

The Effect of Proactive Cognitive Game Method Based on Self-Control Theory on Knowledge and Premarital Sexual Behavior of Indonesian Female Adolescents in Surabaya City: A Quasi-experimental Study

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ARTICLE INFO	ABSTRACT
Article type: Original article	Background & aim: In Indonesia, premarital sex is currently a common concern among many sexual problems affecting adolescents. This study aimed to determine the effect of proactive cognitive game methods based on self-control theory on knowledge and premarital sexual behavior of adolescent girls.
Article History: Received: 29-Dec-2023 Accepted: 14-Jul-2024	Methods: A total of 127 female adolescent students from two senior high schools in Surabaya City, Indonesia, were included in this quasi-experimental research. They were selected using simple random sampling and equally divided into two groups. The students received health education on premarital sexual behavior through a proactive cognitive game (intervention group) and lecture method (control group) in one session each for 60 minutes. Assessment of participants' knowledge and premarital sexual behavior in two groups was performed using knowledge and premarital sexual behavior questionnaires before and three days after intervention. Data were analyzed by Wilcoxon signed-rank and Mann-Whitney test using SPSS version 26.
Key words: Health Education Self-control Knowledge Sexual Behavior Adolescent	Results: There was a significant difference in knowledge (game: $P=0.000$, lecture: $P=0.003$) and sexual behavior (game: $P=0.000$, lecture: $P=0.000$) between pre- and post-test. Moreover, there was a significant difference in knowledge ($P=0.023$) and sexual behavior changes ($P=0.001$) between the game and control groups. The game group showed more impact on improving participants' knowledge and reducing sexual behavior than the control group.
	Conclusion: The proactive cognitive game intervention was more effective in enhancing the knowledge of participants and reducing premarital sexual behavior than the lecture group. This game method is therefore recommended as a reference for health education to prevent premarital sexual behavior.

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Introduction

Premarital sexual behavior (sex before marriage) is a social problem that is increasingly common in society (1). Middle (15–18 years) and late adolescents (19–21 years) are more likely to experience this problem. In Indonesia, the percentage of adolescents who experienced their first sexual intercourse, increased from 59% in 2012 to 74% in 2017 (2). This means that there is an increased incidence of premarital sex in Indonesian adolescents. Furthermore, the shift in

the age of first sexual intercourse in 2023 was younger (15–17 years old) (3) than in 2017, which was at the age of 17–18 years (2). Meanwhile, the average woman in Indonesia gets married at the age of 21–22 years (3). These data show that the phenomenon of premarital sex among Indonesian adolescents is common today.

Although free sex among teenagers is not a new thing, such behavior in the Indonesian community should be avoided due to the

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religious and cultural values of the Indonesian nation (4). The issue of premarital sexual behavior in adolescents cannot be separated from the development and growth experienced by adolescents, such as trying various new things and great curiosity (5) to obtain social recognition without considering the impact (6). Self-control is one of the factors that can influence premarital sexual behavior in adolescents (7). Several studies have reported that adolescents who have high self-control tend not to engage in sexual behavior (8-9). Moreover, other researchers have reported that adolescents who lack self-control tend to get involved in unsafe sexual activities (10-11). In addition, adolescents with premarital sexual behavior lack sexual knowledge (12). Kumalasari et al. (2020) (13) have reported that a high level of adolescent knowledge will result in good self-control actions toward premarital sexual behavior.

Surabaya City in East Java Province has the highest number of adolescent issues, such as unwanted pregnancies. Premarital sex is one of the primary causes that teenagers marry so quickly (12). Moreover, a previous study has shown that most adolescents in Surabaya still have a low level of premarital sex knowledge since premarital sexual behavior is still rarely discussed with adolescents, as this matter is considered taboo (14). Thus, adolescents with good knowledge of premarital sex tend to have good self-control to go through their teenage phase and avoid delinquency that leads to premarital sexual behavior.

