulary and free-text terms related to four key concepts: adolescents, sexual and reproductive health, educational interventions, and experimental study designs. Boolean operators ("AND" and "OR"), truncation symbols, and database-specific indexing terms were applied as appropriate to optimize search sensitivity and specificity. A named behavioral theory was not required in all search combinations, allowing the identification of innovative educational interventions without an explicitly reported theoretical foundation.

Six electronic sources were searched: PubMed, Cochrane Library, ERIC, ScienceDirect, JSTOR, and Wiley Online Library. ScienceDirect, JSTOR, and Wiley Online Library provided publisher-platform coverage, complementing the biomedical,

evidence-synthesis, and educational literature accessible through PubMed, Cochrane Library, and ERIC, respectively. Search strategies were adapted to the available indexing terms and search functionalities of each source while maintaining the same conceptual framework. Table 2 summarizes the conceptual search combinations used across these sources. The final search was conducted across all sources before study screening commenced.

The literature search was limited to peer-reviewed journal articles published in English between January 2000 and December 2025. This interval defined publication eligibility rather than the dates on which the searches were performed. Conference abstracts, editorials, letters, dissertations, books, book chapters, systematic reviews, narrative reviews, scoping reviews, study protocols, and grey literature were excluded. No geographical restrictions were applied in order to capture evidence from diverse sociocultural settings.

Table 2. Electronic Search Strategy

Database	Search Strategy
PubMed	("Adolescent"[Mesh] OR adolescent* OR teen* OR youth* OR "young people" OR "young person") AND ("Sexual Behavior"[Mesh] OR "Sexual Health"[Mesh] OR "Reproductive Health"[Mesh] OR "sexual behavior" OR "sexual health" OR "reproductive health" OR "sexual risk behavior" OR "risky sexual behavior" OR HIV OR STI OR contraception OR condom*) AND (education OR "health education" OR "sexuality education" OR "comprehensive sexuality education" OR "school-based education" OR "peer education" OR mHealth OR gamification OR "web-based" OR "digital learning" OR "serious game*" OR multimedia OR "behavior change") AND ("randomized controlled trial" OR "cluster randomized trial" OR quasi-experimental OR intervention study)
Cochrane Library	(adolescent* OR youth* OR teen*) AND ("sexual health" OR "reproductive health" OR "sexual behavior" OR HIV OR STI OR contraception OR condom*) AND (education OR educational intervention OR sexuality education OR peer education OR digital learning OR mHealth OR gamification) AND (randomized controlled trial OR cluster randomized trial OR quasi-experimental)
ERIC	(adolescent* OR teenager* OR youth*) AND ("sexual education" OR "sexuality education" OR "reproductive health education" OR "sexual health") AND (school-based education OR health education OR peer education OR digital learning OR online learning OR innovative education) AND (experimental OR randomized OR quasi-experimental)
ScienceDirect	Conceptual search combination: (adolescent* OR youth* OR teenager*) AND ("sexual health" OR "reproductive health" OR "sexual behavior" OR HIV OR STI) AND (education OR educational intervention OR sexuality education OR mHealth OR gamification OR web-based OR digital learning) AND (randomized OR quasi-experimental OR intervention)
JSTOR	adolescent* AND ("sexual health" OR "reproductive health" OR "sexuality education") AND (education OR educational intervention OR innovative education OR theory-based education)
Wiley Online Library	(adolescent* OR youth*) AND ("sexual health" OR "reproductive health" OR "sexual behavior") AND (educational intervention OR sexuality education OR health education OR digital education OR peer education OR gamification) AND (randomized trial OR intervention OR quasi-experimental)

Note: The publication eligibility period was January 2000–December 2025. Eligible publications were English-language, peer-reviewed journal articles, with no geographical restrictions. These eligibility criteria do not necessarily represent filters applied within each search platform. The table summarizes the search combinations documented in the review manuscript rather than verified, verbatim search histories. The ScienceDirect entry presents the underlying concepts without the unverified field notation. Source-specific execution dates, search fields, applied filters, and the Cochrane Library collection searched were not documented in the available manuscript, limiting full reproducibility of the search.

Study Selection

All records retrieved from the electronic searches were exported to reference management software, and duplicate records were identified and removed before screening. The remaining records underwent a two-stage selection process following the PRISMA 2020 framework. First, titles and abstracts were independently screened against the predefined eligibility criteria. Full-text reports of potentially eligible studies were subsequently retrieved and assessed for inclusion. Uncertainties or disagreements regarding eligibility were resolved through discussion among the review authors until consensus was reached.

Studies were excluded if they did not involve eligible adolescent participants, did not evaluate relevant educational interventions, employed ineligible study designs, lacked an appropriate comparison group, or failed to report relevant sexual and reproductive health outcomes. Reports with insufficient data for extraction were also excluded. Reports that could not be retrieved were recorded separately from those excluded following full-text assessment.

The electronic searches identified 2,486 records. After removal of 148 duplicates and 416 additional records before screening, 1,922 records underwent title and abstract screening, of which 1,765 were excluded. Full texts were sought for 157 reports; eight could not be retrieved, leaving 149 reports for eligibility assessment. Of these, 109 were excluded because of ineligible study design (n = 38), non-adolescent populations (n = 17), interventions unrelated to sexual and reproductive health education (n = 14), absence of an appropriate comparison group (n = 9), absence of relevant outcomes (n = 18), or insufficient data for extraction (n = 13). Forty studies were included in the narrative synthesis. The study-selection process is presented in the PRISMA 2020 flow diagram (Figure 1).

Data Extraction

Data were extracted independently using a standardized extraction form developed specifically for this review. The extracted information included the first author, publication year, country, study design, participant characteristics, sample size, educational intervention, theoretical framework, comparator, intervention duration, follow-up period, measured outcomes, and principal findings, including statistical measures such as p-values, odds ratios (ORs), adjusted odds ratios (AORs), confidence intervals (CIs), and other reported effect estimates where available.

Interventions were characterized according to their explicitly reported behavioral-theory basis and educational delivery approach. Theory-based interventions explicitly linked a named behavioral theory or model to intervention content or targeted constructs; measurement of theory-related constructs alone was insufficient to establish a theoretical basis. Innovative interventions employed delivery approaches such as gamification, serious games, interactive digital platforms, theater, peer-led learning, sport, or problem-based pedagogy without an explicitly documented behavioral-theory basis. Combined interventions incorporated both an explicit behavioral-theory basis and an innovative delivery approach. The term "innovative" described the delivery approaches examined in this review and did not imply novelty or superior effectiveness.

Rights-based education and comprehensive sexuality education were considered curriculum orientations rather than, by themselves, behavioral theories or innovative delivery methods. Classification therefore depended on the theoretical foundations and delivery components explicitly described in each study. Insufficient reporting did not justify inferring a theoretical basis or assigning an intervention category. These categories provided a descriptive framework for the narrative synthesis rather than a ranking of effectiveness or evidence of the independent contribution of theory and delivery method.

Quality Assessment

The methodological quality of all included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools. Design-specific checklists were applied to assess the methodological features relevant to randomized and non-randomized intervention studies.

Randomized controlled trials (RCTs) and cluster randomized controlled trials were assessed using the 13-item JBI Critical Appraisal Checklist for Randomized Controlled Trials. The checklist addresses randomization, allocation concealment, baseline comparability, blinding of participants, intervention providers and outcome assessors, treatment of comparison groups, completeness and handling of follow-up, analysis according to randomized allocation, consistency and reliability of outcome measurement, appropriateness of statistical analysis, and suitability of the trial design. Quasi-experimental studies were assessed using the nine-item JBI Critical Appraisal Checklist for Quasi-Experimental Studies. This checklist addresses temporal ordering of cause and effect, participant comparability, similarity of care apart from the intervention, presence of a control group, repeated outcome measurements, completeness of follow-up, consistency and reliability of outcome measurement, and appropriateness of statistical analysis.

Each appraisal item was rated as "Yes," "No," "Unclear," or "Not Applicable." Studies were not excluded based on quality assessment results; instead, the findings informed interpretation of the methodological strengths and limitations of the evidence. The item-level assessments are presented in Tables 4 and 5.

JBI critical appraisal was distinguished from the separate risk-of-bias assessments conducted using RoB 2 and ROBINS-I. A higher methodological-quality classification indicates greater methodological rigor and should not be confused with a higher risk-of-bias classification. Interpretation emphasized the individual checklist items and their implications for the findings rather than treating checklist totals as equivalent across study designs. Overall quality labels in Tables 4 and 5 should not be interpreted as standardized JBI thresholds or as substitutes for the domain-specific risk-of-bias judgments.

Risk of Bias Assessment

The risk of bias of the included studies was evaluated using design-specific assessment tools. Randomized controlled trials (RCTs) and cluster randomized controlled trials were assessed using the Cochrane Risk of Bias 2 (RoB 2) tool, whereas quasi-experimental studies were assessed using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool.

