Feasibility and impact of school-based online comprehensive sexuality education on Vocational High School Students: a cluster-randomized controlled trial

MA Haocan Sun[a,b], MPH Shuangyu Zhao[a], PHD Hanxiyue Zhang[a], DPhil Kun Tang[a]*

[a] *Vanke School of Public Health, Tsinghua University, Beijing, China*

[b] *School of Journalism and Communication, Beijing Normal University, Beijing, China*

*corresponding author

TEL: +86 13671129425

Email: tangk@mail.tsinghua.edu.cn

Vanke School of Public Health, Tsinghua University, No. 30, Shuangqing Road, Haidian District, Beijing, 100084, PR China

Funding/Support: This study was funded by the Kadoorie Charitable Foundation.

Declaration of interests: The authors report that there are no competing interests to declare.

Trial Registration No: ChiCTR1900021582

Acknowledgements: The authors would like to acknowledge all the volunteers, teachers, as well as the Kadoorie Charitable Foundation, Kunming Family Planning Association and Health and Health Care Center for Adolescents in Zhongshan. Special thanks to the Xi'an Guangyuan Assistance Charity Centre.

Keywords: Online comprehensive sexuality education, vocational high school, cluster-randomized controlled trial, education equity

Author Contributions: K.T. and H.Z. contributed to the conceptualization and design of the study. H.Z. was involved in the acquisition of the data. H.S. conducted the statistical analysis. H.S. and S.Z. interpreted the result. H.S. contributed to the initial drafting of the manuscript, while S.Z., H.Z., and K.T. all provided critical revisions for content.

Feasibility and Impact of School-Based Online Comprehensive Sexuality Education on Vocational High School Students: A Cluster-Randomized Controlled Trial

To assess the effect of an online CSE package for vocational high school students in China's developed and less-developed regions, a parallel, unblinded, cluster, randomized controlled trial was conducted. The study included 3,415 tenth-grade students from 29 mixed-gender vocational high schools who had not previously received CSE. The intervention group participated in weekly classes over two months, totaling 360 minutes of online CSE. For the primary outcomes, the intervention group exhibited improvements in sexuality knowledge and attitude post-intervention and one year later. However, after one year, the positive effects are less than post-intervention. In addition, the intervention group's growth rate of sexuality knowledge and attitude is not limited by the initial level. In the secondary outcomes, compared with the control group, the online CSE resulted in a higher frequency of intercourse, harassment coping self-efficacy in both post-intervention and one year later, and school bully perception only in post-intervention. There were no significant between-group differences in the growth of STD symptoms, contraceptive usage, unintended pregnancy, and self-efficacy. Finally, curriculum progress positively impacts the slope of sexuality knowledge. Results suggest that more sustained CSE is necessary for vocational high school students in China. Online CSE presents a feasible solution to enhance sexuality knowledge and attitude and bridge the gap in developmental and sexuality education levels. However, behaviors and well-being outcomes did not yield consistent positive results.

Introduction

Significant gaps and inadequacies have long marked China's sex education. Despite growing public awareness of sexual health issues in recent years, the nationwide implementation of comprehensive sex education (CSE) remains challenging and inconsistent (Z. Zou et al., 2023).

Firstly, there is a shortage of qualified sexuality education teachers in China, and many hold traditional, conservative views on sexuality or face external pressures that influence their teaching (Zhao et al., 2020). Furthermore, pre-service teacher education programs in China tend to focus on knowledge while often neglecting practical teaching skills (Xiong et al., 2020). Schools also lack standardized teaching materials and guidelines (Ji & Reiss, 2022), leading to superficial courses primarily focusing on physiology. The psychosexual and sociosexual aspects are often downplayed to align with biosexual norms that reflect traditional cultural values (Liang et al., 2017). In many cases, sexuality education is merged with physiology courses taught by untrained teachers (Liu, 2022; Z. Zou et al., 2023).

Moreover, traditional Chinese culture, deeply influenced by puritanical Confucian norms (Ho et al., 2018; Li et al., 2009), further contributes to unclear standards for sexuality education. Teachers may discourage any form of sexual contact, warning students that it leads to moral corruption (Liu, 2022) and in some cases, even promote sexual abstinence (W. Zou et al., 2023). This lack of comprehensive education fails to adequately prepare adolescents to understand sexual health and rights or to navigate the complexities of adolescence.

Adolescence is a critical period associated with increased risks of problematic behaviors such as pornography use (Chen, 2022), sexting (Steinberg et al., 2019), condomless sex (Szucs et al., 2020), and multiple sexual partners (Huang et al., 2011; Rossi et al., 2017). A study conducted in China, including 109,754 students from 18 provinces in grades 10 to 12, found that 4.8% of adolescents reported having had sexual intercourse, with 32.8% of them experiencing forced sex (Song & Ji, 2010).

Notably, the prevalence of sexual intercourse among vocational school students was twice as high compared to students in regular and elite high schools[1] (Song & Ji, 2010). Similar trends were reported in Beijing (10.4% for vocational vs. 4% for regular) (Song et al., 2006), Guangdong (10.1% for vocational vs. 4.8% for regular vs. 3.1% for elite) (Nie et al., 2007), and Xinjiang (8.7% for vocational vs. 3.0% for regular vs. 4.2% for elite) (Wang et al., 2009).

Challenges Faced by Vocational High School Students

Vocational school students lack sexuality knowledge and exhibit negative attitudes toward sexuality (Yu, 2012), which increases their risk of sexually transmitted diseases (Liang et al., 2019; Zhang et al., 2022). However, institutional discrimination and stratification within China's education system pose challenges to promoting CSE in vocational high schools (Fang et al., 2022; Liu, 2022).

Vocational high schools in China have long been marginalized and face systematic discrimination (Schulte, 2013; Zeng, 2024). Students often come from disadvantaged socioeconomic backgrounds, and parents may lack the resources or knowledge to provide adequate sex education (Liu et al., 2011; Wang & Guo, 2019). Additionally, these schools have fewer resources than regular schools, leading to a more severe shortage of qualified teachers. Vocational students are affected by both educational resource deficiencies and social discrimination, creating more significant barriers to acquiring sexual health knowledge and developing healthy sexual attitudes.

---

[1] Vocational high schools focus on vocational training, with students typically having weaker academic backgrounds. Regular high schools offer a more balanced academic curriculum, while key high schools cater to academic elites, aiming to cultivate future high-level talent. These three types of schools differ significantly in terms of social perception, resource allocation, and student development opportunities.

Moreover, institutional discrimination labels vocational high school students as "low-quality" and "cheap labor" within society (Ling, 2015). As a result, many schools and educational institutions neglect the necessity of providing these students with comprehensive and systematic sexuality education. This institutionalized disregard further exacerbates the lack of sexual education among vocational high school students, leaving them even more vulnerable.

Additionally, bullying is rampant in Chinese vocational high schools. A study involving 95,873 students from 85 vocational schools found that 30.4% reported being bullied, 2.9% admitted to bullying others, and 21.7% experienced both (Xu et al., 2020). Another study across 28 schools in seven provinces showed that bullying incidents in vocational schools were 1.19 times higher than in regular schools, with low academic performance worsening the bullying problem (Han et al., 2017). Due to the lack of sex education, many students are unable to recognize behaviors like sexual harassment or discrimination, often dismissing them as jokes. The silence of victims, inadequate school management, and weak legislation have normalized such behaviors (Fei et al., 2022).

These factors marginalize sexuality education in vocational high school curriculums, resulting in students' low interest in learning about sexuality knowledge and poor classroom participation (Liu, 2022). This issue is especially pronounced among lower socioeconomic status groups (Zou et al., 2022) and adolescents in rural areas of western China (Ji et al., 2018; Yu, 2012). Despite the existence of 7,294 vocational high schools in China, with an enrollment of 13.12 million students—representing 33.49% of secondary education students (Ministry of Education, 2023)—this group is often overlooked. Therefore, the primary aim of this study is to focus on vocational high school students by implementing comprehensive sexuality education.

Comprehensive sexuality education and Internet-based medium

CSE is a curriculum-based theoretical framework to equip adolescents with sexuality knowledge, skills, and values, promoting their health, well-being, dignity, respectful relationships, mindful choices, and protecting their rights throughout their lives. (Herat et al., 2018). CSE is increasingly recognized as essential for promoting sexual health and well-being. In 2018, UNESCO and UNFPA launched the Chinese edition of the revised International Technical Guidance on Sexuality Education (ITGSE), which provides evidence-based recommendations for implementing effective CSE programs for learners aged 5 to 18+. Although voluntary, the guidance reflects international best practices and offers a framework adaptable to various national contexts for implementing sexuality education (UNESCO, 2018).

In China, CSE has led to improved knowledge and more positive attitudes toward sexual minorities among college students (Chi et al., 2015). High school students also benefit from CSE, gaining more accurate sexual knowledge, stronger support for nontraditional gender roles, and a greater rejection of sexual double standards immediately after the intervention (Chi et al., 2015; Sa et al., 2021). Additionally, middle school students demonstrate enhanced sexual knowledge, skills, positive attitudes, and self-efficacy following CSE (Jin et al., 2021; Kaidbey et al., 2023; Zhu et al., 2022). However, all these studies focus on the immediate effects of the intervention. Even international studies typically assess post-intervention effects after 3 or 9 months (Manlove et al., 2021; Pinandari et al., 2023), leaving the long-term impact of CSE unclear.

The computer and internet-based approach has become the primary channel through which students acquire sexual knowledge (Jiang & Ha, 2020; Vamos et al., 2020; Yu, 2012). The inherent transparency and openness of this medium challenge China's sexual repression

and promote a more tolerant attitude towards sex (Liu et al., 2020). Although without the framework of CSE, prior research indicates that online platforms for delivering sexual education can enhance knowledge and attitudes toward sexuality (Guse et al., 2012; Lou et al., 2006; Wadham et al., 2019), as well as influencing contraceptive usage, sexual transmission infection testing (Swanton et al., 2015; Widman et al., 2018), and various aspects of sexual self-efficacy (Nurgitz et al., 2021; Roth et al., 2023; Strauss Swanson & Szymanski, 2022). However, these findings often fail to account for adherence to school-based CSE and overlook the progress achieved through online curriculum delivery. Thus, in response to calls for reform and standardization of sexual health education courses (Ferrand, 2023), the secondary aim of this study is to investigate the effects of standardized online school-based CSE on behavioral and well-being outcomes.

The *You and Me* package, developed by Marie Stopes International China (MSIC)[2] based on the ITGSE (UNESCO & WHO, 2018), provides free, standardized online comprehensive sexuality education (OCSE) for adolescents. The program includes eight teacher-facilitated sessions covering topics such as understanding gender, the reproductive system and puberty, pregnancy and contraception, relationships and values, media literacy and well-being skills, disease prevention and behavior, sexual violence, and love and marriage. The Xi'an Guangyuan Assistance Charity Centre, in collaboration with MSIC, was responsible for implementing the project.