There are various efforts to overcome the problem of premarital sexual behavior in adolescents, such as sexual education. Several studies have reported that delivering health education to adolescents through the lecture method (15) and using games (16-18) can improve their knowledge of premarital sexual behavior. The lecture method is most often used to provide health counseling, but it is usually less interesting and seems boring for the listeners (19). Therefore, alternative methods of sexual education to choose creative and innovative tools are needed to prevent the material from being monotonous and boring so that the delivery of information becomes better. The use of games in learning methods can change the initially boring

subject matter to be more interactive and interesting, and can also increase learning effectiveness and motivation (20).

The proactive cognitive game emphasizes how adolescents in learning activities are encouraged to play an active role (proactive) in communicating their views on an issue (cognitive). As a result, teens can decide for themselves whether the problem is beneficial to them or not (21). Previous studies have shown that the proactive cognitive game is effective in educating the impact of early marriage on adolescents (22-23). However, there is a lack of research on the effects of proactive cognitive games on adolescents' knowledge and premarital sexual behavior, particularly in Surabaya, Indonesia, which highlights the necessity of this study. . Therefore, this study was conducted to evaluate the influence of a proactive cognitive game method based on self-control theory on the knowledge and premarital sexual behavior of adolescent girls in Surabaya City, Indonesia.

Materials and Methods

This research was a quasi-experimental study with a pretest-posttest design. The population included female adolescent students who actively studied in two senior high schools in Surabaya City. The sample size was then determined using the following formula:

$$\text{Sample size} = \frac{N}{1 + N(d^2)}$$

N = population size

d² = confidence level (0.05)

Based on the results of calculations using the formula above, the final sample size of 127 was estimated (Fig. 1). The samples were selected using simple random sampling. A total of 127 participants in this study were grouped into two: control (63 people) and intervention (64 people). The inclusion criteria in this study were female students from grade 11 who were already dating, had never received sexual health education, and those willing to participate in the study. The exclusion criteria included individuals who had never dated, and those unwilling to participate in this study.

