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Sudoku-based health improves Gen Z's knowledge and attitudes toward adolescent pregnancy risks

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ABSTRACT

Adolescent pregnancy remains a public health concern in many countries, including Indonesia, as it increases the risk of maternal and infant mortality. Limited knowledge and inappropriate attitudes are contributing factors. This study explores the use of Sudoku games as an innovative medium for health education, aimed at enhancing student engagement and promoting interactive learning. The objective is to assess the effect of health education through Sudoku games on the knowledge and attitudes of Generation Z regarding adolescent pregnancy. This study employed a quantitative method with a pre-experimental design, utilizing a one-group pretest–posttest approach. The population consisted of 160 students, with a sample of 60 eleventh-grade students from Pembangunan Nasional Vocational School, Purwodadi. Samples were selected using purposive sampling, and the sample size was determined using the Slovin formula with a 5% margin of error. The intervention was conducted over one day, and data were analyzed using the Wilcoxon test. The results of this study indicate a significant effect. The proportion of students categorized as having good knowledge increased from 1.7% to 100%, representing a 98.3 percentage-point increase, with a significant effect ($Z = -6.743$, $p < 0.001$, $r = -0.87$). Attitude scores also improved from 33.3% to 88.3%, reflecting a 55 percentage-point improvement, indicating a shift toward more positive attitudes about the risks ofadolescent pregnancy ($Z = -6.548$, $p < 0.001$, $r = -6.548$). Both outcomes demonstrated medium-to-large effect sizes, confirming the educational relevance of the intervention. The provision of health education through Sudoku as an instructional medium demonstrated a significant influence on the knowledge and attitudes of Generation Z (Gen Z) concerning the risks ofadolescent pregnancy. These findings indicate that the Sudoku game can be utilized as an effective and practical tool for adolescent reproductive health education and holds potential as a reference for future scholarly investigations.

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INTRODUCTION

Adolescent pregnancy remains a pressing public health issue globally. According to the World Health Organization, approximately 12.8 million births occur each year to mothers aged 15–19 years, equivalent to 44 births per 1,000 adolescent girls.(1) Data from UNICEF

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& EAPRO, show that in Southeast Asia, the highest prevalence of adolescent childbirth is found in the Philippines, with 56 per 1,000, followed by Indonesia with 46 per 1,000, and Thailand with 44 per 1,000. In contrast, developed countries report significantly lower rates, with Japan recording 3 per 1,000, Saudi Arabia 5 per 1,000, the United Arab Emirates 7 per 1,000, the United States 23 per 1,000, and Türkiye 24 per 1,000 adolescent births.(2,3)

Teenage pregnancy refers to pregnancy occurring between the ages of 14 and 19 years. It carries higher medical risks due to the immaturity of the reproductive organs, which may negatively affect both maternal and fetal health.(4) The prevalence of adolescent pregnancy in Indonesia is 48 per 1,000 adolescent girls. Data from Statistics Indonesia (BPS) in 2023 indicate that 26–27 out of every 1,000 females aged 15–19 years give birth. Alarmingly, births are also occurring at even younger ages, with 0.179 births per 1,000 females aged 10–14 years.(5)

In Central Java Province, BPS data for 2022 show that the prevalence ofadolescent pregnancy among girls aged 15–19 years was 21.03 per 1,000, increasing slightly to 21.42 per 1,000 in 2023. Moreover, the incidence of early marriage in Central Java exceeds the national average of 8.74%, reaching approximately 9.75% in 2023, with one of the affected regions being Grobogan Regency.(6)

Grobogan Regency is one of the regencies in Central Java with a high incidence of early marriage in Indonesia. Its topography consists of limestone mountain ranges, hilly areas, and lowland plains in the central part of the region. Grobogan Regency covers an area of 2,023.85 km² and, as of 2021, had a population of approximately 1,465,510 people. According to the People's Health Statistics, the prevalence of early marriage in the regency over the past three years has been consistently higher than both provincial and national averages. Based on the Grobogan District Health Office profile (2019–2023), the prevalence of marriage among females aged <19 years was notably high, reaching 30.92% in 2019. This figure increased to 35.76% in 2020, 36.48% in 2021, before declining to 32.87% in 2022 and 31.66% in 2023. Although the prevalence has shown a downward trend,adolescent pregnancy remains a significant public health issue in Indonesia, particularly in Grobogan Regency.(7)