As of September 2018, 21,039 students from 24 schools have participated in the *You and Me*. However, there has been a lack of quantifiable assessment of the outcomes. We aim

[2] Marie Stopes International China (MSIC) is a non-profit organization, delivering relevant, informative, cost effective and sustainable sexual and reproductive health (SRH) services and education to improve the health and well-being of youth (age 13-24).

to address whether the *You and Me* program effectively enhances sexuality knowledge and promotes more positive sexuality attitudes in the short- and long-term among vocational high school students compared to traditional sex education (RQ1). Additionally, considering regional and sexual experience differences, we explore whether *You and Me* mitigates rather than exacerbates disparities in economic and sexual education levels across regions (RQ2). Recognizing that changes in knowledge and attitudes alone are insufficient, we further investigate whether the program leads to healthier behavioral outcomes and improved well-being (RQ3). Given the competition for curriculum time with Chinese cultural subjects, the incomplete provision of sex education, and regular instances of student absenteeism, we also examine how the implementation progress of online courses affects the program's effectiveness (RQ4). To address these questions, we conducted a large-scale cluster randomized controlled trial (RCT) to evaluate the impact of online comprehensive sexuality education (OCSE) on the sexual and reproductive health and rights outcomes of tenth-grade vocational high school students immediately post-intervention and one year later. A nested study was also conducted to assess influencing factors and monitor implementation progress.

Methods

Study design and Participants

A two-arm, parallel-group cluster randomized trial was conducted in Guangdong and Yunnan provinces, China, to compare the effectiveness of the *You and Me OCSE* program with traditional Chinese sexuality education as the control. The intervention was delivered between April 2019 and June 2019, focusing on the general practices of the *You and Me* education program in Zhongshan City (Guangdong Province) and Kunming City (Yunnan Province), two regions with significant economic and sexuality educational disparities. Yunnan Province exhibited a lagging attitude, inadequate education, and consistently lower

knowledge levels than the national average. In 2022, Guangdong province had a population of 127 million and a GDP exceeding 12.95 trillion yuan, maintaining its position as the top-ranked province among the 34 provinces in China for 34 consecutive years, with the second-highest increment in the nation. In contrast, Yunnan lagged with a population of 47 million and a GDP of 2.86 trillion yuan, ranking 18th nationwide (National Bureau of Statistics, 2024). A survey on sexuality knowledge, attitudes, and practices conducted in five regions revealed notable disparities between Guangdong and Yunnan provinces. This includes the prevalence of sexually transmitted diseases (2.5% in Guangdong vs. 3.2% in Yunnan vs. 3.0% average), opposition to premarital sexual activity (54.7% in Guangdong vs. 68.2% in Yunnan vs. 61.2% average), correct identification of HIV/AIDS transmission routes (74.9% in Guangdong vs. 63.5% in Yunnan vs. 73.0% average), and peer acceptance of studying in the same class with HIV/AIDS-infected individuals (36.7% in Guangdong vs. 25.1% in Yunnan vs. 29.0% average; see Sun, 2001). The trial targeted mixed-gender vocational high schools in March 2019, which were public institutions with more than 100 grade ten students. Schools that had already implemented a CSE program or had plans to do so in the upcoming year were excluded. Participants without informed consent from their guardians were also excluded from the study. A total of 29 clusters were involved, with ten vocational high schools from Guangdong province and 19 from Yunnan province (see Figure 1). The baseline survey was conducted in April 2019, followed by a post-intervention survey in June 2019. The long-term effects were measured during a follow-up in June 2020.

Ethical approval statement

All study procedures adhered to the 1964 Helsinki Declaration and its later amendments or by applying comparable ethical standards. Approval was obtained from the Tsinghua University Institutional Review Board (Project No: 20,190,009), and the trial was duly registered with

the Chinese Clinical Trial Registry (Registration No: ChiCTR1900021582). Written informed consents were obtained from schools and students. For students under the age of 18, written consent was provided by their legal guardians. All data were anonymized under a waiver of consent as per data sharing and ethical approval agreements.

Cluster Randomization and Blinding

Randomization was at the school and class levels. School clusters were the unit of randomization. Twenty-nine schools were randomly allocated to the You and Me OCSE or control groups with an equal allocation ratio after being stratified by borough. At the class level, two to four classes were randomly chosen in each selected school as the smallest unit for the intervention to be delivered.

A masked statistician (KT) generated randomization through a computerized process utilizing a random number generator and oversaw the development of the statistical analysis plan but did not conduct any analyses. Blinding is not appropriate to this study as it involves education. Throughout the trial, researchers remained unaware of cluster allocation. Statisticians conducting analyses (HC) were blinded to allocation and were only unmasked after data collection and analyses were completed. Non-site-specific study ID numbers were used on all schools and data collection forms to maintain blinding.

Procedure

Xi'an Guangyuan Assistance Charity Centre provided a day and a half of training to at least two teachers from each school in the intervention groups following the ITGSE guidelines. To familiarize teachers with the You and Me OCSE content and improve their teaching skills, video recordings of trained educators delivering each session were made available as references. The education bureaus in each city supervised the training process. At least two

teachers from each school underwent the training, ensuring every class had trained teachers. Under the supervision of the Family Planning Association (FPA) in Kunming and the Health and Hygiene Institute for Primary and Secondary Schools in Zhongshan (HHIPSS), Tsinghua University Vanke School of Public Health evaluated the knowledge levels of the trained teachers through interviews based on the ITGSE framework. Teachers who did not meet the standards underwent additional half-day training until passing the assessment. Control groups had no systematic CSE program but may have been exposed to regular sexuality education.

Outcomes were evaluated by trained health researchers from Tsinghua University and Peking University under the supervision of local FPA or HHIPSS representatives. People collecting questionnaire data were independent of the intervention implementation team and masked the allocation of communes to trial groups. Data were collected in three waves: at baseline, post-intervention (after eight weeks of education), and first follow-up (12 months since post-intervention).

The baseline survey was conducted in April 2019. All students used their mobile phones to complete a self-administered baseline questionnaire, which took approximately 20 minutes. For students without mobile phones, the research team provided alternative devices. Half of the students were moved to another classroom to provide more privacy during the questionnaire completion, with approximately two desks' distance between every two students. The questionnaire domains encompassed socio-demographic information, lifestyle, family, education, and students' sexual and reproductive knowledge, attitudes, and behaviors. All questionnaire data were directly stored in the backend database.

From April 2019 to June 2019, the *You and Me* program was delivered once a week for 45 minutes each session, totaling eight sessions and 360 minutes. Each session included approximately 30 minutes of autonomous learning through computer-mediated education, supplemented by 2-3 participatory activities. These activities involved teacher-led interactive

elements, such as scenario simulations for sexual harassment and condom use demonstrations. Teachers addressed questions from students and were encouraged to follow the provided manual to ensure standardized instruction. After each class, teachers were required to document the classroom dynamics and report on the session. Each school reported fixed class times, and the FPA and the HHIPSS randomly inspected the implementation of the courses.

Instances of absenteeism and non-compliance with the standard class procedures were documented and cross-referenced with students' self-reported teaching situations to assess the quality of OCSE implementation. The post-intervention follow-up was conducted in June 2019, with most schools completing the You and Me program. In addition to completing the basic questionnaire, students were asked about the program's progress.

Trained health researchers conducted 30-minute semi-structured interviews with teaching staff in the intervention group. Additionally, in each school of the intervention group, 5-10 students were randomly selected to participate in focus group interviews to understand the experiences and suggestions of the You and Me OCSE. The second follow-up was conducted in June 2020, using the same questionnaire to assess the long-term impact.

Outcomes

The primary outcomes were sexuality knowledge and sexuality attitude. To the best of our knowledge, there is no validated scale for assessing Chinese adolescent sexuality knowledge and sexuality attitudes based on CSE. Existing scales such as The Sex Knowledge and Attitudes Test - Adolescents (SKAT-A) and Global Early Adolescent Study do not cover all CSE content. They are lengthy and do not align with the Chinese context, causing confusion among high school students during pre-testing. Therefore, we followed the guidelines in the Reproductive Health Epidemiology (Centers for Disease Control and Prevention, 2003). ITGSE was used as a reference to construct dimensions, and SRHR experts ultimately

designed the sexuality knowledge and attitude scales. The scales underwent validity verification in junior high school (Jin et al., 2021), and based on feedback from pre-test focus group interviews of teachers and students, six questions were added to both sexuality knowledge and attitude. The sexuality knowledge questionnaire comprised 20 true-or-false questions on the reproductive system and puberty, pregnancy and contraception, disease and behavior, and sexual violence. Participants received one point for each correct answer. Kuder-Richardson Formula 20 = 0.7678 (Kuder & Richardson, 1937).

Sexuality attitudes were assessed by a 20-item Likert scale on understanding gender, relationship and value, media literacy and well-being skills, sexual violence, love and marriage. Each item had seven response options, ranging from strongly disagree to strongly agree. The Cronbach's alpha of sexuality attitude = 0.79.

The secondary outcomes assessed were related to sexual and reproductive health and rights. Based on NHS and WHO standards, we measured explicit symptoms of sexually transmitted diseases (STDs) at baseline and one year after the intervention (NHS, 2018; WHO, 2020). The total score ranges between 1 and 4. Students were asked whether they had experienced the following symptoms in the last year: (a) itching and redness in the genital area and anal itching, soreness, or bleeding, (b) sores or warts on the genital area, (c) unusual discharge or abnormal odor from the penis or vagina, and (d) painful or frequent urination. The responses had been counted.

The frequency of penile-vaginal intercourse was measured at three points. Students were asked to report the number of times they had engaged in sexual intercourse.

Contraceptive usage was measured at baseline and one year after the intervention. Students reported the percentage of time they and their partners used condoms or short-acting birth control pills in the past year. The total score ranges between 1 (50% or less) and 4 (100%), with a higher score indicating a higher contraceptive usage ratio.

Unintended pregnancy was measured three times. Female students were asked, "How many times have you been pregnant?" Male students were asked, "How many times has your sexual partner been pregnant?"

Self-efficacy was measured three times using the general self-efficacy scale (Schwarzer & Jerusalem, 1995), validated in China (Zeng et al., 2022). The total score ranges between 10 and 40, with a higher score indicating greater self-efficacy. This scale consists of 10 items, each with four response options, ranging from not at all (1) to absolutely right (4).

Harassment coping self-efficacy was measured three times. Due to the absence of a suitable scale to measure sexual harassment coping, a custom questionnaire was developed. Students were asked to rate their confidence in coping effectively if they were to encounter forced sexual activity or sexual harassment. Responses ranged from 1 (no coping confidence) to 5 (full coping confidence).

School bullying perception was measured three times. Students reported the frequency of classmates' sexual bullying or harassment behavior on a scale from 1 (not at all) to 7 (very often). The total score ranged from 1 to 5, with higher scores indicating a greater perception of bullying.