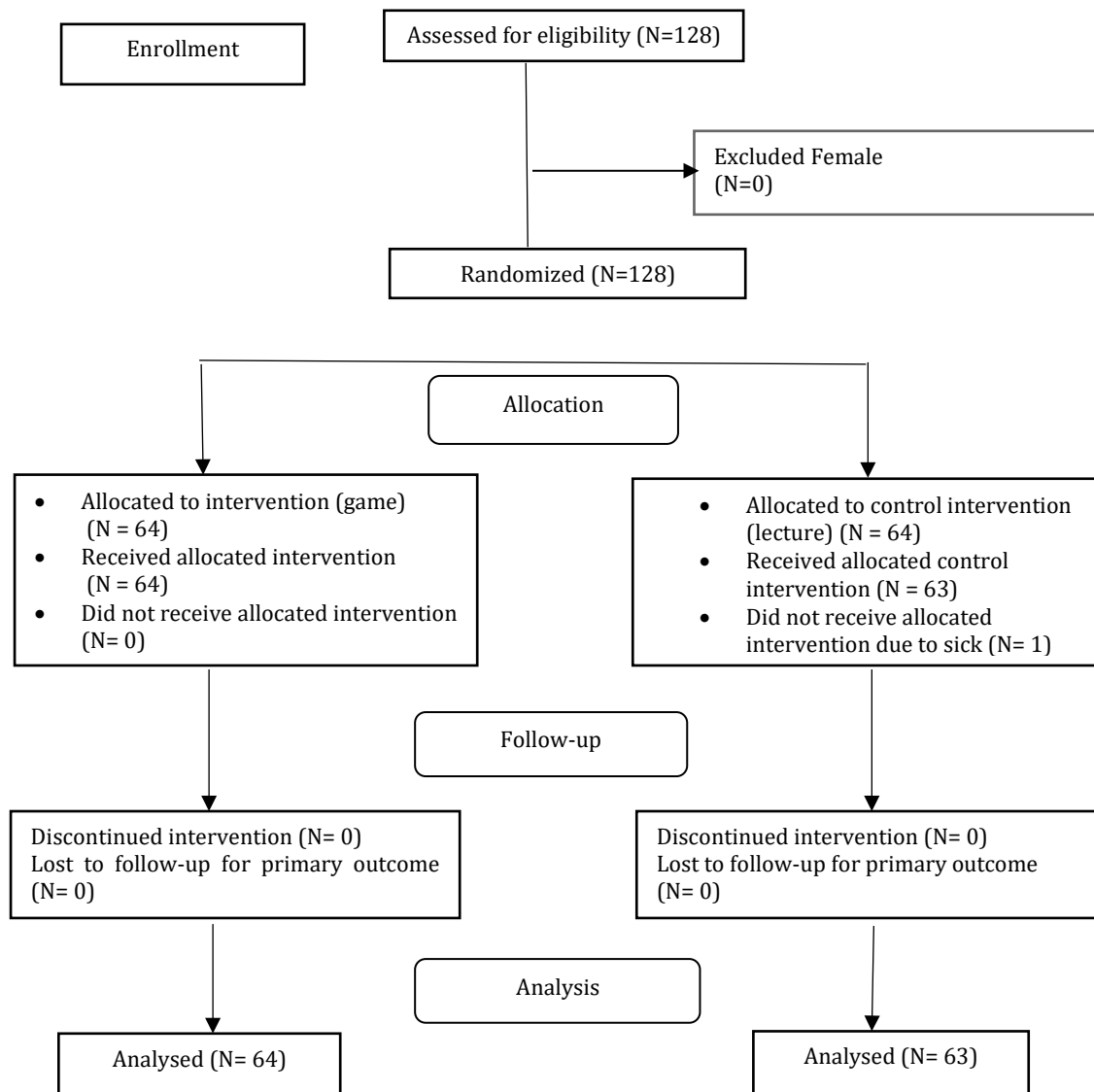


Figure 1. CONSORT Flowchart of the study

Pre- and post-tests were conducted in both groups. Participants in the intervention (game) group received intervention in the form of premarital sexual behavior health education through proactive cognitive game methods. Meanwhile, the participants in the control (lecture) group received sexual health education through the lecture method as a conventional approach (23).

The independent variable in this study was a proactive cognitive game method based on self-control and lecture method, while the dependent variables were knowledge and premarital sexual

behavior. The research instruments in this study included a questionnaire and a game book. The questionnaire for data collection consisted of questions related to knowledge and sexual behavior. The questionnaires were used to evaluate the participants in the two groups before and after the intervention.

The demographic data questionnaire included eight questions for participants' data collection: age, education (participants, father, and mother), occupation (father and mother), and income (father and mother). The knowledge questionnaire on the prevention of premarital

sexual behavior consisted of 11 questions. The questionnaire included the following topics: the negative impact of young premarital pregnancy, the impact of sexual diseases and premarital sex, and the prevention of premarital sex. This questionnaire used the Guttman scale and there were two responses: true or false (24). A correct answer was scored 1 while wrong answer was scored 0. This questionnaire contained 11 questions, hence the total score ranged from 0 to 11. If the total score of the questionnaire was $\geq 75\%$ (correct answer ≥ 8), 56–74% (correct answer = 6–7), and $< 55\%$ (correct answer < 6), the knowledge was categorised as high, medium, and low, respectively (24). Furthermore, the questionnaire on premarital sexual behavior consisted of 25 questions that were modified from another study (25). The questionnaire included the following topics: watching pornographic images/films, attraction to the opposite sex, activities with the opposite sex (kissing, hugging), and sexual intercourse. This questionnaire used the Likert scale with multiple choices: never, rarely, often, and always (25). The score of “never”, “rarely”, “often”, and “always” choices was 1, 2, 3, and 4, respectively. The lowest score was 25 and the highest score was 100. Premarital sexual behavior was categorised as low (score: 25–49), medium (50–74,) and high (75–100). The validity of questionnaires were evaluated by six experts from the public health office (1), ministry of religion (1), psychologist/counseling guidance (1), police (1), national population and family planning agency (1), and obstetricians (1). The questionnaire was then revised based on suggestions from experts to ensure the need, relevance, clarity, and completeness of the questions. The reliability test results of these questionnaires showed a Cronbach’s alpha value of more than 0.6, indicating that the questionnaire was reliable (knowledge questionnaire = 0.831, sexual behavior questionnaire = 0.95).