Based on a preliminary survey conducted at Pembangunan Nasional Vocational School Purwodadi through interviews with 10 eleventh-grade students regarding their understanding ofadolescent pregnancy and its health risks, it was found that all 10 students were able to defineadolescent pregnancy as pregnancy occurring outside of marriage. However, when asked about the health risks associated withadolescent pregnancy, the same students admitted they did not know. Interviews with the school guidance counselor revealed that no health education sessions regarding the risks ofadolescent pregnancy had ever been conducted. This indicates that adolescents' knowledge of reproductive health issues remains very limited.

In Indonesia, Generation Z (Gen Z) constitutes one of the largest demographic groups in Indonesia, totaling approximately 74.93 million people or 27.94% of the national population. In general, Gen Z refers to individuals born between the mid-1997 and 2012 (Christiani & Ikasari, 2020). As a generation born in the era of globalization and advanced technology, Gen Z tends to integrate technology into their daily lives, including learning, communication, and information-seeking activities.(8)

Along with increasingly sophisticated technological advancements, curiosity among adolescents can be amplified, prompting them to engage in new behaviors that may conflict with social norms. One such example is the prevalence of promiscuity, which is more commonly observed in the current digital era and poses significant risks, particularly for females. The ease of access to information and communication through technology can expose Gen Z to riskier content and relationships. Without adequate knowledge and attitudes, this exposure may lead to premarital sexual activity. When adolescent girls experience unintended or out-of-wedlock pregnancies, various adverse consequences may

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arise. These include severe psychological impacts, such as depression caused by the negative stigma imposed by society. Moreover, given their physical immaturity, adolescent girls face the risk of damage to their reproductive organs.(9)

Health education is designed to help individuals improve their health by increasing knowledge or influencing behavior in adopting clean and healthy living practices. Therefore, health education plays an important role in achieving optimal individual health status.(10) Conventional lecture-based methods may not align with Gen Z's learning preferences, and interactive gamified strategies remain underutilized in adolescent reproductive health education. To address the educational gap, innovative learning methods that align with Gen Z's preferences are needed. Game-based learning has been recognized as an effective tool in increasing engagement and knowledge retention, particularly among younger populations.

Sudoku can be utilized as a health education medium to assist adolescents in learning together, fostering closer interpersonal interactions, and following specific rules, thereby making lessons on the risks ofadolescent pregnancy more engaging. Sudoku is a logic-based puzzle game that typically consists of 81 cells arranged in 9 rows, 9 columns, and 9 subgrids. Although variations of Sudoku exist—such as 6×6, 4×4, and 3×2 grids—these are less commonly studied by experts. The primary objective of the game is to fill all the cells.(11) The Sudoku game as a learning medium can be understood as a board-based activity containing questions, in which players answer each question in a cell and then select the appropriate answer option by attaching a card that matches the color of the chosen column. In using Sudoku as a learning medium, it is important to note that the game serves only as a supporting tool in the learning process. Sudoku provides an interactive and cognitively challenging platform, aligning with Generation Z's preference for non-monotonous and more experiential learning. Health education is an effective approach to improving knowledge and attitudes; therefore, Sudoku can serve as a medium that makes learning more engaging and interactive, particularly for Gen Z. This medium has never been used in schools, making it a novel solution. Consequently, the game must be adapted to the specific learning material being taught.(12) Given the pressing need for effective adolescent reproductive health education and the potential of game-based media to enhance learning, this study aims to evaluate the effect of health education using Sudoku game media on Gen Z students' knowledge and attitudes toward adolescent pregnancy risks.

