



Menstrual Hygiene Management Education to Improve Knowledge and Attitudes of Elementary and Secondary School Students in Semarang City

Sutopo Patria Jati^{1*}, Nurhasmadiar Nandini¹, Erlin Friska²,
Vanessa Rizky Aditya³, Nadiya Ridha Afifah¹

¹. Department of Health Administration and Policy, Faculty of Public Health, Universitas Diponegoro, Indonesia

². Public Health Department, Faculty of Medicine, Universitas Negeri Semarang, Indonesia

³. Center of Health Research, Institute for Research and Community Service, Universitas Diponegoro, Indonesia

*Corresponding Author: sutopopatria.jati@gmail.com

Received: 27th Dec 2025, revised: 09th March 2026 accepted: 15th April 2026

Abstract

Background: Inadequate Menstrual Hygiene Management (MHM) among adolescents, driven by cultural stigma and limited access to accurate information, increases the risk of reproductive tract infections and social challenges, such as school absenteeism, in urban settings such as Semarang City, Indonesia. This study assessed changes in MHM knowledge and attitudes following a quiz card game intervention among 1,234 adolescents aged 9–15 years from 19 elementary and junior high schools.

Methods: Using a pre-experimental, one-group, pretest–posttest design, structured questionnaires were administered before and after the intervention. The 30-minute quiz card game sessions, facilitated by trained educators, incorporated visual aids to address menstrual hygiene management (MHM) practices and cultural misconceptions.

Results: The Wilcoxon Signed-Rank Test showed significant improvements in knowledge ($Z = -14.874$, $p < 0.001$; mean: 5.08 to 6.67) and attitudes ($Z = -12.851$, $p < 0.001$; mean: 29.41 to 31.64), with 63% of respondents (777 individuals) demonstrating increased knowledge scores, including 336 with initially poor knowledge.

Conclusion: These findings highlight the effectiveness of quiz card games in engaging adolescents and reducing stigma. Integrating such interactive, culturally sensitive tools into school curricula can promote healthy menstrual practices, reduce health risks, and empower Semarang adolescents to adopt safe and dignified hygiene behaviors early on.

Keywords: Menstrual Hygiene Management, adolescent health, knowledge, attitudes, Semarang

Copyright (c) 2026 by the authors. Published by Faculty of Public Health, Universitas Diponegoro.

This is an open access article under the CC BY-SA License

DOI: <https://doi.org/10.14710/jphtr.v9i1.30729>



Introduction

The World Health Organization (WHO) defines adolescence as the period beginning with the onset of secondary sexual characteristics and continuing until the attainment of reproductive maturity. It encompasses psychological development from childhood to adulthood, as well as a transition from socioeconomic dependence

to independence.¹ During puberty, adolescent girls are particularly vulnerable to reproductive tract infections due to inadequate menstrual hygiene management (MHM), which can lead to health issues such as reproductive and genitourinary tract infections.^{2,3} Globally, over 50% of women are of reproductive age, yet approximately 500 million lack access to adequate menstrual hygiene resources,

contributing to poor MHM practices.⁴ Inadequate knowledge and skills often result in fear, uncertainty, and reduced confidence during menarche, particularly in developing countries where cultural stigmas and limited resources prevail.⁵

In Indonesia, cultural stigma and limited access to accurate information often hinder open discussions on reproductive health. Consequently, many adolescents lack an adequate understanding of critical topics, including menstrual hygiene management (MHM), which can impact their physical health and psychological well-being. The 2012 Indonesia Demographic and Health Survey reported that 25% of adolescent girls had not discussed menstruation before their first menstrual cycle, and 17% were unaware of its physiological significance.⁶ Although the national School Health Program (UKS) integrates menstrual education into primary and secondary school curricula, empirical evidence suggests that conventional methods, such as lectures, often fail to engage adolescents or address cultural misconceptions effectively.⁷

In Semarang City, a densely populated urban area in Central Java, Indonesia, adolescents face similar challenges due to limited access to engaging and age-appropriate educational interventions for smoking cessation. Local surveys indicate that many female and male adolescents hold misconceptions about menstruation, often influenced by cultural myths and a lack of formal education on the topic.⁸ These misconceptions contribute to inadequate MHM practices, increasing the risk of reproductive tract infections and social challenges such as school absenteeism and stigma.⁹ Schools are ideal settings for delivering reproductive health education, as they provide access to adolescents during a critical developmental stage.¹⁰