Curriculum progress was measured in the post-intervention. The total score ranges between 0 and 8, with a higher score indicating more content has been taught. The students in the intervention group were asked which specific lessons they attended in the past two months as part of the course package. The responses had been counted.

Demographic information includes age, sex, ethnicity, location, and parental divorce. Sexual experiences, baseline school bully perception, and sexuality education experiences were entered as covariates to explore the better way to accomplish the series sexuality education. Because of the complexity of sexuality education experience, it has been measured in different ways (Table 1).

Sample Size and Power

Based on previous studies in China (Chi et al., 2015; Lou et al., 2006; Lyu et al., 2020), we assumed an intraclass correlation coefficient (ICC) of 0.10, correct response rates of 50% (with a standard deviation of 20%), a detection power of 80%, and an α value of 0.05, the minimum detectable difference between population means was set at 10%. Given that there are approximately 60 students per vocational high school class, 120 students per cluster, we determined that a minimum of eight clusters would be required in each arm. We oversampled for each arm to increase statistical power and account for the possibility of schools dropping out. Based on our baseline data, we can detect a minimum difference in sexuality knowledge of 0.30 (M = 8.55, SD = 3.76, ICC = 0.06) and sexuality attitude of 0.37 (M = 94.38, SD = 12.51, ICC = 0.10).

Statistical Analysis

Data analysis occurred from March 2022 to December 2023. To answer RQ1, we performed a multigroup parallel process latent growth model (PP-LGM) with freely estimated slopes (Figure 2). PP-LGM is a method for modeling repeated measures as latent variables composed of a random intercept and random slopes that can evaluate the interindividual difference and intraindividual changes over time (Cheong et al., 2003; Cheung & Lau, 2017). Intercept refers to the initial sexuality knowledge and attitude, while the slope represents the growth rate. When estimated freely, trajectories are not constrained to a linear trend, which illustrates the effect of intervention. For a theory-based intervention, PP-LGM provides an efficient way to assess and interpret the relationships of longitudinal effects for intervention studies. Correlations between the latent factors are also included to improve model fit (Cheong et al., 2003). Multigroup is used to compare differences between two groups. Thus, the method was appropriate in this study. To answer RQ2 and RQ4, covariates are included

in the PP-LGM.

The mixed effect model (MEM) uses group and time as the main effects to examine secondary outcomes to solve RQ3. A pairwise comparison with Bonferroni correction was performed to compare the differences between the intervention groups whenever a group and time interaction effect was observed. MEM was conducted using SPSS 26 and modeling analysis using Mplus 8.3. Missing data were treated with pairwise deletion for the MEM and the full information maximum likelihood method for PP-LGM. Statistical significance was defined at a 2-tailed α level of 0.05.

Results

Participant Characteristics

As shown in Table 2, the baseline sample included 3,415 students from 29 schools, aged 14 to 22, collected from March 23, 2019, to March 31, 2019. The mean age of participants was 16.10 (SD = 0.85), and 1,877 (54.96%) were male. A total of 2,889 (84.60%) adolescents completed the two-month follow-up, and 2,816 (82.46%) completed the one-year follow-up. Attrition occurred due to students being absent on the survey day, failing to remember their usernames and passwords to complete the survey online, or answering fewer than 80% of the items on any scale. There were no significant differences between students who only participated at baseline and those who completed at least one follow-up assessment in either the intervention or control groups on any of the outcome measures (sexuality knowledge: F (3,413) = 0.053, p = 0.261; sexuality attitude: F (3,413) = 0.391, p = 0.514).

At baseline, the average score for sexuality knowledge was 8.55 (SD = 3.76), with 60.26% of individuals scoring below 10 points. The average score for sexuality attitude was 94.38 (SD = 12.51). Regarding sexual experiences, 68.46% of the students reported being in love, but only 13.01% had experienced sexual intercourse. Additionally, 19.57% of students reported

encountering sexual harassment. Only 51.70% of the adolescents reported receiving sexuality education, with an average duration of 2.50 (*SD* = 1.74) lessons, totaling approximately 112.50 minutes, and covering an average of 5.14 (*SD* = 2.34) topics. Less than one-third of the students had ever received education on abortion, pregnancy and contraception, sexual behaviors, sexual violence, and love and marriage. Notably, 32.83% of students (1,121) had received sexuality education during only one stage of their schooling.

Primary Outcome

Trajectory analyses showed an excellent model fit for PP-LGM (Appendix Table 1). In response to RQ1, the intervention group exhibited distinct and steeper growth trajectories compared to the control group (sexuality knowledge unstandardized coefficient, control group: $b = 0.27$ [95% CI, 0.12 to 0.41], $p < 0.001$ vs intervention group: $b = 4.19$ [95% CI, 4.00 to 4.37], $p < 0.001$; sexuality attitude, control group: $b = 1.27$ [95% CI, 0.75 to 1.78], $p < 0.001$ vs intervention group: $b = 6.09$ [95% CI, 5.55 to 6.63], $p < 0.001$). Both groups exhibited individual differences at the baseline level and growth of sexuality knowledge and sexuality attitude (Appendix Table 1). Furthermore, the intervention group's sexuality knowledge and sexuality attitude remained higher than those of the control group even after one year (sexuality knowledge short-term difference: 3.97 [95% CI, 3.69 to 4.25], $p < 0.001$; long-term difference: 2.23 [95% CI, 1.93 to 2.53], $p < 0.001$; sexuality attitude short-term difference: 4.06 [95% CI, 3.07 to 5.04], $p < 0.001$; long-term difference: 1.61 [95% CI, 0.53 to 2.69], $p = 0.003$). However, compared to two months after the intervention, both sexuality knowledge and sexuality attitude decreased (Table 3).

Interrelationships between slopes and intercepts of sexuality knowledge and sexuality attitude are described in Table 4. Positive correlations were found between the growth rate of sexuality knowledge and sexuality attitude in both the control group ($r = 0.58$, $p < 0.001$) and

the intervention group ($r = 0.74$, $p < 0.001$). Notably, in the intervention group, a higher initial level of sexuality knowledge was associated with a greater increase in sexuality attitude ($r = 0.23$, $p = 0.003$). In the control group, higher initial levels are associated with slower growth, evident in sexuality knowledge ($r = -0.20$, $p = 0.046$) and sexuality attitude ($r = -0.22$, $p = 0.012$). However, under OCSE, the growth rate is not significantly affected by the initial level.

Secondary Outcomes

In our analysis of RQ2, we found significant interaction effects for intercourse frequency, harassment coping self-efficacy, and perception of school bullying. Compared to the control group, at post-intervention or one-year follow-up, the intervention group showed an increase in intercourse frequency both post-intervention and at the one-year follow-up (mean [SE] post-intervention 0.44 [0.02] vs 0.37 [0.03]; mean difference [MD] = 0.07; 95% CI 0.01–0.14; Bonferroni-corrected $p = 0.048$; one-year follow-up 0.58 [0.02] vs 0.50 [0.03]; MD = 0.08; 95% CI 0.00–0.15; Bonferroni-corrected p = 0.038), harassment coping self-efficacy (post-intervention 3.47 [0.03] vs 3.28 [0.03]; MD = 0.20; 95% CI 0.12–0.27; Bonferroni-corrected $p < 0.001$; one-year follow-up 3.45 [0.02] vs 3.37 [0.02]; MD = 0.08; 95% CI 0.00–0.16; Bonferroni-corrected $p = 0.054$), and school bullying perception (post-intervention 1.55 [0.03] vs 1.46 [0.03]; MD = 0.09; 95% CI 0.02–0.17; Bonferroni-corrected $p = 0.017$; one-year follow-up 1.32 [0.02] vs 1.28 [0.02]; MD = 0.04; 95% CI -0.02–0.10; Bonferroni-corrected $p = 0.185$). There were no differences in growth between the groups in the number of STD symptoms, contraceptive measures, unintended pregnancy, or self-efficacy (Table 5).

Demographic Information and Outcomes

The coefficients of covariates on the intercepts and slopes of sexuality knowledge and attitude were presented in Appendix Tables 2 and 3. In the OCSE group, we identified that females had

higher initial sexuality knowledge (b = 0.80 [95% CI, 0.48 to 1.12], $p < 0.001$) and sexuality attitude (b = 6.78 [95% CI, 5.72 to 7.84], $p < 0.001$), as well as higher growth rates in sexuality knowledge (b = 1.28 [95% CI, 0.91 to 1.65], $p < 0.001$) and sexuality attitude (b = 3.21 [95% CI, 2.09 to 4.33], $p < 0.001$). Students living in the undeveloped region of Yunnan had lower initial sexuality knowledge (b = -0.86 [95% CI, -1.26 to -0.47], $p < 0.001$) and sexuality attitude (b = -3.99 [95% CI, -5.29 to -2.70], $p < 0.001$). However, after receiving OCSE, they showed steeper increases in sexuality knowledge (b = 0.73 [95% CI, 0.29 to 1.18], $p < 0.001$) and sexuality attitude (b = 1.82 [95% CI, 0.52 to 3.12], p = 0.006).

Sexuality Education Experiences and Outcomes

Students who had received more sessions in previous sexuality education demonstrated higher levels of sexuality knowledge and attitudes in both the intervention group (b = 0.13, p = 0.002; b = 0.50, p < 0.001) and the control group (b = 0.21, p < 0.001; b = 0.49, p = 0.004). However, the duration of previous education did not significantly affect growth in sexual attitudes. Sensitivity analysis revealed that education experiences at different stages consistently had a positive influence on initial sexuality knowledge (Primary school: b = 0.50, p = 0.064; Junior High School: b = 0.47, p = 0.007; Vocational High School: b = 0.49, p = 0.011) but not on sexuality attitudes. Moreover, sexuality education during junior high school influenced the growth rate of both sexuality knowledge (b = -0.45, p = 0.021) and sexuality attitude (b = 1.43, p = 0.016) in the OCSE group (Appendix Tables 2 and 3).

Separate models for the intervention group addressed RQ4. The curriculum progress did not significantly alter other coefficients in the PP-LGM for the intervention. However, it did show that curriculum progress positively impacted the slope of sexuality knowledge (b = 0.45, $p < 0.001$, $\Delta R^2 = 0.16$) and sexuality attitude (b = 1.01, $p < 0.001$, $\Delta R^2 = 0.16$; Appendix Table 1).

Discussion

Our study investigated the implementation of *You and Me* OCSE in two district provinces and found that most students had insufficient and sporadic sexuality education experience.

Effectiveness of Comprehensive Sexuality Education

Our findings on the impact of OCSE on sexuality knowledge and attitudes are consistent with prior research across different student stages, but they provide more detailed theoretical insights. Overall, the implementation of the You and Me program among vocational high school students led to a more rapid increase in both sexuality knowledge and attitude, proving more effective in the short and long term compared to traditional sex education. In the control group, given the absence of standalone sex education courses in China, a gradual short-term increase can be attributed to the broad safety education offered upon enrollment or peer interactions (Behler, 2017). Notably, students with higher initial levels of sexuality knowledge and attitudes in the control group exhibited slower growth, reflecting the limitations of informal sex education in China. However, in the OCSE group, growth was not constrained by the initial level. This underscores the limitations of traditional informal sex education in China, where, once basic information such as physiological knowledge is conveyed, there is no additional source of knowledge for vocational high school students. In contrast, CSE offers more comprehensive information, with initial levels—primarily physiological knowledge accumulated in a sexually repressive culture—forming only a small part, thus not limiting the positive growth in sexuality knowledge and attitude.