METHOD

This study employed a pre-experimental research design, without a control group, as the medium used in the study had never been applied in any prior research. Therefore, the pre-experimental approach was chosen to introduce the intervention to all respondents, allowing each to experience the treatment provided. The study utilized a one-group pretest–posttest design. There were two variables in this study: the independent variable was health education using the Sudoku game, and the dependent variables were knowledge and attitudes regarding the risks ofadolescent pregnancy.

The study was conducted at *Pembangunan Nasional* Vocational School Purwodadi ini 2024. The total population consisted of 160 eleventh-grade students, with a sample size of 60 students. Sampling was performed using purposive sampling, and the sample size was determined using Slovin's formula with a 5% margin of error. The inclusion criteria were: eleventh-grade students, being in good health, and participating in the entire series of activities from pretest, intervention, to posttest. The exclusion criteria were: respondents who withdrew from the study and those who did not complete the entire series of activities.

The data collection instruments consisted of knowledge and attitude questionnaires. The validity test results for the knowledge questionnaire yielded a score of 0.581, and for the attitude questionnaire, 0.981, with 20 respondents. The Corrected Item–Total

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Correlation values for all items were greater than 0.444, indicating validity. The reliability test results showed a Cronbach's alpha of 0.838 for knowledge and 0.741 for attitudes, both exceeding the r-table value (> 0.70), thus confirming reliability. The knowledge questionnaire employed the Guttman scale with 20 multiple-choice questions (options a, b, c, and d), while the attitude questionnaire used the Likert scale with 10 statements, comprising 6 favorable and 4 unfavorable items. The pretest activity began with distributing the questionnaires to 60 students, allowing 15 minutes for completion, followed by a 30-minute Sudoku game. The 60 students were divided into 10 groups, with each group consisting of 6 students.

The health education intervention using the Sudoku game was validated through an expert review by Sony Zulfikasari, S.Pd., M.Pd. The Sudoku game was printed on A3-sized paper, with 36 letter cards (A–F) for each group, serving as tools in the gameplay. The Sudoku implementation method was as follows: (1) The game was played for 30 minutes, with each group consisting of 6 students. Each student was assigned one of six column colours and provided with 6 letter cards (A–F) corresponding to the selected column colour. (2) Each column contained 6 cells, with 5 cells containing a question and two answer options. To complete a Sudoku column, the student had to answer all 5 questions, select the correct answers, and attach the corresponding card, ensuring that no letter was repeated in the same column.

The intervention was facilitated by one researcher, assisted by three enumerators. After the Sudoku game intervention, the answers were reviewed collectively, with explanations provided, followed by a Q&A session. A post-test was then administered for 10 minutes. The study was conducted in a single day, beginning during the first recess, and continuing into the second recess. Ethical clearance for this study was granted by the Health Research Ethics Committee of Poltekkes Kemenkes Semarang (No. 491/EA/F.XXIII.38/25), issued on April 8, 2025

The research data included personal identification information (initials, age, address, and telephone number) provided by respondents through the distributed questionnaire. Data on knowledge and attitudes regarding the risks ofadolescent pregnancy were obtained using questionnaires administered before and after the health education intervention with the Sudoku game. Statistical analysis to assess the effect of the health education was performed using the Wilcoxon test (Asymp. Sig. [2-tailed]), preceded by a normality test using the Shapiro–Wilk method, with all analyses conducted using IBM SPSS Statistics version 25.

RESULTS

The results of this study are divided into two types of analysis: univariate analysis of knowledge and attitude. Then bivariate analysis consists of: (1) the effect of health education using the Sudoku game on Z Generation's knowledge regarding the risks ofadolescent pregnancy, and (2) the effect of health education using the Sudoku game on Z Generation's attitudes regarding the risks ofadolescent pregnancy.