The game book was developed to be a tool for reproductive health education about sexual behavior, its impact, and prevention. It consists of a proactive cognitive game guide based on self-control using Uno Stacko (block-stacking tower game) to increase students’ motivation to learn. Some studies have reported that the Uno Stacko game has advantages in educating the premarital

sexual behavior of adolescent girls, which can increase motivation to learn (26) and improve students’ cognitive abilities and knowledge (27). This is because students are required to think critically to solve problems by discussing and training students’ memory related to premarital sex (27).

This study was conducted in the following steps. First, all the subjects in the two groups filled in demographic information and answered the questionnaire related to knowledge and sexual behavior using a self-report method.

Second, materials were delivered to adolescent girls using different methods in the two groups (health education). In the game method, materials were taught to students by playing stacking blocks using Uno Stacko and asking questions about reproductive problems or sexual deviations with cognitive-proactive principles. The cognitive-proactive principle was carried out by encouraging participants to answer reproductive health and sexuality issues in adolescents proactively (proactive) through questions that should be answered (cognitive) in the block stacking game. It was assumed that this method will be more effective and internalized for adolescent education because it follows the stages of youth development.

The game was conducted in one session containing materials such as premarital sexual behavior, influencing factors, impacts, and prevention. Health education using a game was implemented in a senior high school in Surabaya City, and 64 students (intervention group) participated in the game. When the game method was implemented, the 64 participants were divided into 2 teams with 32 team members each. In detail, the technique of proactive cognitive game method based on self-control theory using Uno Stacko for health education in this study was conducted as follows:

1. The game facilitator randomly arranged 24 stacko blocks (12 question blocks + 12 “you’re not lucky yet” blocks).
2. Participants were divided into two teams (e.g., Teams A and B) and competed against each other to stack the highest number of blocks to win the game, in a way that the more participants knew, the more blocks they got to stack.

3. The team that could explain the definition of premarital sexual behavior got the first turn (example: Team A) and had to take one block that had been randomly arranged by the facilitator (could not take the top 3 blocks and had to be one-handed).

4. Once the block was taken, Team A read out the question on the block, and then Team B answered it. If the answer was incorrect, Team B could not take the block; they had to wait for Team A's turn to take the block. If the answer was correct, then it was Team B's turn to take and throw the question at Team A.

5. If the block taken said "You are not lucky," then the block had to be put back to the top of the arrangement, and the turn of another player continued.

6. Only blocks with questions could be taken and stacked in the respective team area.

7. If one team had the most questions answered, that team would have the most blocks to stack.

8. If the facilitator's blocks ran out or collapsed, the game was over (could also be time-limited), and each team's blocks had to be measured to find the highest.

9. In the end, it was known which team knew the most about the topic from the tallest blocks, and the losing team could increase their knowledge through this game.

On the other hand, the control group received the previously mentioned learning materials through the lecture method (traditional method of teaching) by one speaker who is an expert in the field. The lecture method was conducted in one session with the material: premarital sexual behavior, influencing factors, impacts, and prevention delivered by the speaker using Power point slides. In the lecture method, the speaker delivered materials orally and interacted actively with participants through a discussion session.

Three days after the implementation of the game and lecture method, research participants answered the questionnaire again (post-test) to evaluate the influence of the proactive cognitive game method based on self-control on the knowledge and premarital sexual behavior of students. According a previous research (28), the follow-up (post-test) in this study was performed

three days after the health education to give participants enough time to understand and review the materials.

All statistical analyses were performed using SPSS for Windows, version 26.0 (SPSS Inc., Chicago, IL, USA). The Wilcoxon signed-rank test was used to evaluate the differences between before and after the implementation of educational methods. The Mann-Whitney test was used to evaluate the changes in the knowledge and sexual behavior in intervention and control groups.

This study was approved by the Health Research Ethics Committee of Polytechnic Health Ministry of Health Surabaya, Indonesia (no. EA/1963/KEPK-Poltekkes_Sby/V/2023). Before the study, written informed consent was obtained from all participants involved in this research.

Results

The initial sample size in this study was 128 participants. They were divided into two groups, including 64 samples each for the lecture and game methods. However, at the time of data collection for the lecture method group, there were only 63 samples since one sample could not participate due to illness. Table 1 shows the characteristics of participants in this study.