RoB 2 addressed five domains: (1) bias arising from the randomization process; (2) bias due to deviations from intended interventions; (3) bias due to missing outcome data; (4) bias in the measurement of outcomes; and (5) bias in the selection of the reported result. Overall judgments were categorized as low risk of bias, some concerns, or high risk of bias.

ROBINS-I addressed seven domains: (1) bias due to confounding; (2) bias in the selection of participants into the study; (3) bias in the classification of interventions; (4) bias due to deviations from intended interventions; (5) bias due to missing data; (6) bias in the measurement of outcomes; and (7) bias in the selection of the reported result. Overall judgments were categorized as low, moderate, serious, or critical risk of bias.

Risk-of-bias judgments relate to specific intervention-effect estimates and may differ across outcomes and assessment time points within the same study. The study-level summaries presented in Figures 2 and 3 should therefore not be interpreted as demonstrating an identical risk of bias for every reported outcome. For cluster randomized trials, recruitment relative to randomization, baseline differences between clusters, and appropriate handling of clustering are relevant to interpretation. For non-randomized studies, differences in baseline sexual activity, age, sex/gender, socioeconomic circumstances, and school or community characteristics represent potential sources of confounding where relevant.

The assessment findings informed the narrative synthesis by identifying methodological limitations that could influence the reported intervention effects. Positive findings were interpreted cautiously when concerns involved confounding, randomization, missing data, self-reported outcome measurement, or selective reporting. Risk-of-bias judgments were considered alongside study design, outcome definition, and follow-up duration when interpreting the consistency and credibility of the evidence. Detailed assessment summaries are presented in Figures 2 and 3.

Data Synthesis

Due to substantial clinical and methodological heterogeneity across the included studies, a quantitative meta-analysis was not performed. Considerable variability was observed in intervention characteristics, theoretical frameworks, educational delivery

methods, intervention duration, follow-up periods, participant characteristics, and outcome measurements, making statistical pooling of results inappropriate. Therefore, a narrative synthesis was conducted in accordance with established guidance for the synthesis of heterogeneous evidence in systematic reviews.

The intervention categories were used descriptively according to the operational definitions above. Outcome domains remained the organizing structure of the narrative synthesis because interventions often addressed several outcomes and combined more than one educational component. Cross-study comparisons between intervention categories were indirect and could not establish the independent contribution or superiority of theory, delivery innovation, or their combination.

For evidence synthesis, however, findings were organized according to sexual and reproductive health outcomes rather than intervention type to enable direct comparison of intervention effectiveness across different educational approaches. The synthesized outcomes included sexual and reproductive health knowledge, attitudes toward sexual and reproductive health, self-efficacy, behavioral intentions, communication and negotiation skills, condom use and contraceptive behaviors, sexual initiation and abstinence, and risky sexual behaviors.

Within each outcome domain, interpretation distinguished randomized from non-randomized comparisons and active comparators from usual education or no intervention. Between-group effects were distinguished from within-group changes; improvement in both arms did not establish superiority of one intervention. Effect estimates and confidence intervals, where reported, were considered alongside statistical significance. Condom use at last intercourse, consistent condom use, condom-use intention, and condom self-efficacy were treated as distinct endpoints. Differences in scale definitions, recall periods, baseline sexual experience, and assessment timing limited direct comparison; no common effect size or ranking across these measures was inferred.

Intervention dose and follow-up were considered separately: a long intervention assessed only at completion did not demonstrate maintenance after the intervention ended. Behavioral findings were interpreted at their reported time points, and evidence of maintenance required actual behavioral measurement at later follow-up rather than persistence of knowledge or intentions alone. Delivery setting, facilitator, digital access, and comparator intensity provided context for differences in effects, while risk-of-bias concerns limited confidence in apparent benefits. These comparisons were descriptive; no formal subgroup, sensitivity, or moderator analysis was undertaken to quantify the influence of these characteristics.

3. RESULTS AND DISCUSSION

Study Selection

The database search identified 2,486 records from six electronic databases, including PubMed (n = 612), Cochrane Library (n = 148), ERIC (n = 397), ScienceDirect (n = 721), JSTOR (n = 281), and Wiley Online Library (n = 327). After removing 148 duplicate records and 416 ineligible studies, 1,922 unique articles remained for title and abstract screening. Of these, 1,765 records were excluded because they were irrelevant to the review topic, involved non-adolescent populations, evaluated non-educational interventions, reported outcomes unrelated to sexual and reproductive health, or employed ineligible study designs.

A total of 157 full-text articles were sought for retrieval, of which 149 were successfully obtained and assessed for eligibility. Eight reports could not be retrieved because the full texts were unavailable. During full-text assessment, 109 studies were excluded for the following reasons: ineligible study design (n = 38), non-adolescent populations (n = 17), interventions unrelated to sexual and reproductive health education (n = 14), absence of an appropriate comparison group (n = 9), failure to report relevant outcomes (n = 18), and insufficient data for extraction (n = 13).

Ultimately, 40 studies met all eligibility criteria and were included in the qualitative synthesis. These comprised 28 randomized controlled trials or cluster randomized controlled trials and 12 quasi-experimental studies. The complete study selection process is presented in Figure 1.

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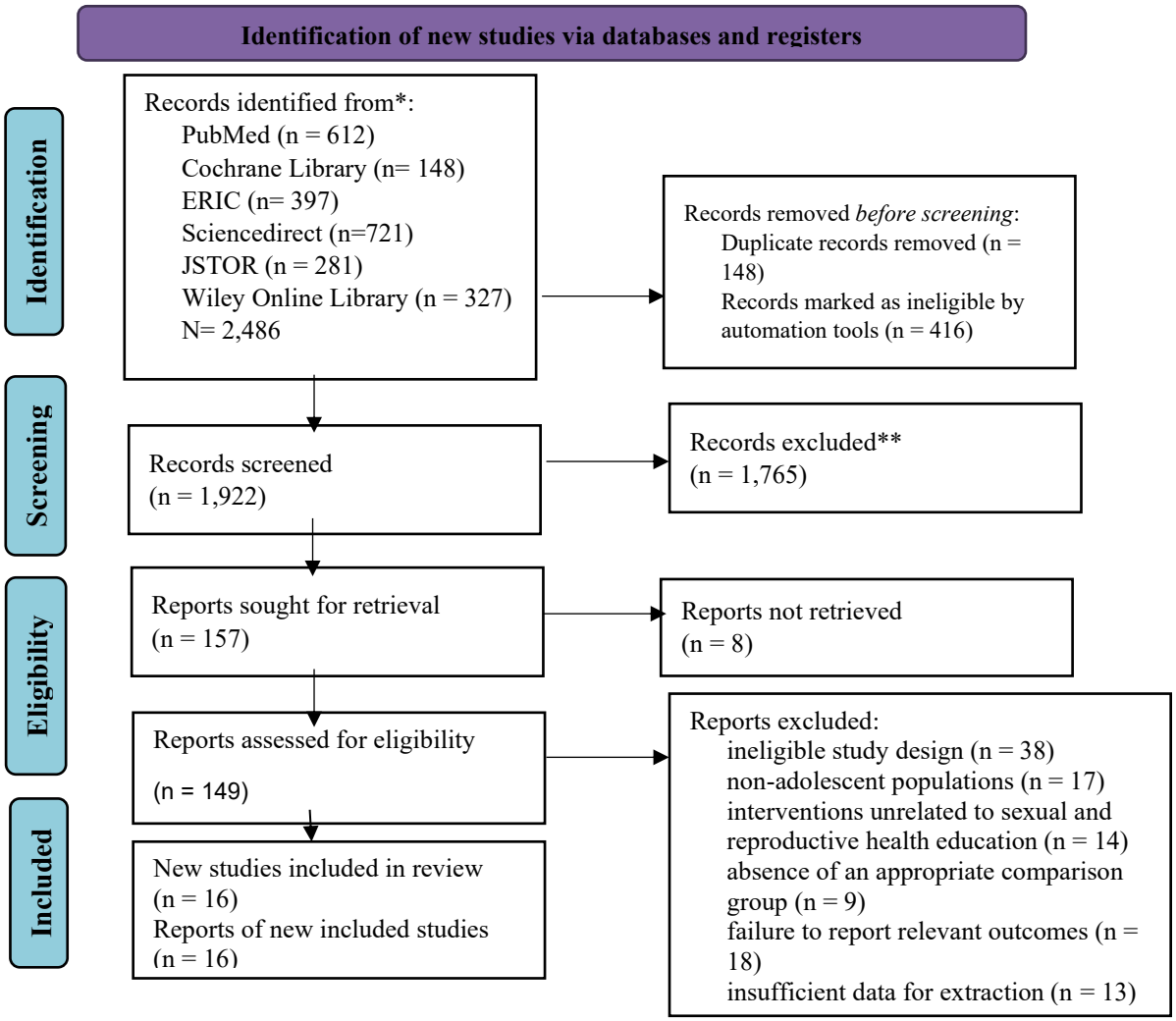