Menstrual Hygiene Management (MHM) is an integral component of reproductive health education, focusing on the practices and resources necessary to manage menstruation safely and with dignity. Effective MHM entails the use of clean menstrual products, access to adequate sanitation facilities, and accurate knowledge of menstrual health.¹¹ Interactive

educational approaches, such as quiz card games, have emerged as promising tools to enhance engagement and knowledge retention among adolescents. These methods align with adolescents' cognitive development by creating a non-intimidating and enjoyable learning environment.^{12,13} Compared with conventional lecture-based methods, card-based quiz games encourage active participation, peer interaction and collaborative learning. This approach is particularly relevant for sensitive topics such as menstruation, which are often associated with stigma and embarrassment among adolescents, because game-based activities can create a more relaxed atmosphere that facilitates open discussion.^{14–16} Previous studies have demonstrated that game-based interventions, such as domino cards and snakes-and-ladders, improve adolescents' understanding of reproductive health topics.^{17,18}

Despite the growing attention to menstrual hygiene management in adolescent health research, several gaps remain in the existing literature.¹⁹ Previous studies in Indonesia have examined various educational approaches to improve adolescents' knowledge of menstrual hygiene, including digital media and school-based educational programs.²⁰ However, many of these studies primarily focus on general reproductive health education or digital platforms rather than simple interactive learning tools that can be easily implemented in school settings. In addition, evidence evaluating quiz-based card games as an educational medium for menstrual hygiene management remains limited.²¹

Based on the importance of Menstrual Hygiene Management (MHM) in the context of reproductive health education and the potential of innovative educational media, this study aimed to examine the effectiveness of a quiz card game in improving adolescents' knowledge and attitudes toward menstrual hygiene management in Semarang City. This research is expected to contribute to the development of effective interventions that are sensitive to local culture, thereby empowering adolescents to adopt healthy menstrual hygiene practices.

Methods

Research Design

This study employed a quantitative approach with a pre-experimental, one-group pretest-posttest design to evaluate differences in knowledge and attitudes toward menstrual hygiene management (MHM) among elementary and secondary school students in Semarang City before and after an educational intervention using quiz card games. A pre-experimental design was chosen for its practicality in assessing the immediate effects of a single educational intervention within a single group without a control group, making it suitable for exploring the effectiveness of innovative educational methods in a school setting. The design facilitated a direct comparison of baseline and post-intervention outcomes, focusing on changes in the dependent variables: knowledge and attitudes toward MHM.

The research procedure began with the administration of a pre-test questionnaire to establish the baseline levels of participants' knowledge and attitudes regarding MHM. The intervention consisted of a structured educational session using quiz card games designed to deliver age-appropriate content on menstrual hygiene in an interactive and engaging format. Each session lasted approximately 30 minutes and utilized a set of 10 question cards categorized into five main themes: basic concepts of menstruation, use of clean and safe menstrual products, personal hygiene practices during menstruation, myths and facts about menstruation, and the disposal of menstrual waste. Each card contained either a multiple-choice question or a short scenario-based question to encourage discussion and critical thinking among the participants. The game was conducted in small groups of four to six students. Each group took turns drawing one card and discussing the answer within approximately 1–2 min before presenting their response. The facilitator then provided clarification and additional explanations to ensure accurate understanding. The sessions were facilitated by trained health educators to ensure consistency, clarity and active student participation. The quiz cards

incorporated visual aids, such as illustrations of hygiene practices, to enhance comprehension and retention, aligning with the cognitive and learning preferences of adolescent boys. The quiz card content was developed based on scientific literature, WHO guidelines on Menstrual Hygiene Management, and adolescent reproductive health education materials. Prior to implementation, the materials were reviewed and validated by public health and health education experts to ensure content accuracy, clarity, and age-appropriateness. To maintain consistency in implementation, the facilitators followed the same instructions, game structure, and discussion procedures across all sessions. Following the intervention, participants completed a post-test questionnaire identical to the pre-test to measure changes in knowledge and attitudes. This pretest–posttest comparison enabled a direct assessment of the intervention's effectiveness in improving MHM understanding and fostering positive attitudes among the students.