Table 1 shows that most adolescent girls were in the age category 1 in the lecture (76.2%) and game methods (76.6%). Almost all participants were Muslim in the lecture and game methods (84.1% and 100%, respectively). All of the participants were 11th-grade senior high school students. In addition, demographics between the lecture and game methods based on the father's and mother's education tend to be the same in number and percentage, which is most dominant in state universities. Furthermore, demographics between the lecture and game methods based on the father's and mother's occupation tend to be the same in number and percentage, the most dominant being working and not working, respectively. Moreover, the demographics between the lecture and game methods based on the father's and mother's income tend to be the same in number and percentage, which is most dominant in the income of 1–10 million.

Table 1. Demographic characteristics of the lecture and game groups (N=127)

Demographic Characteristics	Methods (%)		Total (%) (N=127)
	Lecture (N=63)	Game (N=64)	
Age			
12-16 years old	48 (76.2%)	49 (76.6%)	97 (76.4%)
17-25 years old	15 (23.8%)	15 (23.4%)	30 (23.6%)
Religion			
Islam	53 (84.1%)	64 (100.0%)	117 (92.1%)
Hindu	2 (3.2%)	0 (0.0%)	2 (1.6%)
Buddhist	1 (1.6%)	0 (0.0%)	1 (0.8%)
Christian	7 (11.1%)	0 (0.0%)	7 (5.5%)
Participants' Education			
Senior High School (Grade 11)	63 (100%)	64 (100%)	127 (100%)
Father's Education			
Elementary School	1 (1.6%)	1 (1.6%)	2 (1.6%)
Junior High School	2 (3.2%)	1 (1.6%)	3 (2.4%)
Senior High School	24 (38.1%)	23 (35.9%)	47 (37.0%)
State University	25 (39.7%)	23 (35.9%)	48 (37.8%)
Unknown	11 (17.5%)	16 (25.0%)	27 (21.3%)
Mother's Education			
Elementary School	1 (1.6%)	2 (3.1%)	3 (2.4%)
Junior High School	5 (7.9%)	0 (0.0%)	5 (3.9%)
Senior High School	22 (34.9%)	20 (31.3%)	42 (33.1%)
State University	24 (38.1%)	30 (46.9%)	54 (42.5%)
Unknown	11 (17.5%)	12 (18.8%)	23 (18.1%)
Father's Work			
Not Working	2 (3.2%)	0 (0.0%)	2 (1.6%)
Working	52 (82.5%)	54 (84.4%)	106 (83.6%)
Unknown	9 (14.3%)	10 (15.6%)	19 (15.0%)
Mother's Work			
Not Working	28 (44.4%)	24 (37.5%)	52 (40.9%)
Working	25 (39.7%)	28 (43.8%)	53 (41.7%)
Unknown	10 (15.9%)	12 (18.8%)	22 (17.3%)
Father's Income			
1-10 Million	29 (46.0%)	37 (57.8%)	66 (52.0%)
11-20 Million	1 (1.6%)	1 (1.6%)	2 (1.6%)
Not Filled	33 (52.4%)	26 (40.6%)	59 (46.5%)
Mother's Income			
1-10 Million	13 (20.6%)	18 (28.1%)	31 (24.4%)
11-20 Million	1 (1.6%)	1 (1.6%)	2 (1.6%)
Not Filled	49 (77.8%)	45 (70.3%)	94 (74.0%)

Table 2 shows the category of knowledge and sexual behavior in adolescent girls (%) before and after the implementation of the educational methods. The pre-test results showed that most of the participants' knowledge on prevention of premarital sexual behavior was at a moderate level (73.2%). Low knowledge was more dominant in the lecture group (23.8%), medium knowledge in the game group (82.8%), and high knowledge in the lecture group (12.7%). After the health sexual education (post-test), most participants had medium knowledge (73.2%). In addition, low knowledge was more dominant in

the lecture group (20.6%), moderate knowledge in the game group (75%), and almost balanced with the lecture group (71.4%), and high knowledge in the game group (23.4%).

Regarding sexual behavior, in the pre-test, the findings indicated that most of the participants' sexual behavior was moderate (73.2%). Table 2 shows that low sexual behavior was more dominant in the lecture group (17.5%), moderate sexual behavior in the game group (79.7%), and high sexual behavior in the control group (15.9%).