Secondly, OCSE mitigated the disadvantages of sexuality education faced by students in impoverished areas. Despite having lower initial levels of sexuality knowledge and attitudes, students in these regions exhibited faster growth than their peers in more developed areas. This

highlights the program's effectiveness in addressing the intersectional challenges posed by cultural barriers, economic and educational disparities, and discrimination faced by students.

Thirdly, our findings highlight the necessity of continuous sexuality education (Goldfarb & Lieberman, 2021). While OCSE consistently surpasses traditional Chinese sex education, its effectiveness diminishes after a two-month period, indicating a decline in impact one year later. Therefore, sustained sexuality education across various school stages is crucial for maintaining long-term benefits. Implementing sexuality education at multiple stages positively affects both initial levels and subsequent growth in sexuality knowledge and attitudes.

Additionally, the thorough implementation of the curriculum is critical. Students who received more sessions of sexuality education, rather than longer sessions, had higher initial levels of knowledge and attitudes. This suggests that the current Chinese sexuality education curriculum might contain a considerable amount of ineffective content. Moreover, curriculum progress significantly influences the growth rate of sexuality knowledge and attitudes. This expands the theoretical framework of CSE to its implementation phase, emphasizing that comprehensive implementation of CSE is critical. Although the importance of CSE integrity was highlighted in the early stages of the ITGSE Chinese version (UNESCO, 2018), it remains insufficient in practice today.

Gaps in the Translation of Knowledge and Attitudes

Our study found an increase in the frequency of intercourse, improved self-efficacy in coping with harassment, and an elevated perception of school bullying. While higher harassment-coping self-efficacy is consistent with studies (Roth et al., 2023), our findings are inconsistent with previous studies, indicating that the OCSE group had a higher frequency of sexual intercourse (Swanton et al., 2015), and general self-efficacy did not exhibit a significant

increase (Sa et al., 2021). This discrepancy might be attributed to China's abstinence-oriented policies, which result in low rates of sexual intercourse (Li et al., 2009). Furthermore, while Ramírez-Villalobos et al. (2021) suggest that CSE can delay the onset of sexual activity and increase contraceptive use, our study did not observe significant differences in contraceptive use or unintended pregnancies among vocational high school students in China. Therefore, it is necessary to consider the translation of sexuality knowledge and sexuality attitude into SRHR-related outcomes, with key factors including the accessibility of contraceptive tools and the sexual inclusivity of the environment. Achieving these goals is difficult in undeveloped areas in China. This underscores the need for more sustained sexuality education.

A significant barrier to the effective implementation of OCSE in China lies in deeply rooted cultural factors, which influence high school students' receptiveness to the curriculum. Given that most high school students are over the age of 15, the social stigma surrounding sexuality makes it difficult for them to engage fully in the classroom. Therefore, teacher training is crucial, as educators must present the material in a serious yet approachable manner, rather than conveying compromise or conservatism, which hinders desensitization efforts (Zhao et al., 2020). Moreover, awareness and understanding of sexual orientation and self-identity remain limited. Baseline findings revealed confusion among some students regarding these concepts, which led to revisions in the questionnaire, including the use of same-sex behaviors as behavioral indicators. Future research should take students' levels of acceptance into account. Additionally, OCSE must be adapted to local dialects, as regional variations, such as those in Guangdong and Yunnan, pose challenges. Teacher training can help address these regional language differences. Finally, although *You and Me* follows a standardized procedure and we supervised the progress, OCSE was still not fully implemented in schools, particularly in underdeveloped areas. The absence of sessions significantly impacted its effectiveness. This

highlights the necessity for continuous and institutionalized CSE. Strong supervision alone cannot ensure the comprehensive implementation of the curriculum; legal frameworks and policy support are essential.

Limitations

Several limitations need to be acknowledged. First, due to variations in school size, ranging from approximately 400 to 18,000 students, the two groups were not equal. Second, questionnaire-based self-report data may be influenced by social desirability bias. More comprehensive assessments are needed in the future. Third, the three measurements constrain the interpretability of the model. Future longitudinal studies, including intensive longitudinal research, are essential for understanding the translation of CSE into behavior and well-being.

Conclusions

The findings of this cluster randomized trial revealed that the CSE in China's vocational high schools is insufficient. The *You and Me* OCSE proved to be a feasible solution, leading to faster increase in sexuality knowledge and sexuality attitudes, especially in undeveloped areas both post-intervention and 12 months later. Curriculum progress significantly impacted the growth of sexuality knowledge and attitude. However, *You and Me* is insufficient to alter sexual behaviors. Vocational high school students' behavioral outcomes and well-being did not produce consistent positive results. Therefore, vocational high school students require Long-term, comprehensive, and accurate support. This should include the provision of more sustained and thorough CSE, as well as establishing accessible contraceptive tools and healthcare channels.

Consent for publication

Not applicable

Availability of data and materials

De-identified individual participant data that underlie our study's results will be openly available for three years post-publication. Data is available to anyone upon a reasonable request.

Competing of interests

The authors report that there are no competing interests to declare.

Funding/Support:

This study was funded by the Kadoorie Charitable Foundation.

Role of the Funder/Sponsor:

The funders had no role in the study design and conduct; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication. All authors had full access to the data and had final responsibility for the decision to submit for publication.

List of abbreviations

OCSE: online comprehensive sexuality education package

CSE: comprehensive sexuality education

RCT: randomized controlled trial

GDP: Gross Domestic Product

ITGSE: International Technical Guidance on sexuality education

FPA: Family Planning Association

HHIPSS: Hygiene Institute for Primary and Secondary Schools in Zhongshan

SK: Sexuality knowledge

SA: Sexuality attitude

Reference

Behler, R. L. (2017). You can't always get what you want: Network determinants of relationship inactualization in adolescence. *Social Science Research*, *61*, 181-194. https://doi.org/https://doi.org/10.1016/j.ssresearch.2016.06.012

Chen, L. (2022). Problematic Pornography Use in China. *Current Addiction Reports*, *9*(2), 80-85. https://doi.org/10.1007/s40429-022-00408-9

Cheong, J., MacKinnon, D. P., & Khoo, S. T. (2003). Investigation of Mediational Processes Using Parallel Process Latent Growth Curve Modeling. *Structural Equation Modeling: A Multidisciplinary Journal*, *10*(2), 238-262. https://doi.org/10.1207/S15328007SEM1002_5

Cheung, G. W., & Lau, R. S. (2017). Accuracy of Parameter Estimates and Confidence Intervals in Moderated Mediation Models:A Comparison of Regression and Latent Moderated Structural Equations. *Organizational Research Methods*, *20*(4), 746-769. https://doi.org/10.1177/1094428115595869

Chi, X., Hawk, S. T., Winter, S., & Meeus, W. (2015). The Effect of Comprehensive Sexual Education Program on Sexual Health Knowledge and Sexual Attitude Among College Students in Southwest China. *Asia-Pacific Journal of Public Health*, *27*(2), NP2049-NP2066. https://doi.org/doi: 10.1177/1010539513475655

Fang, Y., Zheng, Y., Jin, Y., Yu, C., Zuo, X., Lian, Q., Lou, C., Li, L., Hong, P., & Tu, X. (2022). Sexual-Related Knowledge, School and Family Sexuality Education and Its Association with Experience of Sexual Intercourse among Vocational Secondary School Students in China. *Children*, *9*(8), 1206. https://www.mdpi.com/2227-9067/9/8/1206

Fei, G., Lihan, L., & Yingfei, S. (2022, 2022/07/11). Perceiving Sexual Harassment in Chinese Higher Education. Proceedings of the 2022 3rd International Conference on Mental Health, Education and Human Development (MHEHD 2022)

Ferrand, L. (2023). Reforming the sexual health education curriculum. *The Lancet Child & Adolescent Health*. https://doi.org/10.1016/S2352-4642(23)00233-X

Goldfarb, E. S., & Lieberman, L. D. (2021). Three Decades of Research: The Case for Comprehensive Sex Education. *Journal of Adolescent Health*, *68*(1), 13-27. https://doi.org/https://doi.org/10.1016/j.jadohealth.2020.07.036

Guse, K., Levine, D., Martins, S., Lira, A., Gaarde, J., Westmorland, W., & Gilliam, M. (2012). Interventions Using New Digital Media to Improve Adolescent Sexual Health: A Systematic Review. *Journal of Adolescent Health*, *51*(6), 535-543. https://doi.org/10.1016/j.jadohealth.2012.03.014

Han, Z., Zhang, G., & Zhang, H. (2017). School Bullying in Urban China: Prevalence and Correlation with School Climate. *International journal of environmental research and public health*, *14*(10).

Herat, J., Plesons, M., Castle, C., Babb, J., & Chandra-Mouli, V. (2018). The revised international technical guidance on sexuality education - a powerful tool at an important crossroads for sexuality education. *Reproductive Health*, *15*(1), 185. https://doi.org/10.1186/s12978-018-0629-x

Ho, P. S. Y., Jackson, S., Cao, S., & Kwok, C. (2018). Sex With Chinese Characteristics: Sexuality Research in/on 21st-Century China. *The Journal of Sex Research*, *55*(4-5), 486-521. https://doi.org/10.1080/00224499.2018.1437593

Huang, D. Y. C., Murphy, D. A., & Hser, Y.-I. (2011). Developmental Trajectory of Sexual Risk Behaviors From Adolescence to Young Adulthood. *Youth & Society*, *44*(4), 479-499. https://doi.org/10.1177/0044118X11406747

Ji, Y., Xu, H., Zhang, Y., & Liu, Q. (2018). Heterogeneity of adolescent health risk behaviors in rural western China: A latent class analysis. *PloS one*, *13*(6), e0199286. https://doi.org/10.1371/journal.pone.0199286

Ji, Y., & Reiss, M. J. (2022). Cherish Lives? Progress and compromise in sexuality education textbooks produced in contemporary China. *Sex Education*, *22*(4), 496-519. https://doi.org/10.1080/14681811.2021.1955670

Jiang, W., & Ha, L. (2020). Smartphones or computers for online sex education? A contraception information seeking model for Chinese college students. *Sex Education*, *20*(4), 457-476. https://doi.org/10.1080/14681811.2019.1672041

Jin, Z., Guo, F., Wang, K., Zhang, H., Cao, W., Hee, J., Yuan, Y., Chen, M., & Tang, K. (2021). Effects of an Internet-Based and Teacher-Facilitated Sexuality Education Package: A Cluster-Randomized Trial. *Children*, *8*(10), 885. https://www.mdpi.com/2227-9067/8/10/885

Kaidbey, M., Zhen, S., Wong, S., Navchaa, S., & Junjian, G. (2023). The Effectiveness of Delivering Comprehensive Sexuality Education Through Live Streaming to Schools in Western China. *American Journal of Sexuality Education*, *18*(1), 115-148. https://doi.org/10.1080/15546128.2022.2064952

Kuder, G. F., & Richardson, M. W. (1937). The theory of the estimation of test reliability. *Psychometrika*, *2*(3), 151-160.