Participants of the Study

The study was conducted in 19 schools in Semarang City, comprising 1 Islamic Elementary School, 13 public elementary schools, and 5 junior high schools, between November 2023 and January 2024. The schools were selected using purposive sampling based on several criteria, including their location in the urban areas of Semarang City, the willingness of school authorities to participate in the intervention program, and accessibility for the research team. The study population consisted of adolescents in grades 4–9, aged 9–15 years, representing a diverse group of early and middle adolescents at a critical stage for learning about reproductive health. A purposive sampling technique was employed to select 1,234 respondents who met the inclusion criteria: students who had experienced or were expected to experience menarche (for girls) and those willing to participate in the study (for both girls and boys). The purposive sampling approach ensured that the participants were representative of the target age group and educational levels, while also accounting for

the diversity of urban school settings in Semarang City. Parental consent was obtained for all participants under 15 years of age, and students were informed about the study's purpose and procedures to ensure voluntary participation. The sample size was determined to provide sufficient statistical power to detect meaningful changes in knowledge and attitudes, considering the expected effect size of the educational intervention.

Instruments

Data were collected using structured questionnaires designed to measure two primary variables: adolescents' knowledge of and attitudes toward MHM. The knowledge questionnaire consisted of 10 multiple-choice items, each assessing the understanding of key MHM concepts, such as the importance of clean menstrual products, proper hygiene practices during menstruation, and common misconceptions about menstruation. Each correct answer was scored 1 point, with a maximum score of ten. The attitude questionnaire comprised 10 statements rated on a 4-point Likert scale (1 = strongly disagree, 4 = strongly agree), with a total score ranging from 10 to 40, evaluating beliefs and perceptions about menstrual hygiene, including comfort in discussing menstruation, and willingness to adopt hygienic practices. The instruments were developed based on menstrual hygiene management guidelines and the relevant literature on adolescent reproductive health education. Prior to data collection, the questionnaires underwent content validation by public health and health education experts to ensure clarity, relevance, and age-appropriateness.

Reliability analysis was conducted using pretest data to assess internal consistency. The knowledge questionnaire yielded a Cronbach's alpha coefficient of 0.601, indicating moderate internal consistency. The attitude questionnaire showed a Cronbach's alpha coefficient of 0.761, indicating acceptable internal consistency.

Data Analysis Techniques

The post-test questionnaire was administered immediately after the

completion of the quiz card game intervention to assess immediate changes in participants' knowledge and attitudes. Data collection was followed by a systematic process of editing, coding, data entry, tabulation, and cleaning to ensure the accuracy and completeness of the data. Each questionnaire was checked for missing or inconsistent responses, and incomplete entries were excluded from the analysis. The data were entered into a statistical software package for processing. A preliminary analysis using the Kolmogorov-Smirnov test revealed that the data for both knowledge and attitude scores were non-normally distributed ($p < 0.05$), necessitating the use of non-parametric statistical methods. The Wilcoxon signed-rank test was employed to analyze differences between pre- and post-test scores for both knowledge and attitudes, as it is well-suited for comparing paired data in pre-experimental designs. The significance level was set at $p < 0.05$ to determine whether the quiz card game intervention significantly improved participants' knowledge and attitudes. Descriptive statistics, including means, standard deviations, and ranges, were calculated to summarize the pre- and post-test scores.

Results

Table 1 shows the demographic characteristics of 1,234 students from 19 schools in Semarang City, including one Islamic Elementary School (Madrasah), 13 public elementary schools, and five junior high schools, detailing their distribution by age (9–15 years) and educational level (grades 4–9). The largest age group was 12-year-olds (277 students, 22.4%), followed by 11-year-olds (266, 21.6%) and 10-year-olds (248, 20.1%), with 64.1% of the sample aged 10–12 years, reflecting early adolescence when menstrual hygiene management (MHM) education is critical for this group. By education level, grade 6 had the highest representation (276 students, 22.4%), followed by grades 4 and 5 (each 261, 21.2%), with elementary students comprising 64.8% (798 students) and junior high students 35.2% (436 students, with 254 in grade 7, 151 in grade 8, and 31 in grade 9). This diverse sample, balanced across

younger and older adolescents, supports the study's aim to evaluate the effectiveness of quiz card games in improving MHM knowledge and attitudes, as it captures students at varying developmental stages likely to benefit from early engaging interventions in Semarang's urban school context.