Table 2. Comparison of the mean scores of knowledge and sexual behavior before and after the intervention in the lecture and game groups (N = 127)

Knowledge Variables						
Categories	Pre-test			Post-test		
	Group		Total	Group		Total
	Lecture	Game		Lecture	Game	
Low	15 23.80%	8 12.50%	23 18.10%	13 20.6%	1 1.6%	14 11.0%
Medium	40 63.50%	53 82.80%	93 73.20%	45 71.4%	48 75.0%	93 73.2%
High	8 12.70%	3 4.70%	11 8.70%	5 7.9%	15 23.4%	20 15.7%
Total	63 100.00%	64 100.00%	127 100.00%	63 100.00%	64 100.0%	127 100.0%
Sexual Behavior Variables						
Categories	Pre-test			Post-test		
	Group		Total	Group		Total
	Lecture	Game		Lecture	Game	
Low	11 17.50%	5 7.80%	16 12.60%	4 6.3%	3 4.7%	7 5.5%
Medium	42 66.70%	51 79.70%	93 73.20%	48 76.2%	61 95.3%	109 85.8%
High	10 15.90%	8 12.50%	18 14.20%	11 17.5%	0 0.0%	11 8.7%
Total	63 100.00%	64 100.00%	127 100.00%	63 100.00%	64 100.0%	127 100.0%

Note: Data is divided based on the mean and standard deviation scores. Low category: less than mean - 1 SD; Medium category: between mean - 1 SD to mean + 1 SD; High category: > mean + 1 SD. Once there were 3 categories, a cross-tabulation analysis with groups was conducted.

After the implementation of the educational method (post-test), most of the participants' sexual behavior was in the moderate category (85.8%) (Table 2). In addition, low sexual behavior (20.6%) was almost the same between lecture and game methods. Moderate sexual behavior in the game group was more dominant

(95.3%), and high sexual behavior in the lecture group (17.5%).

Differences in Knowledge and Sexual Behavior Before and After Implementing Educational Methods

Table 3 shows the differences in knowledge and sexual behavior before and after the lecture and game.

Table 3. Comparison of pre and post-test score of knowledge and sexual behaviour in the lecture and game groups (N = 127)

Variables	Pre-test	Post-test	P-Value
	Mean $\pm$ SD	Mean $\pm$ SD	
Knowledge			
Lecture	7.56 + 1.673	8.27 + 1.096	0.003*
Game	7.69 $\pm$ 1.5	9.02 $\pm$ 0.745	0.000*
Sexual Behavior			
Lecture	34.9 + 7.892	33.48 + 6.599	0.000*
Game	33.94 + 4.823	30.8 + 2.571	0.000*

Wilcoxon Test, *significant difference

There were significant differences in knowledge (P = 0.003) and sexual behavior (P =

0.000) before and after being given the lecture. Moreover, there were significant differences in

the knowledge of female adolescents on the prevention of premarital sexual behavior ($P = 0.000$) and sexual behavior ($P = 0.000$) before and after being given the game.

Changes in Knowledge and Sexual Behavior in the Lecture and Game Groups

Table 4 shows that there was a significant difference in changes in knowledge between the lecture and game groups ($P = 0.023$). Changes in knowledge were lower in the lecture group than in the game group, with median values of 1 (-3 - 5) and 1 (0 - 7), respectively. In the lecture group, there was still a negative minimum value, which means that there was a decrease in knowledge, and the highest increase was 5. In the game

group, some respondents did not change their knowledge with a minimum value of 0, but there was an increase in knowledge with the highest change of 7.

Table 4 indicated a significant difference in sexual behavior change between the lecture and game groups ($P = 0.001$). In detail, the difference test results of sexual behavior changes were higher in the game group than in the lecture group, with median values of -2 (-11 - 0) and -1 (-8 - 0), respectively. The negative symbol indicates that sexual behavior decreases. From the median value, it can be seen that there was a greater decrease in sexual behavior in the game group than in the lecture group.