Table 1. Descriptive Statistics of Students' Knowledge and Attitudes Score (n=60)

Variable	Category	Pre-test n (%)	Post-test n (%)	Mean ± SD	Min	Max
Knowledge	Good	1 (1.7%)	60 (100%)	Pre: 62.97 ± 7.461	Pre: 44	Pre: 78
	Moderate	47 (78.2%)	0 (0%)	Post: 94.60 ± 5.289	Post: 82	Post: 100
	Poor	12 (20.1%)	0 (0%)			
Attitude	Positive	20 (33.3%)	53 (88.3%)	Pre: 25.32 ± 2.159	Pre: 22	Pre: 31
	Negative	40 (66.7%)	7 (11.7%)	Post: 29.27 ± 3.019	Post: 24	Post: 36

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In the table 1 students showed a substantial improvement in knowledge following the intervention. The proportion of students categorized as having “good” knowledge increased from 1.7% to 100%, representing a 98.3 percentage-point increase. This indicates a marked improvement in cognitive achievement following the Sudoku-based education session. The proportion of respondents also demonstrating a positive attitude rose from 33.3% to 88.3%, reflecting a 55 percentage-point improvement, indicating that the game-based intervention substantially strengthened students’ perceptions and readiness to preventadolescent pregnancy.

Table 2. Normality Test Result

Variable	Time Point	Statistic (Kolmogorov-Smirnov)		p-value	Interpretation
		Mean	Std. Deviation		
Knowledge	Pre-test	62.97	7.461	0.000	Normal distribution
Knowledge	Post-test	94.60	5.289	0.000	Normal distribution
Attitude	Pre-test	25.32	2.159	0.000	Normal distribution
Attitude	Post-test	29.27	3.019	0.003	Normal distribution

The Shapiro–Wilk test (Table 2) confirmed that all outcome variables violated assumptions of normality ($p < 0.05$), therefore non-parametric analyses were applied. Descriptive findings indicated noticeable improvements across both outcome measures. The proportion of students classified as having good knowledge increased from 1.7% at pre-test to 100% after the intervention, a 98.3 percentage-point increase. Similarly, positive attitudes increased from 33.3% to 88.3%, reflecting a 55 percentage-point improvement.

Table 3. Effect of Health Education Using Sudoku on Gen Z’s Knowledge and Attitudes

Variable	Z-value	p-value	Effect Size (r)
Knowledge	-6.743	$p < 0.001$	-0.87
Attitude	-6.548	$p < 0.001$	-0.84

The Wilcoxon Signed Rank Test (Table 3) demonstrated statistically significant post-intervention gains in both knowledge ($Z = -6.743$, $p < 0.001$) and attitudes ($Z = -6.548$, $p < 0.001$). Effect sizes were large ($r = 0.87$ for knowledge and $r = 0.84$ for attitudes), indicating that the Sudoku game-based educational method produced a strong learning effect in improving students’ understanding and perceptions ofadolescent pregnancy risk.

DISCUSSION

This study found a significant improvement in both knowledge and attitudes of Gen Z students after receiving health education using the Sudoku game, indicating that this interactive method is an effective alternative to conventional health promotion strategies. The results of this study demonstrated a significant increase in both knowledge ($Z = -6.743$, $p < 0.001$) and attitudes ($Z = -6.548$, $p < 0.001$) with large effect sizes ($r = 0.87$ for knowledge and $r = 0.84$ for attitudes), among students after the intervention using Sudoku-based health education.

These findings are consistent with the study by Nababan & Tanjung (2022) which revealed that game-based learning methods can significantly improve students’ learning outcomes.(13) Developing educational activities through game-based methods can make learning more enjoyable and meaningful. Consequently, messages about the prevention ofadolescent pregnancy can be conveyed concisely and clearly without causing boredom among respondents, while also attracting attention, stimulating interest, and fostering comprehensive understanding. The present findings also align with those of Swamilaksita et al. (2021), which reported positive changes in perceptions following an intervention.(14)

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Therefore, this study aligns with previous research conducted by Binsasi et al., (2019), Erdriani et al., (2023), Rahayu et al., (2017), and Adrianto et al., (2015), which found that the Sudoku game is effective in improving students' mathematics learning outcomes.(15–17) In particular, Erdriani et al., (2023) revealed that Sudoku introduces a new learning atmosphere in mathematics and provides students with the understanding that mathematics can also be applied as a game to sharpen thinking skills and cognitive abilities.(16)