Table 2 presents the descriptive statistics for knowledge and attitude scores for ((MHM) among 1,234 adolescents in Semarang City before and after the quiz card game intervention. The mean knowledge score increased from 5.08 (SD = 2.248, range: 0–10) pre-intervention to 6.67 (SD = 2.585, range: 0–10) post-intervention, indicating a notable improvement in understanding MHM practices, such as proper menstrual product use and infection prevention. Similarly, the mean attitude score rose from 29.41 (SD = 3.599, range: 16–40) to 31.64 (SD = 4.677, range: 17–40), reflecting a shift toward more positive and less-stigmatized attitudes. The increase in the standard deviation post-intervention suggests greater variability in responses, possibly due to diverse learning outcomes among participants. These findings, supported by the Wilcoxon Signed-Rank Test results in Table 3, demonstrate the quiz card game's effectiveness in enhancing MHM knowledge and fostering positive attitudinal changes, highlighting its potential as an engaging educational tool for adolescents in urban school settings such as Semarang.

The categorical analysis also demonstrated notable improvements after the intervention. Prior to the intervention, the majority of students were classified as having poor knowledge (58.1%), while only 15.2% were classified as having good knowledge. After the intervention, the proportion of students with good knowledge increased substantially to 45.6%, whereas those with poor knowledge decreased to 30.6%. A similar trend was observed in attitudes toward menstrual hygiene management. At baseline, most respondents were in the fair attitude category (66.5%), and 33.0% were categorized as having good attitudes. Following the intervention, the proportion of students with good attitudes increased to

54.8%, while that of those with fair attitudes decreased to 44.8%.

Wilcoxon Signed-Rank Test results, based on a sample of 1234 adolescents in Semarang City, demonstrated that a greater number of participants experienced an increase in knowledge after the Quiz Card Game intervention. Significant differences were observed between the pre- and post-intervention scores for both knowledge and attitudes toward Menstrual Hygiene Management (MHM). Specifically, The Wilcoxon signed-rank test (Table 4) revealed a significant difference in the knowledge scores before and after the intervention ($Z = -14.874$, $p < 0.001$), as well as attitude scores ($Z = -12.851$, $p < 0.001$). This indicates that the intervention was effective in enhancing the respondents' understanding of MHM, such as proper menstrual product use and infection prevention, while fostering more positive and less stigmatizing attitudes toward menstruation. The calculated effect sizes indicated a moderate to large effect for knowledge ($r = 0.42$) and a moderate effect for attitudes ($r = 0.37$), suggesting that the quiz card game intervention had a meaningful practical impact on students' MHM understanding and attitudes. The large sample size strengthens the reliability of the results, highlighting the efficacy of gamified educational tools compared with traditional methods. This is likely due to their engaging and nonthreatening approach.

Subgroup analysis based on education level (Table 4) shows a significant increase among elementary and junior high school students. Among elementary school students ($N = 798$), knowledge scores increased significantly ($Z = -12.930$, $p < 0.001$) with a moderate to large effect size ($r = 0.46$), and attitude scores also increased significantly ($Z = -11.283$, $p < 0.001$) with a moderate effect size ($r = 0.40$). Similarly, junior high school students ($N = 436$) showed significant increases in knowledge ($Z = -7.242$, $p < 0.001$; $r = 0.35$) and attitudes ($Z = -6.289$, $p < 0.001$; $r = 0.30$). Although significant improvements were observed in both groups, the effect size was larger in elementary school students, suggesting that the quiz card game intervention may have a stronger impact on younger adolescents than on older ones.