Figure 1. PRISMA flowchart for study selection

Table 3. Extraction of Eligible Studies

Study	Country	Design	Participants	Educational Intervention	Theory / Framework	Comparator	Intervention Dose / Follow-up	Outcomes	Key Findings
Harun a et al. (2018) (Harun a et al., 2018)	Tan zani a	RCT	n=12 0; secon dary schoo l stude nts;	Game-based learning and gamificati on for sexual	Activity Theory; game-based learning	Traditiona l teaching	40 minute s/wee k for 5 weeks; immed iate	Sexual health literacy; motivatio n; attitude; knowledg e;	GBL and gamificati on produced higher post-test scores than

			11–15 years	health education			post-test	engagement	traditional teaching: GBL mean=79.94, gamification mean=79.23, control mean=51.93; F(2,117)=54.75, p=0.001. Motivation constructs also favored GBL/gamification, with pairwise comparisons generally p=0.001.
Akande et al. (2024) (Akande et al., 2024)	Nigeria	Cluster RCT	n=1,280 in-school adolescents	mHealth-based comprehensive sexuality education	CSE; mHealth delivery	Control group	Baseline, immediate post-intervention, and 3-month follow-up	SRH knowledge; attitude; risky sexual behavior	Knowledge improved significantly F=2117.252, p<0.001; attitude improved F=148.493, p<0.001; risky sexual behavior declined but was not significant

									F=0.558, p=0.572.
Awotidebe et al. (2014) (Awotidebe et al., 2014)	South Africa	Quasi-experimental	n=430 rural school-going adolescents	Sport-based HIV prevention using Grassroot Soccer curriculum	Theory of Planned Behavior; Social Cognitive Theory	Control school	12-week program; 11 practice sessions; post-test and 4-month follow-up	HIV knowledge; self-efficacy; negotiation skills; risky sexual behavior	HIV knowledge improved F(2)=72.57, p<0.001; self-efficacy improved F(2)=6.63, p=0.002; negotiation skills improved F(2)=4.07, p=0.02. Between-group effect was significant only for self-efficacy β=1.43, 95% CI 1.07–1.92, p=0.018; no significant effect on risky sexual behavior.
Barbee et al. (2016) (Barbee et al., 2016)	USA	Three-arm cluster RCT	n=1,448 youth; 14–19 years	Reducing the Risk and Love Notes adolescent pregnancy prevention curricula	RTR curriculum; Love Notes relationship/pregnancy prevention curriculum	Power of We control	Delivered over 2 consecutive Saturdays; RTR 16×45-min	Ever had sex; condom use; birth control use; number of partners	RTR reduced recent sexual partners at 3 months 0.26 vs 0.41, p=0.03

							modules plus videos, about 13 hours; 3- and 6-month follow-up		and 6 months 0.41 vs 0.71, p=0.05. Love Notes reduced failure to use condoms at 6 months 9.70% vs 16.60%, p=0.007, failure to use birth control 8.30% vs 17.50%, p=0.001, number of partners 0.32 vs 0.70, p=0.01, and ever had sex 34.00% vs 40.60%, p=0.02.
Boontem et al. (2019) (Boontem et al., 2019)	Thailand	Quasi-experimental	n=68 primary school students	Integrated sex education and life skills program	Life skills approach	Usual school SRH education	Post-test and 3-month assessment	Life skills for preventing risky sexual behavior	Significant between-group difference after the program: t=2.39, p<0.05.
Constantine et al. (2015) (Constantine	USA	Cluster RCT	n=1,750 ninth-grade students	Rights-based sexuality education curriculum	Rights-based sexuality education; gender equality;	Basic sex education curriculum	12-session curriculum; immed	Sexual health knowledge; sexual rights attitudes;	Significant positive effects on 7 of 9 psychosocial

et al., 2015)					sexual rights		iate post-test	parent communication; self-efficacy; condom intention	outcomes; no significant differences for partner communication and condom-use intention.
Coyle et al. (2013) (Coyle et al., 2013)	USA	RCT	n=765 alternative high-school youth; mean age 16.2 years	HIV/STI/pregnancy prevention curriculum, service learning, or combined intervention	Skills-based HIV/STI/pregnancy prevention curriculum	Attention control curriculum	Follow-up over 18 months	Condomless vaginal sex; risk situations; sexual behavior	Curriculum-only condition reduced vaginal intercourse without condom in prior 3 months OR=0.58, p=0.04; effects diminished by final follow-up.
Darabi et al. (2017) (Darabi et al., 2017)	Iran	RCT	n=578 girls; 12–16 years	TPB-based sexual and reproductive health education	Theory of Planned Behavior	Control group	4 sessions; program lasted 3 months; 6-month follow-up	Knowledge; attitude; subjective norms; perceived behavioral control; parental control; intention; behavior	Significant improvements in attitude MD=16.8, 95% CI 15.3–18.3, subjective norms MD=16.4, 95% CI 14.83–18.11, perceived behavioral control

									MD=18.0, 95% CI 16.6–19.4, parental control MD=17.0, 95% CI 15.1–18.9, behavioral intention MD=16.4, 95% CI 14.8–18.0, and behavior MD=18.5, 95% CI 16.8–20.2; all TPB dimensions p<0.001.
Gibson et al. (2020) (Gibson et al., 2020)	USA	RCT	n=262 adolescents; mean age 15.89 years	Motivational interviewing vs behavioral skills training	Theory of Planned Behavior mechanisms	Active comparator between two interventions	Immediate post-test for mediators; 3-month follow-up for behavior	Condom attitudes; norms; self-efficacy; intentions; condom use; unprotected sex	Both interventions significantly improved condom attitudes, self-efficacy, and intentions post-test, and significantly reduced risky sexual behavior and increased condom use at 3

									months; no significant between-condition differences reported in abstract.
Gómez-Lugo et al. (2022) (Gómez-Lugo et al., 2022)	Colombia	Cluster RCT	n=2,047 teenagers; 14–19 years	COMPAS sexual risk-reduction program	Information–Motivation–Behavioral Skills Model; Social Learning Theory	Control schools	5-week intervention period; post-test in week 7; 6-month follow-up	HIV/STI knowledge; condom-use attitudes; sexual assertiveness; self-efficacy; condom intention; condom use	At 6 months, condom-use percentage improved AOR=7.52, 95% CI 0.41–16.62, p=0.03; condom use at last vaginal penetration improved AOR=1.12, 95% CI 1.01–1.25, p=0.02; consistent condom use was not significant AOR=0.93, 95% CI 0.83–1.03, p=0.19; sexual partners increased AOR=1.46, 95%

									CI 1.02–2.08, p=0.03.
Haruna et al. (2021) (Haruna et al., 2021)	Tanzania	Quasi-experimental	n=120; 11–15 years	Serious game and gamification	Gamified learning; MAKE framework	Traditional teaching	Pre-post intervention	Sexual health literacy; motivation; attitude; knowledge; engagement	Mean score increased from 25.10 to 75.86, t119=41.252, p<0.001; post-test differed across groups F2,117=83.98, p<0.001.
Jeihooni et al. (2018) (Jeihooni et al., 2018)	Iran	Quasi-experimental	n=100 male students; 16–17 years	HBM-based HIV/AIDS education	Health Belief Model	No training/control	8 sessions, 55–60 min; 3-month follow-up	Knowledge; perceived susceptibility; severity; benefits; barriers; self-efficacy	Significant improvement in knowledge and HBM constructs p<0.05; perceived barriers decreased significantly p<0.05.
Jemmott et al. (2005) (Jemmott et al., 2005)	USA	RCT	n=682 girls; 12–19 years	Skill-based HIV/STD risk-reduction	Cognitive-behavioral theories	Information-only and health-promotion control	Three 250-min interventions; 3-, 6-, 12-month follow-up	Unprotected sex; partners; STD rate; condom knowledge/intention	Skill-based group had less unprotected sex at 12 months than information-only p=0.03 and health control

									p=0.002; fewer partners p=0.04; lower STD positivity 10.5% vs 18.2%, p=0.05.
Jemmott et al. (2010) (Jemmott et al., 2010)	South Africa	Cluster RCT	n=1,057; mean age 12.4 years	School-based HIV/STD risk-reduction	Behavior-change theories	Health-promotion control	Six-session intervention; 3-, 6-, 12-month follow-up	Unprotected vaginal sex; vaginal intercourse; multiple partners	Reduced unprotected vaginal intercourse OR=0.51, 95% CI 0.30–0.85; vaginal intercourse OR=0.62, 95% CI 0.42–0.94; multiple partners OR=0.50, 95% CI 0.28–0.89.
Jerlström & Adolfsson (2018) (Jerlström & Adolfsson, 2020)	Sweden	Cluster RCT	School students	Theater-based sex education	Theater-based interactive education	Standard sex education	Theater, exercises, games, condom school, interactive replay	Condom knowledge; attitudes; condom behavior	Intervention group showed higher knowledge, improved attitudes, and less risky condom-related behavior than control; exact p-values