The Sudoku game can also serve as a learning material for all parties, particularly for researchers or health institutions, as a medium for health education counselling on the risks of pregnancy. This innovative and refreshing game-based approach can be introduced to respondents or target audiences with engaging and colourful presentations, ensuring that the sessions remain interesting and not monotonous. Such an approach enables respondents or target audiences to actively participate in enhancing their knowledge and attitudes. This is in line with Faruq (2019), who stated that the benefits of game-based methods include stimulating interest, fostering creativity, and promoting cooperation.(18)

Notably, this study supports the emerging body of literature on the effectiveness of game-based learning in health education. While traditional methods such as lectures and printed materials often fail to capture adolescents' attention, especially among digitally oriented generations like Gen Z, gamified interventions offer a novel and engaging alternative. Sudoku, as a logic-based game, encourages critical thinking, problem-solving, and active participation factors that are essential in promoting both knowledge acquisition and attitude change.

The implications of these findings are significant for educators, school health programs, and public health practitioners. First, health education strategies targeting adolescents should consider integrating digital or analog game-based methods to increase engagement and improve outcomes. Second, vocational schools which may have fewer structured reproductive health programs can implement similar interventions as part of extracurricular or counseling activities. Lastly, the use of culturally adapted and age-appropriate games provides an opportunity to address reproductive health topics in a non-threatening and student-centered manner.

The Effect of Health Education Using the Sudoku Game on Gen Z's Knowledge About the Risks ofadolescent pregnancy

This study demonstrates that health education using the Sudoku game has a significant effect on Generation Z's knowledge and attitudes regarding the risks ofadolescent pregnancy. The mean knowledge score increased from 62.88%, with a p-value of less than 0.05, indicating a significant improvement in knowledge scores before and after the health education intervention using the Sudoku game. Similar findings were observed among students at *Pembangunan Nasional* Vocational School Purwodadi, where there were notable differences in the improvement of both knowledge and attitudes before and after the intervention.

The improvement in scores can be observed from the number of respondents who answered correctly, with only 62.88% able to provide correct answers during the pretest, while the remainder lacked a precise understanding of the risks ofadolescent pregnancy to reproductive health. However, after receiving health education using the Sudoku game, the respondents' knowledge was reassessed, and the results showed that 100% answered the questions correctly.

Thus, this study is in line with the research conducted by Tansya et al., (2024), on the use of Sudoku games as a mathematics learning medium, which found that incorporating Sudoku-based game media into the learning process can enhance the effectiveness of improving students' mathematics learning outcomes.(19)

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Education is more effectively delivered and easily understood when supported by the use of media. Media serve as an intermediary for conveying messages, stimulating thoughts, feelings, attention, and willingness that encourage active engagement.(20) The colorful presentation of the Sudoku game media can enhance its appeal and stimulate individuals' curiosity in a particular field of knowledge, thereby facilitating the comprehension process. Reproductive health education through Sudoku game media can ensure that respondents actively contribute to the research process.

The use of Sudoku game media can also activate multiple senses of the research respondents, such as sight, hearing, and touch, thereby making the absorbed information clearer. In addition to playing together, the presence of questions in the boxes of each Sudoku column can train respondents to think critically about a given problem. This, in turn, leads to a greater improvement in knowledge scores, making it easier for respondents to remember the material delivered. Furthermore, the colorful presentation enhances its attractiveness as an educational tool.

This study assisted respondents in reaching the fifth cognitive process in the knowledge level, namely evaluation. The questionnaires provided, along with the questions in each Sudoku column, stimulated respondents to select and assess which answers they considered most accurate. The evaluation process refers to the ability to make judgments about what has been learned, which includes checking and critiquing.(21)

The Effect of Health Education Using the Sudoku Game on Gen Z's Attitudes Toward the Risks ofadolescent pregnancy

The knowledge possessed by the subjects was then applied to evaluate something, as reflected in their acceptance, rejection, or disregard of it.(22) Attitude expresses an individual's feelings and beliefs toward an object.(23) The results of this study indicate that health education significantly improved adolescents' attitudes toward the risks ofadolescent pregnancy. Based on the pretest results, the majority of respondents (66.7%) displayed negative attitudes; however, after receiving health education using the Sudoku game as a medium, their attitudes were reassessed, and the majority (88.3%) demonstrated positive attitudes. This indicates an improvement in adolescents' attitudes following the delivery of health education regarding the risks ofadolescent pregnancy.