Table 1. Frequency Distribution of Respondent Characteristics

Characteristics	Frequency	Percentage (%)
Age		
9 years	124	10.0
10 years	248	20.1
11 years	266	21.6
12 years	277	22.4
13 years	219	17.7
14 years	77	6.2
15 years	23	1.9
Level of education		
Elementary High School/Madrasah		
Class 4	261	21.2
Class 5	261	21.2
Class 6	276	22.4
Junior High School		
Class 7	254	20.6
Class 8	151	12.2
Class 9	31	2.5
Total	1,234	100

Respondents' Knowledge and Attitudes

Table 2. Knowledge and Attitudes Score Before and After Intervention

Variable		Mean	SD	Min	Max
Knowledge	Pre-test	5.08	2.248	0	10
	Post-test	6.67	2.585	0	10
Attitude	Pre-test	29.41	3.599	16	40
	Post-test	31.64	4.677	17	40

Table 3. Knowledge and Attitudes Score Before and After Intervention

Variable	Category	Pre-test N (%)	Post-test N (%)
Knowledge	Good	717 (58.1)	378 (30.6)
	Fair	330 (26.7)	293 (23.7)
	Poor	187 (15.2)	563 (45.6)
Attitude	Good	6 (0.5)	5 (0.4)
	Fair	821 (66.5)	553 (44.8)
	Poor	407 (33.0)	676 (54.8)

Table 4. Wilcoxon Test Result for Knowledge and Attitude Variables

Variable		N	Z value	P	r
Knowledge	Pre-test	1234	-14.874	<0.001	0.42
	Post-test				
Attitude	Pre-test	1234	-12.851	<0.001	0.37
	Post-test				

*Significant differences were assessed using the Wilcoxon Signed-Rank Test

Table 5. Subgroup Analysis by Education Level

Variable	Education Level	N	Z value	P	r
Knowledge	Elementary School	798	-12.930	<0.001	0.46
	Junior High School	436	-7.242	<0.001	0.35
Attitude	Elementary School	798	-11.283	<0.001	0.40
	Junior High School	436	-6.289	<0.001	0.30

Discussion

Characteristics of Respondents

The RISKESDAS data for 2018 indicate that 72.20% of females experienced menstruation between the ages of 10 and 19, with 1.24% experiencing their first menstruation during primary school.²² The Indonesian Demographic and Health Survey (SDKI) of 2017 showed that the majority of females experience menstruation at the age of 11 (26%).²³ The respondents consisted of adolescents aged 9 to 15 years. The majority of patients were 12 years old (277 individuals). The youngest was 15 years old (23 patients). Adolescent females typically begin menstruating at the age of 12 years. Adolescents aged 10-13 are referred to as the "early adolescence" period. During this period, both males and females undergo the initial stages of puberty and begin to grow faster and significantly. The level of maturity and strength in thinking and working are said to be better correlated with one's age sufficiency.²⁴

The respondents in this study had educational levels ranging from Elementary School (SD)/MI to Junior High School (SMP). The majority of respondents were elementary school students from 14 schools in Semarang City, totaling 801 respondents. Meanwhile, at the Junior High School level from five schools in Semarang City. A total of 433 respondents participated in the study. The higher the educational level, the better-formed thought patterns they become. Therefore, respondents with higher education levels tended to be more open to new experiences, including knowledge and attitudes towards answering questionnaires about menstrual hygiene management.

Knowledge Before and After Intervention with Menstrual Hygiene Management Quiz Card Game Media

Improving adolescent health by enhancing their knowledge is crucial for improving their health. Adolescents are generally embarrassed to discuss their menstrual hygiene. They seldom receive education on the importance of menstrual hygiene management. Knowledge about menstruation is usually limited to biology classes in schools without delving into appropriate menstrual hygiene for adolescents.¹⁸ Knowledge about adolescent personal hygiene practices can lead to Reproductive Tract Infections if not addressed. Therefore, increasing knowledge on this topic is necessary. A lack of knowledge about proper personal hygiene during menstruation can lead to various problems such as abnormal vaginal discharge, irritation, Urinary tract infection (UTI), unpleasant odors, and vaginal infections (vaginitis). Vaginitis occurs when the vagina is disturbed by pathogenic microorganisms or changes in the vaginal environment that allow pathogenic microorganisms to proliferate.²⁵

Based on the research results, there is effectiveness in increasing adolescent knowledge by comparing pre- and post-test results related to adolescent knowledge after being given a quiz card game media intervention about menstrual hygiene management. Quiz card games were used to teach menstrual hygiene management before the intervention. A total of 336 respondents had poor knowledge of diabetes. There were 777 respondents (63%) who showed an increase in pre-test to post-test scores (positive ranks) in the knowledge variable compared to the values before the intervention (27.2%). These results indicate that quiz card games can

positively impact adolescents' knowledge of menstrual hygiene management.