									perlu diekstrak dari tabel hasil.
Kemigisha et al. (2019) (Kemigisha et al., 2019)	Uganda	Cluster randomized trial	n=1,096 pupils; 10–14 years	School-based CSE	Comprehensive sexuality education	Control schools	School-based CSE; baseline to endline	SRH knowledge; sexual debut; behavioral intention; self-esteem; gender norms	SRH knowledge improved AOR=2.18, 95% CI 1.66–2.86; no significant effect on sexual debut, self-esteem, body image, or gender-equitable norms.
Lawrence et al. (2002) (St Lawrence et al., 2002)	USA	RCT	n=161 substance-dependent adolescents	Safer-sex skills training	IMB model	Information-only intervention	12 sessions	Condom attitudes; unprotected vaginal sex; condom-protected sex; abstinence	Skills-based interventions improved condom attitudes, reduced unprotected vaginal sex, increased condom-protected sex, and increased abstinence versus information-only.
Li et al. (2011) (Li et al., 2011)	China	Quasi-experimental	n=304 high-school	Culturally adapted FOK HIV prevention	Social Cognitive Theory; Protection	Control schools	Baseline and 6-month	HIV knowledge; stigma; response cost; intentions;	Significant effect at 6 months on HIV knowledge,

			students		Motivation Theory		follow-up	sexual behavior	reduced response cost for abstinence, and reduced HIV-related stigma; exact p-values perlu diekstrak dari tabel hasil.
Ma et al. (2022) (Ma et al., 2022)	China	Quasi-experimental	n=469 middle-school students	Interactive SRH education	Social Cognitive Theory	Usual SRH education	Two 40-min sessions; immediate and 1-month follow-up	Sexual knowledge; attitudes; refusal self-efficacy	Intervention improved knowledge p<0.01, attitudes p<0.05, and refusal self-efficacy p<0.05 compared with control.
Maduakolam et al. (2022) (Maduakolam et al., 2022)	Nigeria	Pragmatic RCT	n=647 secondary-school adolescents	Structured HIV health education	Structured health education	Control group	Pretest-posttest control design	HIV risky behavior	Intervention significantly reduced risky behavior compared with control; post-intervention gender differences were not significant in rural p=0.285,

									urban p=0.179, or combined schools p=0.956.
Oman et al. (2018) (Oman et al., 2018)	USA	Cluster RCT	n=1,036; mean age 16.1 years; youths in group care homes	Power Through Choices sexual health education	Sexual health education / pregnancy prevention	Control group	Follow-up at 6 and 12 months	Birth control use; pregnancy	Lower odds of recent sex without birth control at 6 months AOR=0.72, 95% CI 0.52–0.98; lower odds of ever being/getting someone pregnant at 12 months AOR=0.67, 95% CI 0.46–0.99.
Markham et al. (2012) (Markham et al., 2012)	USA	Three-arm RCT	n=1,258 seventh-grade students; mean age 12.6 years	Risk avoidance and risk reduction multimedia programs	Theory-based multimedia sexual education	Control	Followed from 7th to 9th grade	Sexual initiation; unprotected sex; psychosocial outcomes	RR delayed sexual initiation AOR=0.65, 95% CI 0.54–0.77; reduced unprotected sex at last intercourse AOR=0.67, 95% CI 0.47–0.96; reduced

									anal sex AOR=0.53, 95% CI 0.33–0.84 and unprotected vaginal sex AOR=0.59, 95% CI 0.36–0.95.
Mathews et al. (2016) (Mathews et al., 2016)	South Africa	Cluster RCT	Grade 8 adolescents; 42 high schools	PREPARE multi-component HIV/IPV prevention	Reasoned Action Framework; I-Change Model	Control schools	Baseline, 6-, and 12-month follow-up	Sexual debut; condom use; IPV	No significant effect on sexual risk behaviors at 12 months; reduced IPV victimization 35.1% vs 40.9%, OR=0.77, 95% CI 0.61–0.99.
Mbizvo et al. (2023) (Mbizvo et al., 2023)	Zambia	3-arm randomized controlled study	In-school adolescent girls and young women	CSE linked to SRH services	CSE + health facility linkage	CSE only / non-intervention arm	3-year exposure; baseline, midline, endline	Early and unintended pregnancy; SRH outcomes	Pregnancy declined significantly in intervention arms: arm 2 0.74% at endline, p<0.001; arm 3 1.34%, p<0.001; no significant decline in CSE-only control.

Michielsen et al. (2012) (Michielsen et al., 2012)	Rwanda	Non-randomized controlled trial	n=1,950 secondary-school students	Peer-led HIV prevention	Peer education	Control schools	Baseline, 6-, and 12-month surveys	Sexual activity; condom use; HIV knowledge; stigma	No significant intervention effect on sexual risk behavior, HIV knowledge, perceived severity, or susceptibility; significantly reduced reported stigma.
Millanzi et al. (2022) (Millanzi et al., 2022)	Tanzania	Cluster RCT	n=660 adolescents; mean age 15 years	RH lesson materials in problem-based pedagogy	Problem-based pedagogy	Lecture-based pedagogy control	Baseline, immediate post-intervention, 3- and 6-month follow-up	Soft skills; abstinence intention; condom negotiation; coercion resistance	Hybrid PBP improved soft skills β=9.0986, p<0.01, 95% CI 4.7772–14.2311; pure PBP β=8.7114, p<0.01, 95% CI 3.9990–10.1208; retained at 3 months β=2.0044, p<0.01 and 6 months β=1.9803, p<0.01.
Mmbaga et al. (2017) (Mmba	Tanzania	Cluster RCT	n=5,091; mean age	PREPARE school-based SRH	Theory-based behavior change	Control schools	Baseline, 6-, and 12-	Sexual initiation; condom	Significant effect on delaying sexual

ga et al., 2017)			12.4 years	intervention	intervention		month follow-up	use; action planning	initiation; condom-use action planning improved among girls p=0.042; actual condom use improved among boys p=0.004, not girls p=0.463.
Morrison-Beedy et al. (2013) (Morrison-Beedy et al., 2013)	USA	RCT	n=738 sexually active urban adolescent girls	Theory-based sexual risk-reduction intervention + boosters	Social-cognitive / IMB-informed SRR	Health promotion control	4 sessions + 2 booster sessions; 3-, 6-, and 12-month follow-up	Abstinence; vaginal sex; unprotected sex; partners; pregnancy	Intervention increased abstinence; reduced vaginal sex at all follow-ups; reduced unprotected vaginal sex at 3 and 12 months; reduced partners at 6 months; pregnancy tests reduced by 50% at 12 months in clinical subsample.
Mwale & Muula	Malawi	Quasi-experi	n=305 schoo	Peer education HIV risk-	Peer education	Health promotion package	8-month	Sexual activity; condom	Intervention group was less

(2019) (Mwale & Muula, 2019)		mental	l-going adolescents	reduction intervention			follow-up	use; multiple partners; abstinence	likely to have sex OR=0.04, 95% CI 0.01–0.20; more likely to report condom use OR=3.49, 95% CI 0.96–12.65; lower odds of multiple partners; abstinence not significant.
Nkrumah et al. (2025) (Nkrumah et al., 2025)	Ghana	Quasi-experimental	n=317 adolescents; 11–15 years	SRH educational materials with varying difficulty levels	Health literacy / educational materials design	Control group	6 weekly sessions; endline and 8-week post-intervention evaluation	SRH decision-making skills	Decision-making improved in difficult text 10.808 points, 95% CI 1.2–20.36, p=0.027, simplified text 11.60 points, 95% CI 4.68–18.52, p=0.001, and picture-enhanced text 11.145 points, 95% CI 3.96–