Li, L., King, M. E., & Winter, S. (2009). Sexuality education in China: the conflict between reality and ideology. *Asia Pacific Journal of Education*, *29*(4), 469-480. https://doi.org/10.1080/02188790903309066

Liang, M., Simelane, S., Fortuny Fillo, G., Chalasani, S., Weny, K., Salazar Canelos, P., Jenkins, L., Moller, A.-B., Chandra-Mouli, V., Say, L., Michielsen, K., Engel, D. M. C., & Snow, R. (2019). The State of Adolescent Sexual and Reproductive Health. *Journal of Adolescent Health*, *65*(6, Supplement), S3-S15. https://doi.org/https://doi.org/10.1016/j.jadohealth.2019.09.015

Liang, J. Y., Tan, S., & O'Halloran, K. (2017). Representing sexuality and morality in sex education picture books in contemporary China. *Social Semiotics*, *27*(1), 107-126. https://doi.org/10.1080/10350330.2016.1161117

Ling, M. (2015). "Bad Students Go to Vocational Schools!": Education, Social Reproduction and Migrant Youth in Urban China. *The China Journal*, *73*, 108-131. https://doi.org/10.1086/679271

Liu, C. (2022). Secondary Education and Class Stratification: Understanding the Hierarchy of Sexuality Education in a Chinese Vocational High School. *Children*, *9*(10), 1524. https://www.mdpi.com/2227-9067/9/10/1524

Liu, J., Cheng, M., Wei, X., & Yu, N. N. (2020). The Internet-driven sexual revolution in China. *Technological Forecasting and Social Change*, *153*, 119911. https://doi.org/https://doi.org/10.1016/j.techfore.2020.119911

Liu, W., Van Campen, K. S., Edwards, C. P., & Russell, S. T. (2011). Chinese Parents' Perspectives on Adolescent Sexuality Education. *International Journal of Sexual Health*, *23*(3), 224-236. https://doi.org/10.1080/19317611.2011.596256

Lou, C.-h., Zhao, Q., Gao, E.-S., & Shah, I. H. (2006). Can the Internet Be Used Effectively to Provide Sex Education to Young People in China? *Journal of Adolescent Health*, *39*(5), 720-728. https://doi.org/https://doi.org/10.1016/j.jadohealth.2006.04.003

Lyu, J., Shen, X., & Hesketh, T. (2020). Sexual Knowledge, Attitudes and Behaviours among Undergraduate Students in China—Implications for Sex Education. *International journal of environmental research and public health*, *17*(18), 6716. https://www.mdpi.com/1660-4601/17/18/6716

Manlove, J., Welti, K., Whitfield, B., Faccio, B., Finocharo, J., & Ciaravino, S. (2021). Impacts of Re:MIX—A School-Based Teen Pregnancy Prevention Program Incorporating Young Parent Coeducators. *Journal of School Health*, *91*(11), 915-927. https://doi.org/https://doi.org/10.1111/josh.13078

Ministry of Education, P. s. R. o. C. (2023). *The report on the development of vocational education in China (2012-2022)*. https://www.csdp.edu.cn/article/8940.html

Money, W. H., & Dean, B. P. (2019). Incorporating student population differences for effective online education: A content-based review and integrative model. *Computers & Education*, *138*, 57-82. https://doi.org/https://doi.org/10.1016/j.compedu.2019.03.013

National Bureau of Statistics. (2024). *National data*. Retrieved September 8, 2024, from https://data.stats.gov.cn/easyquery.htm?cn=E0103

Nie S, Li H, Xu Y, Ma W, & Xu H. (2007). Analysis on sex-related behaviours of senior high school and professional technical school students in cities of Guangdong province. *China Preventive Medicine (in Chinese)* (05), 581-584. https://kns.cnki.net/kcms2/article/abstract?v=yXT3uqWUX__OlCejjiufDye7tTZJoXUWBCfZ7KDWpRp260vUMDaPPiI4lBiqrghMVYZa4zP3OGdl60P9eNGV-r2pPAdKbCQQPtHtuZQ8p-AWfW1Qncv0H48V0kUK2Q-onqhvllp8DSE=&uniplatform=NZKPT&language=CHS

NHS. (2018). *Sexually transmitted infections (STIs)*. Nhs.Uk. https://www.nhs.uk/conditions/sexually-transmitted-infections-stis/

Nurgitz, R., Pacheco, R. A., Senn, C. Y., & Hobden, K. L. (2021). The impact of sexual education and socialization on sexual satisfaction, attitudes, and self-efficacy. *The Canadian Journal of Human Sexuality*, *30*(2), 265-277. https://doi.org/10.3138/cjhs.2021-0028

Pinandari, A. W., Kågesten, A. E., Li, M., Moreau, C., van Reeuwijk, M., & Wilopo, S. A. (2023). Short-Term Effects of a School-Based Comprehensive Sexuality Education Intervention Among Very Young Adolescents in Three Urban Indonesian Settings: A Quasi-Experimental Study. *Journal of Adolescent Health*, *73*(1), S21-S32. https://doi.org/10.1016/j.jadohealth.2023.01.030

Centers for Disease Control and Prevention (2003). *Questionnaire design reproductive health Epidemiology series module 4*. chrome-extension://cdonnmffkdaoajfknoeeecmchibpmkmg/assets/pdf/web/viewer.html?file=https%3A%2F%2Frepository.dinus.ac.id%2Fdocs%2Fajar%2FEpi_Module_04_Questionnaire_Design.pdf

Ramírez-Villalobos, D., Monterubio-Flores, E. A., Gonzalez-Vazquez, T. T., Molina-Rodríguez, J. F., Ruelas-González, M. G., & Alcalde-Rabanal, J. E. (2021). Delaying sexual onset: outcome of a comprehensive sexuality education initiative for adolescents in public schools. *BMC Public Health*, *21*(1), 1439. https://doi.org/10.1186/s12889-021-11388-2

Rossi, E., Poulin, F., & Boislard, M.-A. (2017). Trajectories of Annual Number of Sexual Partners from Adolescence to Emerging Adulthood: Individual and Family Predictors. *Journal of Youth and Adolescence*, *46*(5), 995-1008. https://doi.org/10.1007/s10964-016-0571-6

Roth, D., Nellhaus, E., Ruley, M., Hess, A., Lamichhane, R., & Yoost, J. (2023). A virtual sex education tool improved reproductive health knowledge among adolescent girls. *Sex Education*, 1-11. https://doi.org/10.1080/14681811.2023.2203909

Sa, Z., Tian, L., & Wang, X. (2021). Evidence for a Comprehensive Sexuality Education Intervention that Enhances Chinese Adolescents' Sexual Knowledge and Gender Awareness and Empowers Young Women. *Sex Roles*, *85*(5), 357-370. https://doi.org/10.1007/s11199-021-01223-8

Schulte, B. (2013). Unwelcome stranger to the system: vocational education in early twentieth-century China. *Comparative Education*, *49*(2), 226-241. https://doi.org/10.1080/03050068.2012.713581

Schwarzer, R., & Jerusalem, M. (1995). Generalized Self-Efficacy scale. In J. Weinman, S. Wright, & M. Johnston, *Measures in health psychology: A user's portfolio. Causal and control beliefs* (pp. 35-37). Windsor, UK: NFER-NELSON.

Song, Y., & Ji, C.-Y. (2010). Sexual intercourse and high-risk sexual behaviours among a national sample of urban adolescents in China. *Journal of Public Health*, *32*(3), 312-321. https://doi.org/10.1093/pubmed/fdp123

Song S, Zhang Y, Zhou Y, Liu Y, & Xu S. (2006). Comparison on sex knowledge, attitude, behaviour, and demand between common high school students and occupational high school students. *Maternal and Child Health Care of China (in Chinese),* (04), 507-509.

Steinberg, D. B., Simon, V. A., Victor, B. G., Kernsmith, P. D., & Smith-Darden, J. P. (2019). Onset Trajectories of Sexting and Other Sexual Behaviors Across High School: A Longitudinal Growth Mixture Modeling Approach. *Archives of Sexual Behavior*, *48*(8), 2321-2331. https://doi.org/10.1007/s10508-019-1414-9

Strauss Swanson, C., & Szymanski, D. M. (2022). Sexual Violence and Psychological Distress: The Roles of Coping Self-Efficacy, Self-Blame, Shame, Activism, and Feminism. *Sex Roles*, *87*(7), 419-434. https://doi.org/10.1007/s11199-022-01314-0

Swanton, R., Allom, V., & Mullan, B. (2015). A meta-analysis of the effect of new-media interventions on sexual-health behaviours. *Sexually Transmitted Infections*, *91*(1), 14-20. https://doi.org/10.1136/sextrans-2014-051743

Sun J, Ma Y, Chen H, Chen J , Song Y, Yu X, Zhang B, Si K, Ji H. (2001). The status quo of the dangerous behavior of middle school students in 5 provinces and cities in China (1) -The knowledge attitude and behavior of AIDS and sexual behavior. *Chinese school hygiene(in Chinese),* (03), 202-204. https://kns.cnki.net/kcms2/article/abstract?v=3IEynGI71r_GVdRiju0fGrmBL6tiryk8a_Lig9B_VJZSFtLxXRWUe_cObEvem6CqDxv-z2jooQW6aonj0tB-EZzoxqiBMpJKMhAsF2nOdSFMFEHKhtFAfC8HY4PEGOx5I_PWrp_f5yo=&uniplatform=NZKPT&language=CHS

Szucs, L. E., Lowry, R., Fasula, A. M., Pampati, S., Copen, C. E., Hussaini, K. S., Kachur, R. E., Koumans, E. H., & Steiner, R. J. (2020). Condom and Contraceptive Use Among Sexually Active High School Students - Youth Risk Behavior Survey, United States, 2019. *MMWR Suppl*, *69*(1), 11-18. https://doi.org/10.15585/mmwr.su6901a2

UNESCO. (2018, June 20). Chinese language edition of the revised International Technical Guideline on Sexuality Education published. *UNESCO*. Retrieved September 9, 2024, from https://www.unesco.org/en/articles/chinese-language-edition-revised-international-technical-guideline-sexuality-education-published

UNESCO, UNAIDS, UNFPA, UNICEF, UN Women and WHO. (2018, July 18). *International technical guidance on sexuality education*. UNFPA China.

https://china.unfpa.org/en/publications/international-technical-guidance-sexuality-education-0

Vamos, C. A., Thompson, E. L., Logan, R. G., Griner, S. B., Perrin, K. M., Merrell, L. K., & Daley, E. M. (2020). Exploring college students' sexual and reproductive health literacy. *Journal of American College Health*, *68*(1), 79-88. https://doi.org/10.1080/07448481.2018.1515757

Wadham, E., Green, C., Debattista, J., Somerset, S., & Sav, A. (2019). New digital media interventions for sexual health promotion among young people: a systematic review. *Sexual Health*, *16*(2), 101-123. https://doi.org/https://doi.org/10.1071/SH18127

Wang, A., & Guo, D. (2019). Technical and vocational education in China: enrolment and socioeconomic status. *Journal of Vocational Education & Training*, *71*(4), 538-555. https://doi.org/10.1080/13636820.2018.1535519

Wang J, Yang X, & Liu Y. (2009). Investigation on AIDS knowledge, attitude and behaviour of high school students in Xinjiang Uygur autonomous. *Chinese Journal of Health Education (in Chinese)*, 25(05), 372-374.