The change in respondents' attitudes through the use of the Sudoku game onadolescent pregnancy risk occurred because they were encouraged to engage all their senses in learning and understanding information about the risks ofadolescent pregnancy. The messages on pregnancy prevention were delivered concisely and clearly to avoid boredom, capture attention, stimulate interest in participation, and promote more comprehensive understanding among respondents. The findings of this study are consistent with previous research by Swamilaksita et al., (2021) which demonstrated a positive shift in perspectives following an intervention.(14)

Thus, the Sudoku game as a medium is capable of reaching the action phase in health education. Respondents actively engaged in health education on the risks ofadolescent pregnancy, indirectly stimulating the initiation of appropriate actions. This phase of health education focuses on facilitating respondents' ability to take action, helping them to foster the intention to act, make changes, and maintain those changes in the future. The improvement in attitude scores was influenced by the increase in knowledge scores, accompanied by positive shifts in thoughts, beliefs, and emotions.(24) When individuals have acquired accurate knowledge, positive attitudes begin to develop. However, attitude change depends on certain conditions and situations. Continuous improvement in knowledge and attitudes can guide individuals toward positive development, enabling them to change their character or habits over time.

The level of attitude achieved in this study is the value of internalization (characterization). Respondents considered the steps to be taken in certain situations so

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that they could provide an appropriate response regarding whether they agreed or disagreed. The value of characterization represents the stage of attitude that governs respondents' behavior in accordance with their internalized system of values. Internalization (characterization) includes both generalization and characterization.(21)

This study has several limitations that should be acknowledged. First, the use of a one-group pretest-posttest design without a control group limits the ability to attribute changes in knowledge and attitudes solely to the intervention. External factors such as exposure to media, peer discussions, or concurrent school lessons may have influenced the outcomes. Second, the sample was selected using purposive sampling from a single school, which restricts the generalizability of the findings to other adolescent populations with different sociodemographic or cultural backgrounds. Third, the assessment of knowledge and attitudes relied solely on self-reported questionnaires, which may be subject to response bias or social desirability bias, particularly when dealing with sensitive topics likeadolescent pregnancy. Additionally, the study measured outcomes immediately after the intervention, providing no insight into the long-term retention of knowledge or sustained changes in attitudes.

Future research should consider employing a randomized controlled trial (RCT) design to establish stronger causal inferences. Including a control group and conducting follow-up assessments would provide more robust evidence of the intervention's effectiveness over time. Moreover, expanding the study to include diverse schools and regions would enhance the external validity of the findings. Qualitative approaches such as focus group discussions could also be used to gain deeper insight into how adolescents perceive game-based education and how it influences their decision-making and behavior related to sexual and reproductive health.

CONCLUSION

This study demonstrates that health education delivered through Sudoku game media significantly improves both knowledge and attitudes of Generation Z adolescents regarding the risks ofadolescent pregnancy. The statistically significant differences observed in pretest and posttest scores ($p < 0.001$) indicate that interactive, game-based learning methods can be effective tools for engaging youth in reproductive health education. These findings highlight the potential of integrating innovative and age-appropriate educational strategies into school-based health programs. Utilizing game media not only enhances cognitive understanding but also promotes affective engagement, thereby supporting behavior change related toadolescent pregnancy prevention.

Future research should consider using controlled experimental designs to further validate these results and explore long-term outcomes. Expanding the implementation to diverse adolescent populations and integrating qualitative feedback could also enrich understanding of how digital or analog game-based interventions shape reproductive health awareness.

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AUTHOR CREDIT STATEMENT

INH: Conceptualization, Investigation, Writing – Original Draft; **SS**: Methodology, Formal Analysis, Writing – Review & Editing; **TSH**: Supervision, Validation, Project Administration.