The effectiveness of quiz card games can be interpreted using the Health Belief Model (HBM). According to the HBM, individuals are more likely to adopt preventive behaviors when they recognize their vulnerability to health risks, understand the severity of potential consequences, and believe that the benefits of action outweigh the perceived barriers.^{26,27} By discussing the consequences of poor menstrual hygiene and correcting myths during interactive sessions, the intervention may have increased the participants' perceptions of vulnerability and perceived benefits while reducing informational barriers. This theoretical mechanism helps to explain the observed increase in knowledge scores.

The quiz card game media in this study is a learning medium with a fun concept for adolescents to learn about diabetes. as it can increase their enthusiasm, spirit, and positively impacted the learning process. This allowed them to gain insights into the menstrual hygiene management. This enthusiasm can enhance knowledge acquisition. A similar study conducted by Sommer et al.²⁸ using domino cards as a medium for menstrual self-hygiene management education showed an increase in knowledge of self-hygiene management among respondents. The domino card learning media used in this study made female students appear more enthusiastic, happy, and spirited. The game had a positive impact on the learning process, providing insights and knowledge about menstrual self-hygiene.

This enthusiasm should be maintained by students during the learning process, as high enthusiasm can enhance knowledge acquisition. This finding is consistent with that of Mukarramah.¹⁸ Found that female students' knowledge increased after the "snake ladder" edutainment intervention because of engaging visuals about personal menstrual hygiene, which captured students' interest in learning and receiving information. Additionally, The "snake ladder" game made it easier for educators to convey the material to the students. The enthusiasm of female adolescents increased because the

media was unique to them, engaging, and had a competitive element that boosted students' motivation.

In addition to education, a person's knowledge can also be obtained through experience or stories from others. Therefore, various factors can influence respondents' knowledge of menstrual hygiene management, such as information obtained from parents, friends, siblings, and electronic media. Knowledge of menstrual hygiene management is crucial because good knowledge can improve health status.²⁹

Attitudes Before and After Intervention with Menstrual Hygiene Management Quiz Card Game Media

Menstruation is a natural process that occurs in women. Misunderstandings and improper practices regarding genital hygiene can have serious health implications. Poor menstrual hygiene management can lead to various diseases or infections in adolescents. Sommer et al. (2015) indicated that many adolescent girls in developing countries have misconceptions regarding menstrual hygiene, such as excessive use of antiseptic soap to prevent odor, which is not always medically necessary and may disrupt the balance of vaginal flora.⁹ Research has reported that reproductive tract infections, Vaginal yeast infection, Abnormal vaginal discharge in adolescent girls in India is caused by inadequate hygiene during menstruation.³⁰ Therefore, education on maintaining menstrual hygiene is necessary for this population. The Wilcoxon Signed-Rank Test showed a statistically significant difference between pre- and post-test attitude scores ($Z = -12.851$, $p < 0.001$), indicating that the intervention led to a significant improvement in adolescents' attitudes toward menstrual hygiene management. The effect size ($r = 0.37$) indicated a moderate magnitude of change, suggesting that the intervention had both practical and statistical significance. This increase is consistent with the findings of Wulandari.³¹ This study found a difference in the attitudes of adolescent girls before and after being provided health education related to

menstrual hygiene. with an average pre-test result of 35.75, which increased to 38.91. Attitude is a readiness with a tendency to react in a certain way; positive attitudes encourage positive behavior. Putri et al. and Wulandari et al. found that respondents with good attitudes towards menstrual hygiene tended to demonstrate better personal hygiene practices during menstruation.^{25,32} However, it should be noted that the present study assessed only knowledge and attitudes and did not directly measure the behavioral outcomes.

Another study by Zuhriya with 186 female students from grades I, II, and III at SMPN 2 Depok showed that there are still misconceptions about genital hygiene among the students. both those who have experienced menstruation and those who have not experienced menstruation. Respondents mostly agreed with the use of antiseptic soap to clean their genitals to prevent bacterial infections. Antiseptics are used when experiencing itching and odor in the genital area. and agreed that antiseptic soap can provide comfort and freshness.³³ Azwar (2013) identified six factors that influence a person's attitude. including personal experiences. the influence of significant others. culture. mass media. educational and religious institutions. and emotions. Based on this. Health promotion media and education on reproductive organ hygiene can influence respondents' attitudes toward good external genital organ hygiene.