									18.32, p=0.002.
Phillib er (2021) (Phillib er, 2021)	US A	Clust er RCT	n=1,4 01 LGB TQ youth	IN$clued sex education program	LGBTQ-inclusive sexual health education	Control group	Works hop; 1-year follow -up	Knowledg e, healthcare self-efficacy, sexual healthcare use, unprotect ed sex	Reduced vaginal sex without condom; increased knowledg e and healthcar e self-efficacy; increased contracep tion/birt h control receipt.
Pinand ari et al. (2023) (Pinan dari et al., 2023)	Ind ones ia	Quasi - experi menta l	n=3,3 35 stude nts; 10–14 years	Rights-based teacher-led CSE	Rights-based CSE	Matched control schools	2-year interve ntion; post-test	Knowledg e, gender attitudes, SRHR communi cation, self-efficacy	Improved pregnanc y knowledg e, gender-equal attitudes, SRHR communi cation, and pregnanc y-preventio n self-efficacy versus control.
Reyna & Mills (2014) (Reyna & Mills, 2014)	US A	RCT	n=73 4 adoles cents	RTR+ fuzzy-trace theory enhanced curriculu m	Fuzzy-Trace Theory	RTR and control	1-year follow -up	Sexual initiation, intentions, attitudes, norms, self-efficacy	RTR+ improved 17/26 outcomes ; RTR improved 12/26. RTR+ effects were greater than RTR for 9

									outcomes and remained significant versus control for 12 outcomes at 1 year.
Tabarsa et al. (2024) (Tabarsa et al., 2024)	Iran	RCT	n=50 adolescent girls	EPPM-based sexual risk education	Extended Parallel Process Model	Control group	Pre-post intervention	High-risk sexual behavior	Post-intervention difference significant $p<0.01$; ANCOVA remained significant after controlling baseline $\eta=0.27$, $p<0.01$.
Thamaraksa et al. (2025) (Thamaraksa et al., 2025)	Thailand	Quasi-experimental	n=60 female adolescents; 13–15 years	STOPMRB mobile application + text messages	Theory of Planned Behavior	Standard education curriculum	8 weeks; assessments at weeks 4 and 8	MRB, perceived behavioral control, intention	Higher perceived behavioral control $p<0.001$ and intention to avoid MRB $p<0.001$ at weeks 4 and 8; no MRB reported in intervention vs 6.7% control $p=0.492$.
Tingey et al. (2017) (Tinge	USA	Cluster RCT	n=267 American	Respecting the Circle of Life SRH	Theoretical constructs: self-efficacy,	Control group	Post-intervention and	Condom-use intention, self-	Condom-use intention improved

y et al., 2017)			Indian adolescents; 13–19 years	intervention	response efficacy, severity		additional follow-up	efficacy, response efficacy	post-intervention RR=1.39, p=0.008; stronger among ages 13–15 RR=1.42, p=0.007 and sexually inexperienced adolescents RR=1.44, p=0.01.
Villa-Rueda et al. (2022) (Villa-Rueda et al., 2022)	Mexico	Quasi-experimental	Mexican adolescents	"Usando Condón" condom-use intervention	Theory-based intervention	Control/comparison group	Pre-post intervention	Condom-use self-efficacy	Improved perceived self-efficacy for condom use among adolescents; exact statistical values need extraction from results table.
Widman et al. (2018) (Widman et al., 2018)	USA	RCT	n=222 tenth-grade girls; mean age 15.2 years	HEART web-based sexual health program	Theory-based online program	Attention-matched control	Single online program; immediate post-test and 4-month follow-up	Assertiveness, decision-making, knowledge, norms, condom self-efficacy	Improved assertiveness skills, self-reported assertiveness, communication intentions, HIV/STD

									knowledge, safer sex norms/attitudes, and condom self-efficacy post-test; knowledge, condom attitudes, and condom self-efficacy remained at 4 months.
Wong et al. (2017) (Wong et al., 2017)	Singapore	RCT	n=688 sexually active adolescents; 16–19 years	Skills-based abstinence and safer sex intervention	PRECEDE-PROCEED; Self-efficacy theory	Usual STI clinic care	2 onsite sessions + online/phone support; 6-month follow-up	Abstinence, partners, condom use	Young men more likely to report secondary abstinence aRR=2.03, 95% CI 1.25–3.30; non-abstinent young women more likely to keep one partner aRR=1.25, 95% CI 1.04–1.50; no effect on consistent condom use.

Yakubu et al. (2019) (Yakubu et al., 2019)	Ghana	Cluster RCT	n=363 adolescent girls; 13–19 years	HBM-based abstinence education	Health Belief Model	Normal classes/control	1-month intervention; 3-month follow-up	Knowledge, attitude, sexual abstinence	Sexual abstinence significantly higher in intervention group OR=13.89, 95% CI 2.46–78.18, p<0.003.

Characteristics of Included Studies

A total of 40 experimental studies met the eligibility criteria and were included in this systematic review. The included studies were published between 2002 and 2025 and comprised 28 RCTs/cluster RCTs (Akande et al., 2024; Barbee et al., 2016; Constantine et al., 2015; Coyle et al., 2013; Darabi et al., 2017; Gibson et al., 2020; Gómez-Lugo et al., 2022; Haruna et al., 2018; Jemmott et al., 2005, 2010; Jerlström & Adolfsson, 2020; Kemigisha et al., 2019; Maduakolam et al., 2022; Markham et al., 2012; Mathews et al., 2016; Mbizvo et al., 2023; Millanzi et al., 2022; Mmbaga et al., 2017; Morrison-Beedy et al., 2013; Oman et al., 2018; Philliber, 2021; Reyna & Mills, 2014; St Lawrence et al., 2002; Tabarsa et al., 2024; Tingey et al., 2017; Widman et al., 2018; Wong et al., 2017; Yakubu et al., 2019) and 12 quasi-experimental or non-randomized controlled studies (Awotidebe et al., 2014; Boontem et al., 2019; Haruna et al., 2021; Jeihooni et al., 2018; Li et al., 2011; Ma et al., 2022; Michielsen et al., 2012; Mwale & Muula, 2019; Nkrumah et al., 2025; Pinandari et al., 2023; Thammaraksa et al., 2025; Villa-Rueda et al., 2022).

The interventions included theory-based education, innovative education, and comprehensive sexuality education. Several studies explicitly used behavioral theories such as TPB, HBM, IMB, SCT, PMT, Fuzzy-Trace Theory, EPPM, and rights-based frameworks (Constantine et al., 2015; Darabi et al., 2017; Gibson et al., 2020; Jeihooni et al., 2018; Pinandari et al., 2023; Reyna & Mills, 2014; Tabarsa et al., 2024; Yakubu et al., 2019). Innovative delivery methods included game-based learning, gamification, mHealth, web-based education, multimedia learning, theater-based education, problem-based pedagogy, peer education, and sport-based education (Akande et al., 2024; Awotidebe et al., 2014; Haruna et al., 2018, 2021; Jerlström & Adolfsson, 2020; Markham et al., 2012; Michielsen et al., 2012; Millanzi et al., 2022; Mwale & Muula, 2019; Widman et al., 2018).

Participants were adolescents aged 10–19 years, with sample sizes ranging from small school-based trials to large cluster trials involving thousands of students. Most studies recruited school-going adolescents, while others focused on specific or vulnerable groups, including sexually active girls, LGBTQ+ youth, adolescents in juvenile justice or group care settings, American Indian adolescents, and clinic-attending adolescents (Gibson et al., 2020; Jemmott et al., 2005; Morrison-Beedy et al., 2013; Oman et al., 2018; Philliber, 2021; Tingey et al., 2017; Wong et al., 2017). Outcomes commonly included SRH knowledge, attitudes, self-efficacy, intentions, condom use, abstinence, sexual initiation, number of partners, contraceptive use, risky sexual behavior, and pregnancy-related outcomes (Gómez-Lugo et al., 2022; Jemmott et al., 2010; Markham et al., 2012; Mbizvo et al., 2023; Mmbaga et al., 2017; Oman et al., 2018; Yakubu et al., 2019).

The Result of Quality and Risk of Bias Assessment

Summary of Risk of Bias Assessment

Tabel 4. Quality Appraisal for RCT

Study	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q1 0	Q1 1	Q1 2	Q1 3	Overall
Haruna 2018	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate
Akande 2024	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Barbee 2016	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Constantine 2015	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Coyle 2013	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Darabi 2017	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Gibson 2020	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Gómez-Lugo 2022	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Jemmott 2005	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Jemmott 2010	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Jerlström 2018	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Kemigisha 2019	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Lawrence 2002	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Maduakolam 2022	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Markham 2012	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Mathews 2016	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Mbizvo 2023	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Millanzi 2022	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	High
Mmbaga 2017	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High

Morrison-Beedy 2013	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Oman 2018	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Philliber 2021	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Reyna & Mills 2014	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Tabarsa 2024	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate
Tingey 2017	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Widman 2018	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Wong 2017	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High
Yakubu 2019	Y	U	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	Moderate –High

Table 5. Quality Appraisal for Quasi Experimental studies

Study	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Overall**
Awotidebe et al. (2014)	Y	Y	Y	Y	Y	N	Y	Y	Y	Moderate
Boontem et al. (2018/2019)	Y	N	Y	Y	N	Y	Y	Y	Y	Moderate
Haruna et al. (2021)	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Jeihooni et al. (2018)	Y	Y	Y	Y	N	Y	Y	Y	Y	Moderate–High
Li et al. (2011)	Y	Y	Y	Y	N	Y	Y	Y	Y	Moderate–High
Ma et al. (2021)	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Michielsen et al. (2012)	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Mwale & Muula (2019)	Y	Y	Y	Y	U	Y	Y	Y	Y	Moderate–High
Nkrumah et al. (2025)	Y	Y	Y	Y	Y	Y	Y	Y	Y	High

Pinandari et al. (2023)	Y	Y	Y	Y	N	Y	Y	Y	Y	Moderate–High
Thammaraksa et al. (2025)	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Villa-Rueda et al. (2022)	Y	U	Y	Y	N	U	Y	Y	Y	Moderate

Summary of Risk of Bias Assessment

The methodological quality of the 12 quasi-experimental studies was assessed using the ROBINS-I tool (Figure 2). Overall, 11 studies were judged to have a moderate risk of bias, while one study was rated as having a serious risk of bias. The most common sources of bias were confounding, participant selection, and outcome measurement, reflecting the inherent limitations of non-randomized study designs and the reliance on self-reported behavioral outcomes. No study was classified as having a critical risk of bias.