Table 4. Comparison of the mean difference scores of knowledge and sexual behavior between the lecture and game groups (N= 127)

Variables	Lecture	Game	P-Value
	Median (Range) Mean + SD	Median (Range) Mean + SD	
Knowledge	1 (-3 - 5) 0.71 + 1.782	1 (0 - 7) 1.33 + 1.322	0.023*
Sexual Behavior	-1 (-8 - 0) -1.43 ± 1.898	-2 (-11 - 0) -3.14 ± 3.101	0.001*

Mann-Whitney Test, *Significant differences

Results showed that the game group had a greater impact on increasing respondents' knowledge and reducing sexual behavior than the lecture group. This indicates that the game method was more effective in improving the knowledge on the prevention of premarital sexual behavior and reducing sexual behavior of senior high school adolescent girls.

Discussion

This study aimed to determine the effect of proactive cognitive game methods based on self-control theory on knowledge and premarital sexual behavior of adolescent girls. Most of the participants in this study were in early and middle adolescence (12-16 years old), while 23.6% of them were in late adolescence. Teenagers in the early adolescence phase tend to desire to experience new activities, particularly things related to sexuality (29). During middle adolescence, teenagers start experimenting with various things to learn about themselves (30). Moreover, at this phase,

adolescents experience the puberty phase, and then they begin to consider having sex and are attracted to the opposite sex (31). All participants were adolescent girls in grades 11. During this period, adolescents begin to build connections with many friends and are susceptible to inappropriate peer behavior if they lack self-control. Duru et al. have reported that peer pressure is one of the main drivers of premarital sex in Africa (32).

This study focused on the effect of the proactive cognitive game method based on self-control theory on the knowledge and premarital sexual behavior of adolescent girls. In addition to using the game method, this study used the lecture method as a control because it is a traditional learning method frequently used. This study proved that the total number of participants who had high sexual behavior decreased both after the implementation of the lecture and game methods. Meanwhile, the study findings showed an increased number of participants who had a high knowledge of premarital sexual behavior after the

implementation of lecture and game methods). Based on these results, the decrease in the number of participants who had high sexual behavior could be due to an increase in their knowledge regarding premarital sexual behavior after the implementation of the lecture and game methods. This is in line with Nasution, as cited in Nurmala et al. (2020) (12), who revealed that sexual behavior before marriage is significantly influenced by sexual knowledge, as premarital sex is more likely when there is a lack of knowledge and delicate emotional states Nurmala et al. (2020) (12).

The attitude about free sex of an adolescent can be influenced by knowledge factors. Since sex is considered taboo in Indonesia, adolescents become reluctant or embarrassed to discuss reproductive health or sexual education with elders (33). Consequently, they seek sexual knowledge from invalid sources. This will distort adolescents' understanding and perception of sex, leading to unhealthy sexual activity among adolescents (34). Hastuti et al. (2021) (35) study also reported that teenagers' curiosity about sex can be heightened by their lack of knowledge. As a result, they will naturally look for sexual knowledge from anywhere, thus triggering them to apply what they see. Therefore, proper knowledge or information plays an important role in determining attitudes toward action and behavior toward premarital sex.

Previous studies showed that improving adolescents' knowledge about premarital sexual behavior could be achieved by delivering education either through the lecture method (15) or using games (16) at various levels of education, including at the senior high school level. This study showed that there were differences in sexual behavior and the level of knowledge of participants about premarital sexual behavior before and after implementation of the lecture and game methods.

In this study, although the lecture method could also provide significant changes in sexual behavior and knowledge in adolescent girls, the proactive cognitive game method based on self-control theory had a more significant effect in reducing premarital sexual behavior and increasing participants' knowledge of premarital sexual behavior. This finding is supported by another research that showed a higher

improvement in knowledge and attitudes toward premarital pregnancy in the group using games as compared to the lecture method (18). This finding showed that the cognitive-proactive game education method using Uno Stacko can be an effective tool for health education on premarital sex to adolescents. The cognitive-proactive principle is applied by encouraging adolescents to participate in a discussion about a topic proactively (in this case, premarital sexual behavior) until they can decide on their own if something is positive or negative for them (22).