Study Limitations

This study used a pre-experimental one-group pretest-posttest design, which may introduce potential threats to internal validity, including the absence of a control group and the possibility of external influences affecting the participants' responses. To minimize these potential biases, the intervention and data collection were conducted within a relatively short time frame and under the same classroom conditions. However, the findings should still be interpreted with caution, and future studies using more rigorous designs with comparison groups are recommended.

Conclusion

This study demonstrates the effectiveness of the quiz card game intervention in significantly improving knowledge and attitudes toward Menstrual Hygiene Management (MHM) among 1,234 adolescents aged 9–15 years across 19 elementary and junior high schools in Semarang. However, this study employed a pre-experimental design without a control group and assessed only short-term outcomes, which may limit the causal inference and generalizability of the findings. Despite these limitations, the results highlight the potential of gamified educational tools to enhance adolescents' engagement and improve their knowledge and attitudes toward menstrual hygiene management compared with conventional approaches. Therefore, integrating interactive media, such as quiz card games, into school-based health education may support more effective menstrual health education for adolescents.

Ethics approval

This study was conducted in accordance with the ethical standards. This study was approved by the Ethics Committee of the Faculty of Public Health, Universitas Diponegoro (No. 37/EA/KEPK-FKM/2024). ensuring informed consent. confidentiality. and voluntary participation in the study.

Availability of data and materials

The data collected and analyzed during this research were not published because they were private.

Acknowledgement

We are grateful to all parties who supported this research. especially the schools where the data were collected. and all respondents who participated in this study.

Funding

This research was funded by the Faculty of Public Health, Universitas Diponegoro, based on the Dean's Decree number 20/UN7.F9/HK/V/2024.

Author Contribution

VRA and NRA collected and analyzed data. SPJ. NN. and EF developed the research. corrected the results. prepared. discussed and reviewed the manuscript.