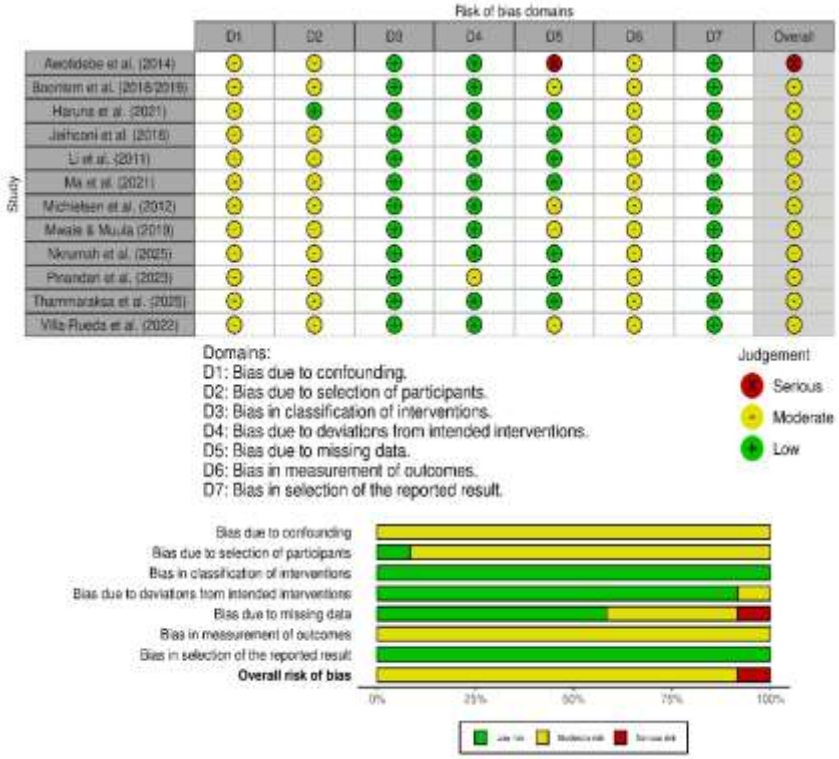


Figure 2. Traffic light plot of Quasi Experimental studies (n=12)

The risk of bias of the 28 randomized controlled trials was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool (Figure 3). Overall, 27 studies were judged as having some concerns, while one study (Wong et al., 2017) was classified as having a high risk of bias. The most common concerns were related to the randomization process, outcome measurement, and selection of reported results, largely due to insufficient reporting of allocation concealment, reliance on self-reported behavioral outcomes, and limited information on pre-specified analysis protocols.

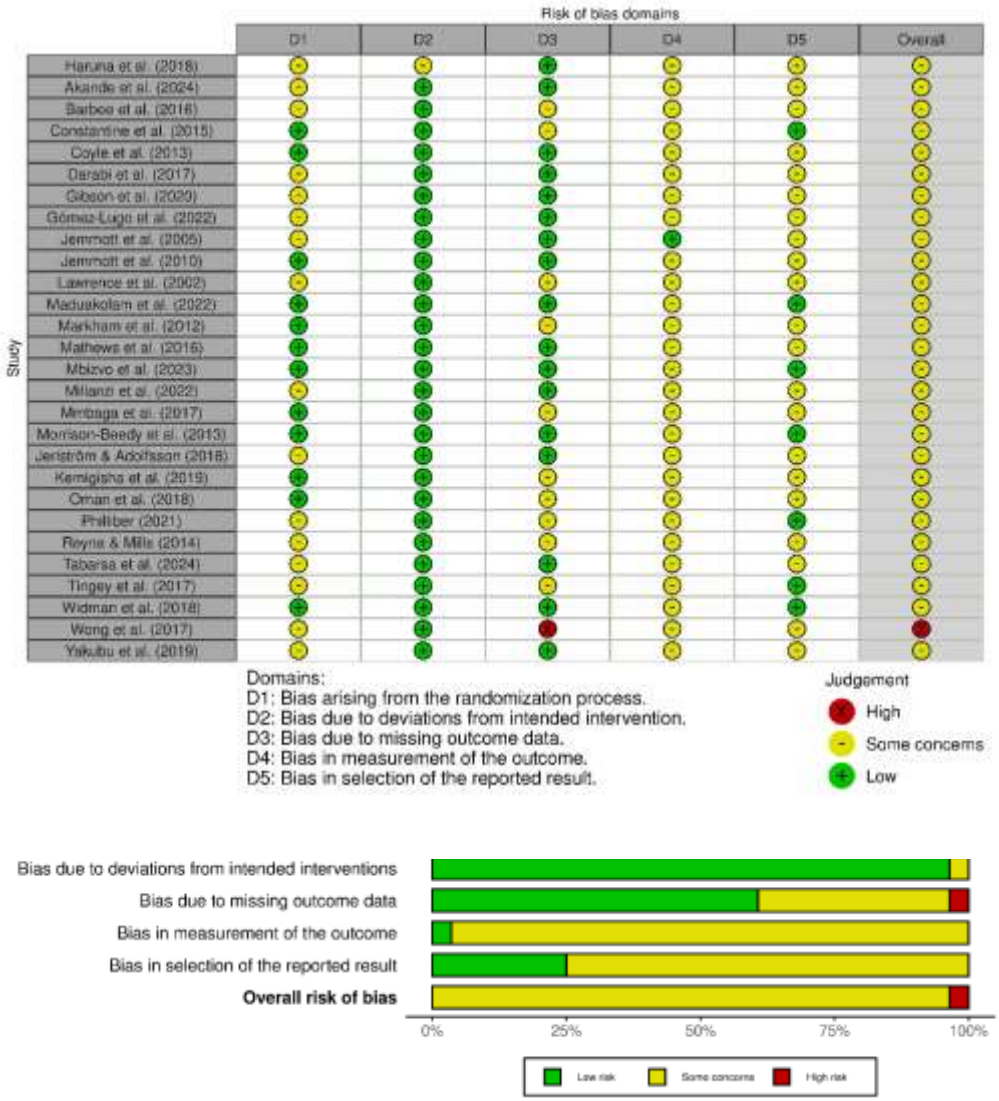


Figure 3. Traffic-Light plot of RCT studies (n=28)

Effects of Educational Interventions on Sexual and Reproductive Health Outcomes

Effects on Sexual and Reproductive Health Knowledge

Sexual and reproductive health (SRH) knowledge was the most consistently improved outcome across the included studies. Significant improvements were observed following both theory-based educational interventions, including those grounded in the Theory of Planned Behavior (TPB), Health Belief Model (HBM), Information–Motivation–Behavioral Skills (IMB) model, Social Cognitive Theory (SCT), Fuzzy-Trace Theory, and the Extended Parallel Process Model (EPPM), as well as innovative educational approaches such as game-based learning, gamification, mHealth, web-based education, peer education, sport-based education, theater-based learning, and problem-based learning (Akande et al., 2024; Awotidebe et al., 2014; Darabi et al., 2017; Gibson et al., 2020; Haruna et al., 2018, 2021; Jeihooni et al., 2018; Jemmott et al., 2005; Jerlström & Adolfsson, 2020; Michielsen et al., 2012; Millanzi et al., 2022; Mwale & Muula, 2019; Nkrumah et al., 2025; Philliber, 2021; Reyna & Mills, 2014; St Lawrence et al., 2002; Tabarsa et al., 2024; Yakubu et al., 2019). Studies integrating behavioral theories with innovative delivery methods similarly demonstrated substantial improvements in SRH knowledge, particularly when comprehensive sexuality education was delivered through multimedia platforms, digital technologies, or interactive classroom activities (Gómez-Lugo et al., 2022; Kemigisha et al., 2019; Markham et al., 2012; Mbizvo et al., 2023; Thammaraksa et al., 2025; Widman

et al., 2018; Wong et al., 2017). Overall, despite variation in intervention characteristics and assessment methods, the evidence consistently indicates that educational interventions effectively improve adolescents' SRH knowledge.