World Health Organization: WHO. (2020, June 4). Sexually transmitted infections (STIs). *World Health Organization: WHO*. https://www.who.int/health-topics/sexually-transmitted-infections#tab=tab_2

Widman, L., Nesi, J., Kamke, K., Choukas-Bradley, S., & Stewart, J. L. (2018). Technology-Based Interventions to Reduce Sexually Transmitted Infections and Unintended Pregnancy Among Youth. *Journal of Adolescent Health*, *62*(6), 651-660. https://doi.org/https://doi.org/10.1016/j.jadohealth.2018.02.007

Xiong, Z., Warwick, I., & Chalies, S. (2020). Understanding novice teachers' perspectives on China's sexuality education: a study based on the national pre-service teacher

education programme. *Sex Education*, *20*(3), 252-266. https://doi.org/10.1080/14681811.2019.1640113

Xu, S., Ren, J., Li, F., Wang, L., & Wang, S. (2020). School Bullying Among Vocational School Students in China: Prevalence and Associations With Personal, Relational, and School Factors. *Journal of Interpersonal Violence*, *37*(1-2), NP104-NP124. https://doi.org/10.1177/0886260520907360

Yu, J. (2012). Teenage sexual attitudes and behaviour in China: a literature review. *Health & Social Care in the Community*, *20*(6), 561-582. https://doi.org/https://doi.org/10.1111/j.1365-2524.2011.01054.x

Zeng, G., Fung, S.-f., Li, J., Hussain, N., & Yu, P. (2022). Evaluating the psychometric properties and factor structure of the general self-efficacy scale in China. *Current Psychology*, *41*(6), 3970-3980. https://doi.org/10.1007/s12144-020-00924-9

Zeng, L. (2024). An Analysis of Diploma Discrimination in Chinese Higher Vocational Education within the Context of a Knowledge-Based. *Transactions on Social Science, Education and Humanities Research*, *5*, 169-176. https://doi.org/10.62051/1wyfyy88

Zhang, J., Ma, B., Han, X., Ding, S., & Li, Y. (2022). Global, regional, and national burdens of HIV and other sexually transmitted infections in adolescents and young adults aged 10–24 years from 1990 to 2019: a trend analysis based on the Global Burden of Disease Study 2019. *The Lancet Child & Adolescent Health*, *6*(11), 763-776. https://doi.org/10.1016/S2352-4642(22)00219-X

Zhao, P., Yang, L., Sa, Z., & Wang, X. (2020). Propriety, empowerment and compromise: challenges in addressing gender among sex educators in China. *Sex Education*, *20*(5), 552-567. https://doi.org/10.1080/14681811.2019.1705779

Zhu, F., Zhu, G., Jia, B., Wang, P., Zhao, T., Ma, Y., & Dong, B. (2022). The Influencing Factors of Comprehensive Sexuality Education Capacity and Its Correlation with Subjective Social Status among Chinese Junior High School Students. *Children*, *9*(8).

Zou, S., Cao, W., Jia, Y., Wang, Z., Qi, X., Shen, J., & Tang, K. (2022). Sexual and reproductive health and attitudes towards sex of young adults in China. *BMJ Sexual & Reproductive Health*, *48*(e1), e13-e21. https://doi.org/10.1136/bmjsrh-2020-200766

Zou, W., Zhang, X., & He, J. (2023). Making Sense of Jiese: An Interview Study of Members from a Porn-Free Self-Help Forum in China. *Archives of Sexual Behavior*, *52*(1), 385-397. https://doi.org/10.1007/s10508-022-02456-8

Zou, Z., Dong, Y., Song, Y., & Ma, J. (2023). Strengthening sexual and reproductive health education for children and adolescents in China. *The Lancet Child & Adolescent Health*, *7*(9), 603-605. https://doi.org/https://doi.org/10.1016/S2352-4642(23)00138-4

Table 1. Definitions of covariates

Baseline covariate	Measurement	Description
Age		
Sex	Binary variable	Students voluntarily providing their registered gender: 1 = female, 0 = male.
Ethnicity	Binary variable	Minority ethnicity = 1, Han ethnicity = 0
Parental Divorce	Binary variable	Parents' divorce=1
Romantic Relationship	Binary variable	Current involvement in a romantic relationship=1
Sexual Experiences	Binary variable	Having had intercourse (sexual experience) =1
Same Sex	Binary variable	Having had same-sex sexual experience =1
School Bully Perception	The total score ranges between 1 and 5, with a higher score indicating more bully perception.	Classmates' sexual bullying/harassment behavior? 1=Not at all, 7=Very often
Sexual Education Experience		
Time in Sexual Education Experience	Range: 0-5	From the start of sexual education until now, students have attended how many lessons of sexuality education (each lasting 45 minutes). Students were asked to exclude knowledge taught by teachers, parents, and others during fragmented time. 1=1 lesson 2=2-3 lessons 3=4-5 lessons 4=6-7 lessons 5=8 or more lessons
Sessions Covered in Sexual Education Experience	Range: 0-9	The number of sexuality education sessions among the nine topics the students have taken
Primary School Sexual Education Experience	Binary variable	Having had sexual education =1
Junior High School Sexual Education Experience	Binary variable	Having had sexual education =1
High School Sexual Education Experience	Binary variable	Having had sexual education =1

Table 2. Baseline characteristics of participants in each study group

	Yunnan (N=2342)				Guangdong (N=1073)				Total (N=3415)			
	Intervention (N=1447)		Control (N=895)		Intervention (N=567)		Control (N=506)		Intervention (N=2014)		Control (N=1401)	
	Mean (N)	SD (%)	Mean (N)	SD (%)	Mean (N)	SD (%)	Mean (N)	SD (%)	Mean (N)	SD (%)	Mean (N)	SD (%)
Age	16.28	0.84	16.19	0.88	15.75	0.69	15.81	0.80	16.13	0.83	16.06	0.87
Sex												
Female	630	43.54	399	44.58	282	49.74	227	44.86	912	45.30	626	44.68
Male	817	56.46	496	55.42	285	50.26	279	55.14	1102	54.70	775	55.32
Ethnic Minority	488	33.70	303	33.90	12	2.10	16	3.20	500	24.80	319	22.80
School bully perception	1.48	1.06	1.47	1.05	1.32	0.79	1.27	0.83	1.43	0.99	1.39	0.98
Parental divorcee	184	12.70	141	15.80	57	10.10	44	8.70	241	12.00	185	13.20
Romantic relationship	1101	76.09	690	77.09	301	53.09	246	48.62	1402	69.60	936	66.81
Sexual Experience	249	17.20	153	17.10	21	3.70	21	4.15	270	13.40	174	12.40
Sexual Harassment	267	18.50	190	21.20	114	20.11	99	19.57	381	18.90	289	20.60
Same Sex	67	4.60	36	4.02	17	3.00	18	3.56	84	4.20	54	3.85
Sexuality Education Experience												
Duration	1.56	1.85	1.19	1.57	1.71	1.74	1.62	1.67	1.60	1.82	1.34	1.62
Sessions Covered	2.56	3.05	2.19	2.94	3.23	3.21	3.10	3.02	2.75	3.11	2.52	3.00
Primary School	100	6.90	46	5.10	102	18.00	84	16.60	202	10.03	130	9.28
Junior High School	571	39.50	314	35.10	275	48.50	239	47.23	846	42.00	553	39.50
High School	327	22.60	167	18.70	192	33.90	174	34.39	519	25.77	341	24.34
Sessions Covered in Previous Sexuality Education												
Sex and gender	529	36.60	288	32.18	253	44.62	224	44.27	782	38.83	512	36.55
Reproductive System	541	37.40	296	33.07	276	48.68	230	45.45	817	40.60	526	37.54
Adolescence	645	44.57	339	37.88	320	56.44	284	56.13	965	47.91	623	44.50
Pregnancy and Contraception	364	25.20	188	21.01	168	29.63	135	26.68	532	26.42	323	23.05
Abortion	166	11.47	86	9.61	103	18.17	64	12.65	269	13.40	150	10.70
STDs	601	41.50	309	34.50	277	48.85	244	48.22	878	43.59	553	39.47
Sexual Behavior	431	29.79	212	23.70	219	38.62	204	40.32	650	32.27	416	29.69
Sexual Violence	202	14.00	115	12.80	115	20.28	103	20.36	317	15.70	218	15.56
Love and Marriage	224	15.48	126	14.10	100	17.64	83	16.40	324	16.10	209	14.92
Curriculum Progress	6.32	2.90	NA	NA	6.88	2.41	NA	NA	6.48	2.78	NA	NA

Table 3. Sexuality knowledge and attitudes in different groups: differences in baseline, growth slope, post-intervention, and follow-up

		Intervention			Control			Difference		
		Estimate (95% CI)	**SE**	***p* value**	**Estimate (95% CI)**	**SE**	***p* value**	**Estimate (95% CI)**	**SE**	***p* value**
Baseline (intercept)	Knowledge	8.56 (8.40 to 8.73)	0.08	＜0.001	8.52 (8.32 to 8.71)	0.10	＜0.001	0.05 (-0.20 to 0.30)	0.13	0.72
	Attitude	94.05 (93.52 to 94.59)	0.27	＜0.001	94.82 (94.15 to 95.49)	0.34	＜0.001	-0.77 (-1.63 to 0.01)	0.44	0.08
Growth (slope)	Knowledge	4.19 (4.00 to 4.37)	0.09	＜0.001	0.27 (0.12 to 0.41)	0.07	＜0.001	3.92 (3.69 to 4.15)	0.12	＜0.001
	Attitude	6.09 (5.55 to 6.63)	0.28	＜0.001	1.27 (0.75 to 1.78)	0.25	＜0.001	4.82 (4.07 to 5.58)	0.37	＜0.001
Post-intervention	Knowledge	12.75 (12.56 to 12.94)	0.10	＜0.001	8.78 (8.58 to 8.99)	0.11	＜0.001	3.97 (3.69 to 4.25)	0.14	＜0.001
	Attitude	100.15 (99.48 to 100.81)	0.34	＜0.001	96.09 (95.38 to 96.80)	0.37	＜0.001	4.06 (3.07 to 5.04)	0.50	＜0.001
follow-up	Knowledge	11.24 (11.05 to 11.43)	0.10	＜0.001	9.02 (8.79 to 9.24)	0.12	＜0.001	2.23 (1.93 to 2.53)	0.15	＜0.001
	Attitude	98.79 (98.12 to 99.47)	0.35	＜0.001	97.18 (96.36 to 98.00)	0.42	＜0.001	1.61 (0.53 to 2.69)	0.54	0.003