It is believed that the proactive cognitive game method based on self-control in this study increases the knowledge of adolescent girls because it involves peers in an open discussion process using the Uno Stacko game in a fun way, so that the material is easier to understand. In this study, the significant effect of using the Uno Stacko game may be influenced by an increase in the motivation of adolescent girls. This is in line with research conducted by Irvansyah and Romadona (2019) (26), who showed the effect of using the Uno Stacko game on students' motivation for literacy learning. This demonstrates that the Uno Stacko game is an effective medium in improving study motivation to make learning more interesting and less boring. This finding is also supported by Indriastuti and Abidin (2021) (36), who stated that game-based learning serves to attract cognitive interest and learning motivation.

Furthermore, game is effective for improving students' social interaction skills because it can encourage active participation of learners, allow for feedback that makes the learning process more effective, and improve the ability to express opinions in group discussions (37). In this study, the game will be a stimulus for students to interact with each other to maintain the integrity of the beam tower in the Stacko game. Moreover, students will organize strategies to solve this Uno Stacko game so that students will be more tolerant and learn to accept ideas, views, ideas, or strategies shown by their friends (38). Therefore, through this game in this study, adolescents learn about communicative skills such as interacting and getting along, communicating well, having good manners in speaking, being friendly, helping others, and respecting each other, to teachers, and the surrounding environment.

Moreover, the packaging of proactive cognitive games based on self-control plays an important role in teaching students self-control, namely, the ability to control their emotions. Calhoun and Acocella, as cited in Alkusani et al. (2022) (39), have defined self-control as a person's ability to regulate all processes related to physical, psychological, and behavioral. Self-control can be concluded as a set of processes that occur to form themselves. Therefore, self-control along with knowledge about premarital sexual behavior, risk factors, impacts, and prevention that can be improved in adolescent girls after the implementation of proactive cognitive games in this study, plays an important role in their self-control of sexual behavior before marriage.

The strength of this study is that it provides results that show changes before and after intervention. Moreover, it shows the effectiveness of the game method over the lecture method for health education in enhancing knowledge on the prevention of premarital sexual behavior and decreasing sexual behavior observed in female students. In addition, this study allows the cause-and-effect relationship of the variables studied to be known from both intervention and control subjects.

The short period between data collection for the post-test evaluation and the research intervention is one of the limitations of this study. Extending the time interval after the intervention to evaluate participants' sexual behavior and knowledge for the post-test could be one suggestion for similar studies in the future. It is recommended that, in further research, a strategy is needed using multimedia and more modern methods, along with examples of real cases in society, to increase reproductive health knowledge of premarital sexual behavior and efforts to prevent premarital sexual behavior. This study suggests that the proactive cognitive game method using Uno Stacko can be used by related parties such as schools and health offices as a reference for health education on premarital sexual behavior in adolescents.

Practically, the application of this research is that the game in this study can be used as one of the methods of reproductive health education on premarital sexual behavior by related parties such as the education office, health office, and

other institutions, both public and private. In addition, this game method can be integrated with learning methods in the reproductive health courses. It is expected that the results of this study can be a source of information in choosing tools and methods to educate adolescents about reproductive health, especially premarital sexual behavior, its impact, and prevention.

Conclusion

In conclusion, there were significant differences in knowledge between the lecture and game groups. The game group demonstrated a greater increase in knowledge compared to the lecture group. There were also significant differences in premarital sexual behavior between the game and lecture groups, where the game group showed a more substantial reduction in premarital sexual behavior than the lecture group. These results highlight the potential of proactive game interventions as an engaging and impactful tool for adolescent sexual health education.

Declarations

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Conflicts of interest

The authors declared no conflicts of interest.

Ethical approval

All procedures were conducted according to Declaration of Helsinki and approved by the Health Research Ethics Committee Before the study, written informed consent was obtained from all participants involved in this research.

Code of Ethics

This study was approved by the Health Research Ethics Committee of Polytechnic Health Ministry of Health Surabaya, Indonesia (no. EA/1963/KEPK-Poltekkes_Sby/V/2023).

Use of Artificial Intelligence (AI)

AI tools and technologies are not used to prepare this manuscript.

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Authors' contribution

DP and K contributed substantially in the conception and design of the study. KK carried out the data collection. DP analysed and interpreted the data and drafted the manuscript. DP and KK reviewed the manuscript critically for important intellectual content. All authors read and approved the final manuscript and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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