Effects on Attitudes toward Sexual and Reproductive Health

Attitudes toward sexual and reproductive health (SRH) generally improved following educational interventions across the included studies. Positive attitudinal changes were consistently reported after both theory-based interventions, including those based on the Theory of Planned Behavior (TPB), Health Belief Model (HBM), Social Cognitive Theory (SCT), Information–Motivation–Behavioral Skills (IMB) model, Fuzzy-Trace Theory, and the Extended Parallel Process Model (EPPM), and innovative educational approaches such as game-based learning, peer education, sport-based education, theater-based learning, digital learning, mHealth, and problem-based learning (Akande et al., 2024; Awotidebe et al., 2014; Darabi et al., 2017; Gibson et al., 2020; Haruna et al., 2018, 2021; Jeihooni et al., 2018; Jemmott et al., 2005; Jerlström & Adolfsson, 2020; Michielsen et al., 2012; Millanzi et al., 2022; Mwale & Muula, 2019; Nkrumah et al., 2025; Philliber, 2021; Reyna & Mills, 2014; St Lawrence et al., 2002; Tabarsa et al., 2024; Yakubu et al., 2019). Interventions combining behavioral theories with innovative delivery methods likewise demonstrated significant improvements in attitudes toward HIV prevention, condom use, gender equality, healthy relationships, and responsible sexual decision-making through multimedia, web-based, and school-based educational programs (Gómez-Lugo et al., 2022; Kemigisha et al., 2019; Markham et al., 2012; Mbizvo et al., 2023; Thammaraksa et al., 2025; Widman et al., 2018; Wong et al., 2017). Overall, despite variations in intervention characteristics and cultural settings, the evidence consistently indicates that educational interventions effectively foster positive attitudes supporting healthy sexual and reproductive health behaviors among adolescents.

Effects on Self-Efficacy

Self-efficacy was one of the most consistently improved psychosocial outcomes across the included studies. Significant improvements were observed following theory-based educational interventions, including those based on the Theory of Planned Behavior (TPB), Health Belief Model (HBM), Information–Motivation–Behavioral Skills (IMB) model, Social Cognitive Theory (SCT), Protection Motivation Theory (PMT), Fuzzy-Trace Theory, and the Extended Parallel Process Model (EPPM), as well as innovative educational approaches such as game-based learning, web-based education, mHealth, peer education, sport-based interventions, theater-based education, and LGBTQ+-inclusive sexuality education (Akande et al., 2024; Awotidebe et al., 2014; Darabi et al., 2017; Gibson et al., 2020; Haruna et al., 2018, 2021; Jeihooni et al., 2018; Jemmott et al., 2005; Jerlström & Adolfsson, 2020; Michielsen et al., 2012; Millanzi, 2022; Morrison-Beedy et al., 2013; Mwale & Muula, 2019; Nkrumah et al., 2025; Philliber, 2021; Reyna & Mills, 2014; St Lawrence et al., 2002; Tabarsa et al., 2024; Tingey et al., 2017; Yakubu et al., 2019). Studies combining behavioral theories with innovative educational delivery similarly reported substantial gains in adolescents' confidence to negotiate safer sexual practices, refuse unwanted sexual activity, communicate with sexual partners, and access SRH services through multimedia, digital, and school-based programs (Gómez-Lugo et al., 2022; Kemigisha et al., 2019; Markham et al., 2012; Mbizvo et al., 2023; Thammaraksa et al., 2025; Widman et al., 2018; Wong et al., 2017). Overall, the evidence indicates that educational interventions consistently strengthen adolescents' self-efficacy across diverse educational settings and intervention approaches.

Effects on Behavioral Intentions

Behavioral intentions improved in several studies, but effects were not universal. Constantine et al. (2015) reported no significant effect on condom-use intention despite improvements in several other psychosocial outcomes. Tingey et al. (2017) reported improved condom-use intention immediately after the intervention, whereas Thammaraksa et al. (2025) reported improved intentions at weeks 4 and 8 without a statistically significant difference in the measured multiple-risk-behavior outcome. Intention is a proximal psychosocial endpoint and should not be interpreted as observed condom use, abstinence, or sustained risk reduction (Table 3).

Effects on Communication and Negotiation Skills

Communication and negotiation skills consistently improved following both theory-based and innovative educational interventions. Theory-based interventions grounded in the Theory of Planned Behavior (TPB), Information–Motivation–Behavioral Skills (IMB) model, Social Cognitive Theory (SCT), Protection Motivation Theory (PMT), and Fuzzy-Trace Theory significantly enhanced adolescents' ability to communicate about sexual and reproductive health (SRH), negotiate condom use, refuse unwanted sexual activity, and discuss sexual health issues with partners, parents, and healthcare providers (Darabi

et al., 2017; Gibson et al., 2020; Jemmott et al., 2005; Morrison-Beedy et al., 2013; Reyna & Mills, 2014; St Lawrence et al., 2002; Tingey et al., 2017; Yakubu et al., 2019). Similar improvements were observed following innovative educational approaches, including game-based learning, web-based education, peer education, sport-based interventions, theater-based learning, mHealth, and LGBTQ+-inclusive sexuality education, as well as interventions integrating behavioral theories with multimedia, digital, and school-based educational strategies (Akande et al., 2024; Awotidebe et al., 2014; Gómez-Lugo et al., 2022; Haruna et al., 2018, 2021; Jerlström & Adolfsson, 2020; Kemigisha et al., 2019; Markham et al., 2012; Mbizvo et al., 2023; Michielsen et al., 2012; Millanzi, 2022; Mwale & Muula, 2019; Philliber, 2021; Thammaraksa et al., 2025; Widman et al., 2018; Wong et al., 2017). Overall, educational interventions consistently strengthened adolescents' communication and negotiation skills, supporting healthier sexual decision-making across diverse educational settings.

Effects on Condom Use and Contraceptive Behaviors

Evidence for actual condom use and contraceptive behavior was mixed and depended on the endpoint. Gómez-Lugo et al. (2022) reported improvement in condom use at last vaginal intercourse at six months but no significant effect on consistent condom use. Wong et al. (2017) likewise found no effect on consistent condom use at six months. Mmbaga et al. (2017) reported improvement in actual condom use among boys but not girls. Oman et al. (2018) reported lower odds of sex without birth control at six months. These findings support benefits for selected outcomes and populations, rather than a uniform improvement in consistent protective behavior across studies (Table 3).

Effects on Sexual Initiation and Abstinence

Findings for sexual initiation and abstinence varied across studies and follow-up periods. Markham et al. (2012) reported delayed initiation in the risk-reduction arm, while Jemmott et al. (2010) reported reduced vaginal intercourse during follow-up. Kemigisha et al. (2019), however, reported no significant effect on sexual debut, and Mathews et al. (2016) found no significant effect on sexual risk behaviors at 12 months. Wong et al. (2017) reported secondary abstinence among young men, an endpoint that differs from preventing first sexual intercourse. Abstinence intentions and negotiation skills were not treated as evidence of actual abstinence (Table 3).

Effects on Risky Sexual Behaviors

Reductions in sexual risk behavior were reported in some trials, but were not consistently maintained or replicated. Jemmott et al. (2005) reported less unprotected sex at 12 months, and Morrison-Beedy et al. (2013) reported reductions in unprotected vaginal sex at three and 12 months. In Coyle et al. (2013), effects diminished by the final follow-up. Michielsen et al. (2012) reported no significant intervention effect on sexual risk behavior. Follow-up benefits in selected trials therefore support the possibility of maintained behavioral effects, but do not establish sustained effectiveness across all approaches. Pregnancy and STI outcomes were interpreted separately from self-reported behaviors because these clinical outcomes do not identify which behavioral pathway changed (Table 3).