References

- World Health Organization (WHO). WHO recommendations on adolescent sexual and reproductive health and rights. Switzerland: 2018;
- Anand E, Singh J, Unisa S. Menstrual hygiene practices and its association with reproductive tract infections and abnormal vaginal discharge among women in India. *Sexual and Reproductive Healthcare* 2015;6(4):249–254.
- Belayneh Z, Mekuriaw B. Knowledge and menstrual hygiene practice among adolescent school girls in southern Ethiopia: a cross-sectional study. *BMC Public Health* 2019;19(1):1595
- Sommer M, Chandraratna S, Cavill S, Mahon T, Phillips-Howard P. Managing menstruation in the workplace: An overlooked issue in low- and middle-income countries. *Int. J. Equity Health*. 2016;15(1).
- Hennegan J, Shannon AK, Rubli J, Schwab KJ, Melendez-Torres GJ. Women's and girls' experiences of menstruation in low-and middle-income countries: A systematic review and qualitative metasynthesis. *PLoS Med* 2019;16(5).
- Ministry of Health. Indonesia Demographic and Health Survey 2012 Special Report on Adolescent Reproductive Health. 2013;
- Miller J, Rosso D, Arlianti R. Investing in School Health and Nutrition in Indonesia: 2009.
- Wulandari P, Aini DN, Astuti SW. Faktor-Faktor yang Berhubungan dengan Kejadian Menarche Siswi di SMPN 31 Semarang. 2015.
- Sommer M, Hirsch JS, Nathanson C, Parker RG. Comfortably, Safely, and Without Shame: Defining Menstrual Hygiene Management as a Public Health Issue. *Am J Public Health* 2015;105(7):1302–1311.
- Pragita RR, Purwandari R, Sulistyorini L, et al. Pengaruh Pendidikan Kesehatan Metode stratagem dengan Media Audiovisual terhadap Pengetahuan Kesehatan Reproduksi Remaja. 2018;
- Phillips-Howard PA, Caruso B, Torondel B, Zulaika G, Sahin M, Sommer M. Menstrual hygiene management among adolescent schoolgirls in low- and middle-income countries: Research priorities. *Glob Health Action* 2016;9(1).
- Haery AH. Pengaruh Penyuluhan Seksualitas dengan Metode Stratagem terhadap Pengetahuan Bahaya Seks Pranikah pada Remaja Awal. 2017;
- Hasnah H, Istiqomah N, Sysnawati S. Metode Stratagem Dapat Meningkatkan Pengetahuan Remaja Tentang Vulva Hygiene. *Jurnal Smart Keperawatan* 2019;6(1):31.
- Fazrin I, Anggraeni S, Hidajaturokhmah NY, Siwi RPY, Wahyuni C. Media Education Quartet Card Play on Reproductive Health Learning in Adolescents. *Journal of Nursing Practice*.2023;7(1):127–132.
- Zhou Y. Designing a Health Education Card Game for Adolescents Based on Constructivist Learning Theory: A Case Study of "Night of Hospital". *Journal of Contemporary Educational Research*.2025;9(6):257–263.
- Yu X, Wu J, Zhang Y, et al. Randomized trial on the impact of card game-based teaching on learning and memory retention of neurological syndromes. *BMC Medical Education*.2025;25(1):1046-.
- Latifah LS, Linggardini K. Pengaruh permainan edukatif domino card terhadap pengetahuan anak usia sekolah dasar tentang manajemen kebersihan diri saat menstruasi. *Journal of Nursing Practice and Education* 2023;4(1).
- Zuhriya C, Ketut N, Armini A, Wahyuni ED. Pengaruh Edutainment Ular Tangga Terhadap Perilaku Remaja Tentang Personal Hygiene Menstruasi. 2018;
- Hennegan J, Brooks DJ, Schwab KJ, Melendez-Torres GJ. Measurement in the study of menstrual health and hygiene: A systematic review and audit. *PLoS One*. 2020;15(6):e0232935.
- Fuadah F, Yogisutanti G, Saragih BD. The effectiveness of digital media in improving menstrual hygiene knowledge among adolescent girls: a study in junior high schools in Bandung Regency. *BMC Public Health*.2025;26(1).
- Edwards EA, Lumsden J, Rivas C, et al. Gamification for health promotion: systematic review of behavior change techniques in smartphone applications. *BMJ* .2016;6(10):e012447.
- Steinberg L. Cognitive and affective development in adolescence. *Trends Cogn Sci* .2005;9(2):69–74.
- Mukarramah. Hubungan Pengetahuan dan Sikap Remaja Putri Terhadap Perilaku Personal Hygiene saat Menstruasi. 2020;
- Glanz K, Rimer BK, Viswanath K. Health behavior: Theory, research, and practice, 5th ed. Hoboken, NJ, US: Jossey-Bass/Wiley, 2015;
- Alamer AS. Behavior Change Theories and Models Within Health Belief Model Research: A Five-Decade Holistic Bibliometric Analysis. *Cureus* .2024;16(6).
- Latifah LS, Linggardini K. Pengaruh permainan edukatif domino card terhadap pengetahuan anak usia sekolah dasar tentang manajemen kebersihan diri saat menstruasi. *Journal of Nursing Practice and Education* 2023;4(1).
- Ilmiawati H, Kuntoro. Pengetahuan Personal Hygiene Remaja Putri pada Kasus Keputihan. *Jurnal Biometrika dan Kependudukan* 2016; 5:43–51.
- Arora A, Mittal A, Pathania D, Singh J. Impact of Health Education on Knowledge and Practices about Menstruation Among Adolescent School

- Girls of Rural Part of District Ambala, Haryana
Article Cycle Citation. Comm Health
2013;(4):492–497.
29. Puspitaningrum W, Agushybana F, Mawarni A, Nugroho Bagian Biostatistika dan Kependudukan D, Kesehatan Masyarakat F. Pengaruh Media Booklet Terhadap Pengetahuan dan Sikap Remaja Putri terkait Kebersihan dalam Menstruasi di Pondok Pesantren Al-Ishlah Demak Triwulan II Tahun 2017.2017.
30. Putri NA, Setianingsih A. Hubungan Pengetahuan dan Sikap Terhadap Perilaku Personal Hygiene Menstruasi. Ilmu Kesehatan Masyarakat 2016;5(1).
31. Muhammadiyah JK, Rohimah CI, Solehati T, et al. Pengaruh Pengetahuan, Sikap dan Tindakan Siswi Sekolah Dasar Terkait Genitalia Hygiene. Jurnal Keperawatan Muhammadiyah.2019;4(1):201