Table 4. Interrelationships between slopes and intercepts of sexuality knowledge and attitude

	INTK	**SLPK**	**INTA**	**SLPA**
INTK [a]	NA	-0.196*	0.551***	-0.015
SLPK [b]	-0.159	NA	0.050	0.580***
INTA [c]	0.630***	-0.005	NA	-0.216*
SLPA [d]	0.230**	0.739***	0.317	NA

note: [a] INTK: intercept of the sexuality knowledge, [b] SLPK slope of the sexuality knowledge, [c] INTA: intercept of the sexuality attitude, [d] SLPA: slope of the sexuality attitude.
The correlation matrix above the diagonal represents the control group, while the correlation matrix below the diagonal represents the intervention group; * $p < .05$, ** $p < .01$, *** $p < .001$; NA: not applicable

Table 5. Mixed model and post hoc for repeated measures of secondary outcomes

	Mean（SE）						*p*		
Measurement	**Baseline**		**Post-Intervention**		**Follow-up**		**Interaction**	**Group effect**	**Time effect**
Intercourse time							0.001	0.076	＜0.001
IG[a]	0.28	0.02	0.44	0.02	0.58	0.02			
CG[b]	0.27	0.02	0.37	0.03	0.50	0.03			
STD symptoms							0.220	0.072	＜0.001
IG	0.35	0.01	NA	NA	0.27	0.01			
CG	0.33	0.02	NA	NA	0.22	0.02			
Contraceptive usage							0.331	0.434	0.429
IG	2.45	0.08	NA	NA	2.46	0.07			
CG	2.45	0.10	NA	NA	2.31	0.09			
Unintended pregnant							0.596	0.517	＜0.001
IG	0.05	0.01	0.09	0.01	0.12	0.01			
CG	0.03	0.01	0.08	0.01	0.12	0.02			
Self-efficacy							0.718	0.002	＜0.001
IG	25.76	0.12	26.31	0.13	25.98	0.15			
CG	25.33	0.15	25.72	0.16	25.44	0.17			
Harassment coping self-efficacy							＜0.001	＜0.001	＜0.001
IG	3.24	0.03	3.47	0.03	3.45	0.03			
CG	3.18	0.03	3.28	0.03	3.37	0.03			
School bully perception							0.021	＜0.001	0.356
IG	1.43	0.02	1.55	0.03	1.32	0.02			
CG	1.39	0.03	1.46	0.03	1.28	0.02			

	Post-Intervention				**Follow-up**			
Measurement	**Mean dif**	**95%CI**		***p***	**Mean dif**	**95%CI**		***p***
Intercourse time	0.07	0.01	0.14	0.048	0.08	0.00	0.15	0.038
Harassment coping Self-efficacy	0.20	0.12	0.27	＜0.001	0.08	0.00	0.16	0.054
School bully perception	0.09	0.02	0.17	0.017	0.04	-0.02	0.10	0.185

Note: The Bonferroni correction was used in the mixed model. [a]IG: intervention group, [b]CG: control group

CG	1.39	0.03	1.46	0.03	1.28	0.02		
	Post-Intervention				**Follow-up**			
Measurement	**Mean dif**	**95%CI**		***p***	**Mean dif**	**95%CI**		***p***
Intercourse time	0.07	0.01	0.14	0.048	0.08	0.00	0.15	0.038
Harassment coping Self-efficacy	0.20	0.12	0.27	＜0.001	0.08	0.00	0.16	0.054
School bully perception	0.09	0.02	0.17	0.017	0.04	-0.02	0.10	0.185

Note: The Bonferroni correction was used in the mixed model. [a]IG: intervention group, [b]CG: control group

Figure 1: Trial profile

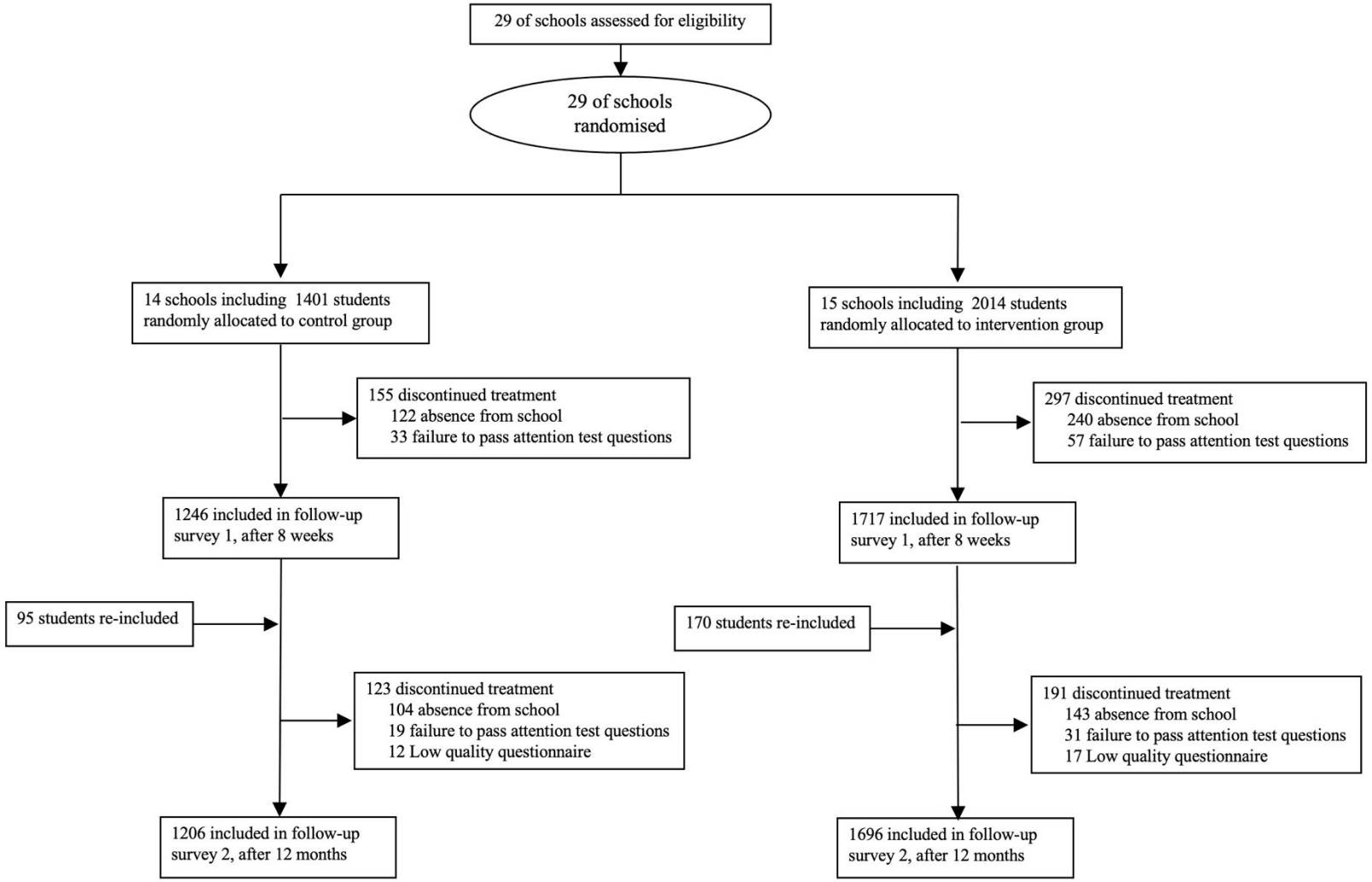
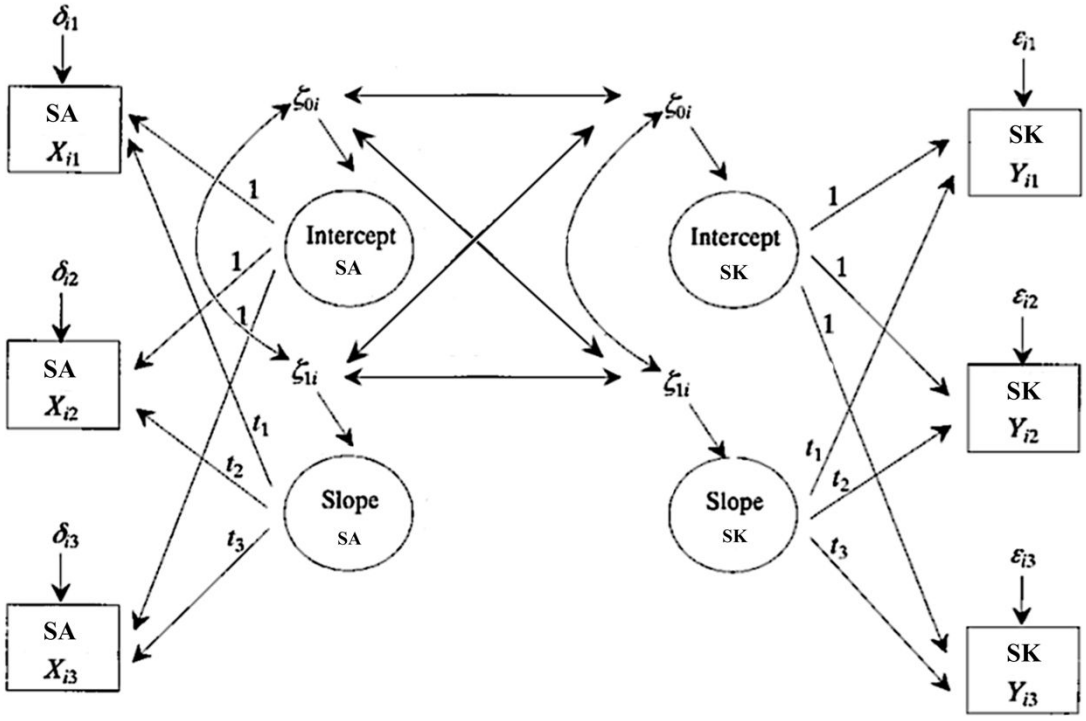


Figure 2: Parallel process latent growth model profile



SK: sexuality knowledge, SA: sexuality attitude.