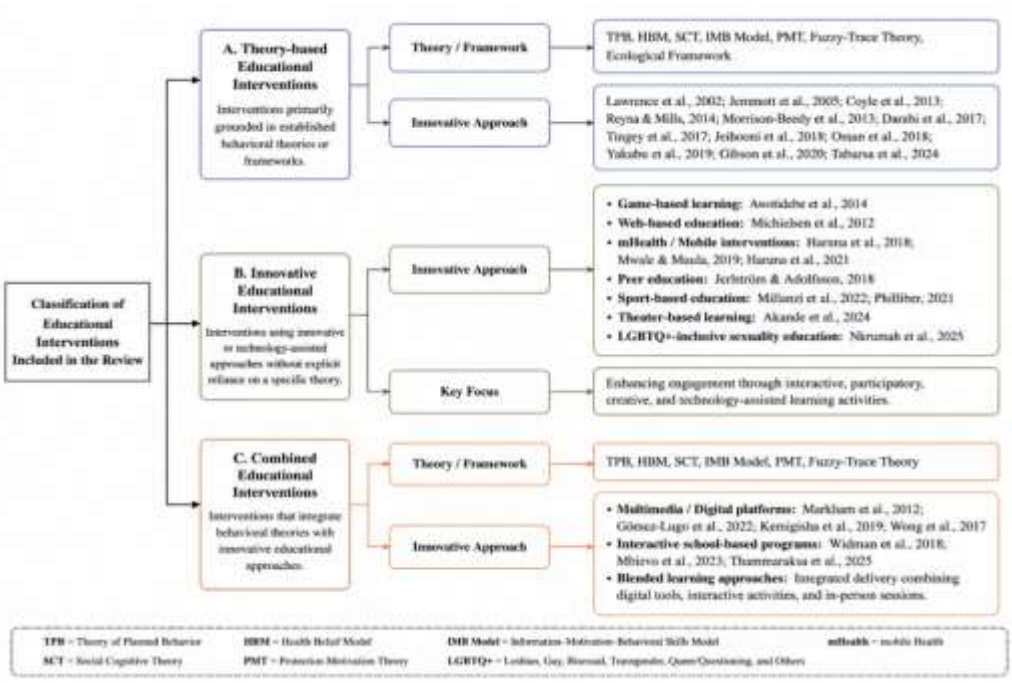


Figure 4. Taxonomy of Educational Interventions Included in the Systematic Review

3.4 Discussion

This review synthesized 40 experimental studies of adolescent sexual and reproductive health education. Improvements were reported more frequently for knowledge and proximal psychosocial outcomes than for actual sexual behavior. Behavioral effects were mixed across endpoints, populations, and follow-up periods, including null findings and effects that diminished over time. Theory-informed and innovative delivery approaches are promising, but the heterogeneous evidence does not establish that combined interventions produce broader or more sustained benefits than other approaches.

The consistent improvement in psychosocial outcomes observed in this review is supported by established theories of health behavior. Models such as the Theory of Planned Behavior, Health Belief Model, Social Cognitive Theory, Information–Motivation–Behavioral Skills model, Protection Motivation Theory, and Fuzzy-Trace Theory all propose that behavior change begins with improvements in knowledge, beliefs, motivation, perceived control, and behavioral skills before observable behavioral modification occurs. Innovative educational approaches, including digital learning, gamification, peer education, and multimedia-based interventions, likely strengthened these processes by increasing learner engagement, active participation, and opportunities for repeated skills practice. These findings are consistent with previous systematic reviews reporting that comprehensive sexuality education and technology-assisted interventions effectively improve adolescents' SRH knowledge, attitudes, and self-efficacy while enhancing communication and decision-making skills (Sell et al., 2023; Setiyorini et al., 2025). Collectively, the available evidence suggests that educational interventions are particularly effective in modifying proximal psychosocial determinants that precede behavioral change.

In contrast, behavioral outcomes were generally less responsive than psychosocial outcomes. Although many studies reported improvements in condom use, contraceptive behaviors, delayed sexual initiation, and reductions in risky sexual behaviors, these effects were less consistent and often smaller in magnitude. This discrepancy reflects the complex nature of adolescent sexual behavior, which is influenced not only by individual knowledge and motivation but also by interpersonal relationships, peer norms, parental communication, gender dynamics, cultural expectations, religious values, socioeconomic conditions, and access to adolescent-friendly health services. Consequently, educational interventions alone may be insufficient to achieve sustained behavioral change. Similar observations have been reported in previous reviews and international guidance, which emphasize that comprehensive sexuality education is most effective when integrated with supportive family, school, community, and healthcare environments (Jämiä et al., 2024; Kim et al., 2023).

Integrating theoretical content and educational delivery within one descriptive framework helps identify potentially useful program components. However, interventions also differed in design, comparator intensity, participant risk, setting, dose, and outcome measurement. These differences prevent attribution of apparent advantages to an intervention category alone. Without direct comparisons isolating these components, superiority of combined approaches and the independent contribution of behavioral theory remain uncertain.

Cultural context may influence both engagement and the opportunity to enact safer behavior. Gender norms, religious expectations, family communication, stigma, and norms surrounding premarital sexuality may affect curriculum acceptability, willingness to disclose sexual activity, and condom negotiation. Table 3 includes culturally adapted education in China and programs tailored to American Indian and LGBTQ youth in the USA; these contextual adaptations do not establish that the same effects would occur in other populations. Differences between countries should therefore be interpreted as contextual observations rather than evidence that culture causally moderated effectiveness.

Intervention duration, intensity, and implementation fidelity may also help explain differences in findings. A single online session, repeated classroom sessions, booster-supported skills training, and a multiyear program represent different exposure opportunities. Duration alone does not demonstrate sufficient dose or fidelity: attendance, facilitator training, adherence to core content, participant engagement, and contamination between groups may alter the intervention actually received. These features were not systematically summarized in the available extraction, so their contribution cannot be quantified. Null findings may reflect either limited intervention effectiveness or incomplete implementation, while positive effects under supported trial conditions may not transfer to routine delivery.

Access to adolescent-friendly health services may determine whether knowledge and intentions translate into protective action. Confidentiality, affordability, nonjudgmental care, availability of contraception and condoms, and practical referral pathways can affect opportunities to use newly acquired skills. Mbizvo et al. (2023) evaluated sexuality education linked to SRH services, illustrating that educational and service components can coexist. Such evidence should be interpreted as a multicomponent intervention rather than an isolated educational effect; pregnancy reductions cannot be attributed to education alone. Service access was not measured consistently across studies and therefore remains a plausible contextual explanation rather than a demonstrated review-level moderator.

Interpretation is limited by clinical and methodological heterogeneity and differences in study quality. The reported RoB 2 results classified 27 randomized studies as having some concerns and one as high risk; ROBINS-I classified 11 non-randomized studies as moderate risk and one as serious risk. Thus, positive findings cannot be treated as uniformly robust causal evidence. Non-randomized comparisons are vulnerable to residual confounding, whereas cluster trials require appropriate recruitment and cluster-adjusted analyses. Self-reported sexual behavior is susceptible to recall and social desirability bias, potentially varying by cultural setting. Different instruments, recall periods, comparator conditions, and follow-up times precluded a common quantitative estimate. Knowledge or intention gains immediately after education do not establish sustained behavior change, and improvements at one later assessment do not establish continuous maintenance or persistence beyond the observed follow-up. English-language and peer-reviewed-publication restrictions may have omitted relevant evidence. Incomplete reporting of fidelity and service access further limits explanation of variation. The synthesis therefore supports cautious, outcome-specific conclusions rather than an overall ranking of intervention effectiveness.

The findings of this review have important implications for research and practice. Future adolescent SRH programs should integrate evidence-based behavioral theories with innovative and learner-centered educational strategies to strengthen both psychosocial and behavioral outcomes. Educational interventions should also extend beyond schools by involving families, healthcare providers, and communities to address the broader social and environmental determinants of adolescent sexual behavior. Future research should prioritize rigorously designed randomized controlled trials with longer follow-up periods, standardized outcome measures, and objective assessments of behavioral outcomes. Evaluating implementation strategies and cost-effectiveness across diverse sociocultural settings will also be essential for supporting the large-scale adoption of effective educational interventions.

4. CONCLUSION

Theory-based and innovative educational interventions can improve adolescent SRH knowledge and selected psychosocial outcomes. Evidence for actual condom use, contraceptive behavior, delayed initiation, abstinence, and reduced sexual risk is

mixed, with maintained benefits documented only for selected outcomes in some studies. The available narrative comparisons do not establish the superiority of combined interventions or durable behavioral change across settings. Interpretation requires attention to study design and risk of bias, cultural context, intervention dose and fidelity, assessment timing, and access to adolescent-friendly services.

Future adolescent SRH programs should adopt comprehensive, theory-informed, and learner-centered approaches that actively involve families, schools, communities, and healthcare services. Further high-quality randomized controlled trials with longer follow-up periods and standardized outcome measures are needed to strengthen the evidence base and evaluate the long-term effectiveness of integrated educational interventions

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AUTHOR CONTRIBUTIONS

Dian Hariani Salamena: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing—Original Draft.

Anwar Mallongi: Methodology, Validation, Formal Analysis, Writing—Review & Editing.

Shanti Riskiyani: Supervision, Project Administration, Validation, Writing—Review & Editing. All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

Ethical approval was not required for this study because it is a systematic review of previously published studies and involved no direct contact with human participants or collection of new personal data.

DATA AVAILABILITY STATEMENT

No new datasets were generated for this study. The data analyzed were extracted from the published studies listed in the References and are summarized in Tables 1–5 and Figures 1–4. The completed extraction form and the full search strategies are available from the corresponding author upon reasonable request.

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