Appendix Table 1. PP-LGM model fit for sexuality knowledge and attitude

	PP-LGM (N = 3,415)			PP-LGM with covariate[a] (N = 3,415)			PP-LGM with covariate[b] (N = 3,415)			Intervention group PP-LGM (N = 2,014)		
Residual Variances	**Estimates**	**SE**	***p* value**	**Estimates**	**SE**	***p* value**	**Estimates**	**SE**	***p* value**	**Estimates**	**SE**	***p* value**
Intervention group												
SK intercept	8.98	0.73	＜0.001	8.16	0.72	＜0.001	8.30	0.73	＜0.001	8.13	0.74	＜0.001
SK slope	7.35	1.07	＜0.001	7.99	1.15	＜0.001	7.95	1.16	＜0.001	6.95	1.12	＜0.001
SA intercept	97.56	13.67	＜0.001	74.61	14.06	＜0.001	73.51	14.04	＜0.001	75.56	14.84	＜0.001
SA slope	37.45	17.34	0.031	29.92	18.94	0.114	27.12	19.00	0.153	26.13	19.29	0.176
Control group												
SK intercept	11.68	0.85	＜0.001	9.76	0.77	＜0.001	10.00	0.79	＜0.001	NA	NA	NA
SK slope	1.31	0.56	0.02	1.03	0.67	0.122	0.99	0.7	0.159	NA	NA	NA
SA intercept	133.73	9.25	＜0.001	103.49	8.51	＜0.001	105.18	8.51	＜0.001	NA	NA	NA
SA slope	16.91	6.38	0.008	10.45	4.73	0.027	10.60	4.58	0.021	NA	NA	NA
Model fit												
RMSEA (90%CI)	0.092 (0.080-0.106)			0.017 (0.009-0.025)			0.017 (0.009-0.024)			0.021 (0.012-0.030)		
CFI	0.983			0.997			0.997			0.995		
TLI	0.950			0.990			0.990			0.985		
SRMR	0.033			0.012			0.013			0.013		
R-Squared												
slope of the intervention group												
SK	NA	NA	NA	0.12	0.02	＜0.001	0.12	0.02	＜0.001	0.28	0.04	＜0.001
SA	NA	NA	NA	0.15	0.09	0.081	0.18	0.11	0.096	0.34	0.17	0.043
slope of the control group												
SK	NA	NA	NA	0.02	0.02	0.151	0.03	0.02	0.104	NA	NA	NA
SA	NA	NA	NA	0.12	0.04	0.002	0.14	0.04	0.002	NA	NA	NA

Note: SK: sexuality knowledge, SA: sexuality attitude. [a] Sexuality content and time were included in the model as covariates. [b] Sexuality education at different schooling stages was included in the model as covariates. NA: not applicable

Appendix Table 2. The effects of duration of education and sessions covered on the intercepts and slopes of sexuality knowledge and attitude

		SK Intercept			SK Slope			SA Intercept			SA Slope		
		Estimate	**SE**	***p***	**Estimate**	**SE**	***p***	**Estimate**	**SE**	***p***	**Estimate**	**SE**	***p***
Age	Intervention	0.26	0.10	0.013	-0.17	0.11	0.123	-0.17	0.33	0.618	-0.37	0.37	0.325
	Control	0.15	0.12	0.181	-0.03	0.07	0.634	-0.72	0.38	0.055	-0.03	0.18	0.855
Sex	Intervention	0.84	0.16	＜0.001	1.26	0.19	＜0.001	6.72	0.53	＜0.001	3.20	0.56	＜0.001
	Control	0.66	0.20	0.001	0.15	0.12	0.208	6.48	0.68	＜0.001	2.06	0.49	＜0.001
Minority	Intervention	-0.35	0.19	0.062	-0.31	0.22	0.147	-1.25	0.61	0.039	-0.06	0.69	0.933
	Control	-1.00	0.24	＜0.001	0.08	0.12	0.520	-2.98	0.78	＜0.001	-0.23	0.42	0.580
School Bully Perception	Intervention	-0.21	0.08	0.007	-0.34	0.09	＜0.001	-1.15	0.26	＜0.001	-0.60	0.34	0.073
	Control	-0.32	0.09	＜0.001	0.00	0.05	0.928	-1.20	0.38	0.002	0.07	0.20	0.726
Location	Intervention	-0.90	0.20	＜0.001	0.82	0.22	＜0.001	-3.98	0.65	＜0.001	1.78	0.65	0.006
	Control	-0.36	0.23	0.126	0.01	0.14	0.957	-1.53	0.74	0.039	0.26	0.37	0.484
Romantic Relationship	Intervention	0.57	0.18	0.002	-0.53	0.20	0.009	-0.02	0.59	0.975	-0.46	0.63	0.464
	Control	0.21	0.22	0.339	-0.13	0.14	0.368	-0.79	0.73	0.280	-0.12	0.35	0.728
Sexual Experience	Intervention	1.48	0.25	＜0.001	-1.07	0.27	＜0.001	1.19	0.79	0.131	-0.42	0.86	0.626
	Control	1.41	0.30	＜0.001	-0.09	0.16	0.595	1.27	0.99	0.198	-1.04	0.58	0.071
Sexual Harassment	Intervention	0.78	0.20	＜0.001	-0.10	0.22	0.656	1.12	0.72	0.122	2.43	0.72	0.001
	Control	1.40	0.25	＜0.001	-0.13	0.12	0.276	3.75	0.89	＜0.001	0.01	0.43	0.988
Same Sex Intercourse	Intervention	0.65	0.38	0.085	-0.91	0.45	0.042	0.58	1.28	0.652	-3.19	1.30	0.014
	Control	0.32	0.48	0.507	-0.21	0.26	0.416	-0.60	1.85	0.746	-0.21	0.93	0.820
Parent Divorce	Intervention	0.60	0.24	0.012	-0.19	0.27	0.477	2.29	0.75	0.002	1.21	0.77	0.117
	Control	0.09	0.28	0.755	0.18	0.13	0.172	0.54	1.00	0.587	0.53	0.49	0.280
Duration of Sexuality	Intervention	0.16	0.07	0.018	-0.10	0.09	0.250	-0.27	0.23	0.237	0.30	0.24	0.210
Education Received	Control	0.11	0.09	0.234	-0.04	0.05	0.472	0.19	0.32	0.558	-0.11	0.18	0.519
Sessions Covered in	Intervention	0.13	0.04	0.002	-0.09	0.05	0.062	0.50	0.14	＜0.001	-0.10	0.14	0.506
Sexuality education	Control	0.21	0.05	＜0.001	0.00	0.03	0.998	0.49	0.17	0.004	-0.07	0.09	0.460
Experience													
Curriculum Progress	Intervention	0.09	0.03	0.001	0.45	0.04	＜0.001	0.28	0.09	0.002	1.01	0.12	＜0.001

Note: SK: sexuality knowledge, SA: sexuality attitude

Appendix Table 3. The effects of different sexual education periods on the intercepts and slopes of sexuality knowledge and attitude

		SK Intercept			SK Slope			SA Intercept			SA Slope		
		Estimate	**SE**	***p***	**Estimate**	**SE**	***p***	**Estimate**	**SE**	***p***	**Estimate**	**SE**	***p***
Age	Intervention	0.25	0.11	0.018	-0.17	0.11	0.135	-0.22	0.33	0.503	-0.34	0.37	0.363
	Control	0.17	0.12	0.148	-0.03	0.07	0.634	-0.68	0.38	0.073	-0.03	0.18	0.857
Sex	Intervention	0.90	0.17	＜0.001	1.22	0.19	＜0.001	6.81	0.54	＜0.001	3.30	0.56	＜0.001
	Control	0.72	0.21	＜0.001	0.16	0.12	0.186	6.65	0.69	＜0.001	2.07	0.49	＜0.001
Minority	Intervention	-0.36	0.19	0.061	-0.32	0.22	0.140	-1.29	0.61	0.034	-0.05	0.69	0.947
	Control	-1.04	0.24	＜0.001	0.07	0.12	0.526	-3.09	0.78	＜0.001	-0.21	0.42	0.622
School Bully Perception	Intervention	-0.21	0.08	0.007	-0.34	0.09	＜0.001	-1.19	0.26	＜0.001	-0.58	0.34	0.084
	Control	-0.31	0.09	＜0.001	-0.01	0.05	0.908	-1.18	0.38	0.002	0.06	0.20	0.772
Location	Intervention	-0.87	0.20	＜0.001	0.79	0.22	＜0.001	-4.06	0.65	＜0.001	1.74	0.65	0.008
	Control	-0.37	0.24	0.126	-0.01	0.13	0.929	-1.57	0.76	0.038	0.28	0.37	0.453
Romantic Relationship	Intervention	0.64	0.19	0.001	-0.57	0.21	0.005	0.14	0.59	0.809	-0.52	0.63	0.407
	Control	0.24	0.22	0.275	-0.12	0.14	0.389	-0.72	0.73	0.324	-0.13	0.36	0.726
Sexual Experience	Intervention	1.56	0.25	＜0.001	-1.10	0.28	＜0.001	1.49	0.79	0.060	-0.50	0.86	0.565
	Control	1.51	0.31	＜0.001	-0.08	0.16	0.609	1.48	0.98	0.132	-1.09	0.58	0.059
Sexual Harassment	Intervention	0.83	0.21	＜0.001	-0.12	0.22	0.588	1.34	0.72	0.063	2.35	0.71	0.001
	Control	1.42	0.26	＜0.001	-0.12	0.12	0.299	3.79	0.89	＜0.001	0.03	0.43	0.954
Same Sex Intercourse	Intervention	0.71	0.38	0.062	-0.97	0.45	0.033	0.56	1.30	0.667	-3.24	1.32	0.014
	Control	0.24	0.48	0.623	-0.22	0.26	0.389	-0.80	1.86	0.666	-0.21	0.94	0.824
Parent Divorce	Intervention	0.60	0.24	0.013	-0.18	0.28	0.515	2.37	0.75	0.002	1.17	0.77	0.131
	Control	0.07	0.28	0.793	0.18	0.13	0.174	0.54	1.00	0.589	0.51	0.49	0.299
Primary School	Intervention	0.50	0.27	0.064	-0.50	0.29	0.089	0.88	0.94	0.347	-1.31	0.95	0.168
Sexuality Education	Control	0.72	0.36	0.045	0.08	0.17	0.640	1.49	1.27	0.242	1.10	0.62	0.075
Junior High School	Intervention	0.47	0.17	0.007	-0.45	0.19	0.021	-0.28	0.55	0.617	1.43	0.59	0.016
Sexuality Education	Control	0.69	0.22	0.002	-0.10	0.17	0.539	2.04	0.69	0.003	-0.74	0.37	0.044
Vocational High School	Intervention	0.49	0.19	0.011	-0.19	0.21	0.373	1.39	0.63	0.026	-0.59	0.63	0.350
Sexuality Education	Control	0.46	0.24	0.058	-0.19	0.12	0.110	0.64	0.82	0.435	-0.77	0.45	0.088
Curriculum Progress	Intervention	0.10	0.03	0.001	0.44	0.04	＜0.001	0.29	0.09	0.001	1.00	0.12	＜0.001

Note: SK: sexuality knowledge, SA: sexuality attitude