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DECLARATION OF COMPETING INTEREST

The authors declare that they have no competing interests.

REFERENCES

1. Vieira Martins M, Karara N, Dembiński L, Jacot-Guillarmod M, Mazur A, Hadjipanayis A, et al. Adolescent pregnancy: An important issue for paediatricians and primary care providers—A position paper from the European academy of paediatrics. Front Pediatr. 2023 Feb 7;11:1119500.

2. Poudel S, Dobbins T, Razee H, Akombi-Inyang B. Adolescent Pregnancy in South Asia: A Pooled Analysis of Demographic and Health Surveys. Int J Environ Res Public Health. 2023 June 10;20(12):6099.

3. UNICEF East Asia and Pacific Regional Office (EAPRO). Beyond Marriage and Motherhood: Empowering girls by addressing adolescent pregnancies, child marriages, and early unions [Internet]. Bangkok: UNICEF East Asia and Pacific Regional Office (EAPRO); 2022. Available from: https://www.unicef.org/eap/media/11021/file/Beyond%20Marriage%20and%20Motherhood%20-%20Patterns%20and%20Trends.pdf

4. Kartikasari RI, Ummah F, Wahyu DI. The relationship between the role of parents and the incidence of teenage pregnancy in Blimbing Village, Paciran District, Lamongan Regency. SURYA J Media Komun Ilmu Kesehat. 2022 Oct 31;14(2):76–84.

5. Ayuandini S, Habito M, Ellis S, Kennedy E, Akiyama M, Binder G, et al. Contemporary pathways to adolescent pregnancy in Indonesia: A qualitative investigation with adolescent girls in West Java and Central Sulawesi. PLOS Glob Public Health. 2023 Oct 27;3(10):e0001700.

6. Badan Pusat Statistik Indonesia. Proporsi Perempuan Pernah Kawin 15-49 tahun yang Melahirkan Anak Lahir Hidup Yang Pertama Kali Berumur Kurang dari 20 tahun Menurut Kabupaten/Kota - Tabel Statistik [Internet]. [cited 2025 Jan 14]. Available from: https://www.bps.go.id/id/statistics-table/2/MjE5OCMy/proporsi--perempuan-pernah-kawin-15-49-tahun-yang--melahirkan--anak-lahir-hidup-yang-pertama-kali-berumur-kurang-dari-20-tahun-menurut-kabupaten-kota.html.

7. Dinas Kesehatan Kabupaten Grobogan. Profil Dinas Kesehatan Kabupaten Grobogan Tahun 2019-2024. Grobogan: Dinas Kesehatan Kabupaten Grobogan; 2024.

8. Prayoga RA, Lajira T. Strategi Pengembangan Kualitas SDM “Generasi Millenial & Generasi Z” dalam Menghadapi Persaingan Global Era 5.0. 2021;

9. Ansari R, Suwarni L, Selviana S, Mawardi M, Rochmawati R. Media Komik Sebagai Alternatif Media Promosi Kesehatan Seksualitas Remaja. J Ilm Kesehat. 2020 Mar 21;19(01):10–4.

10. Mustar YS, Susanto IH, Bakti AP. Pendidikan Kesehatan: Perilaku Hidup Bersih dan Sehat (PHBS) di Sekolah Dasar. JISIP J Ilmu Sos Dan Pendidik [Internet]. 2018 July 8

Jurnal Kesehatan Ibu dan Anak Vol.19, No.1, July 2025, pp. 22~32
ISSN: 2599-3224 (Online), ISSN: 2302-6014 (Print)

[cited 2025 Jan 23];2(2). Available from: https://ejournal.mandalanursa.org/index.php/JISIP/article/view/359

11. Crnković VM, Crnković B, Dlab MH, Traunkar I. Sudoku-Based Educational Games for Developing STEM Skills.

12. Hidayati N. Pengembangan Media Buku Latihan Soal Teka Teki Silang (TTS) Matematika untuk Kelas IV SD. J Penelit Pendidik Guru Sekol Dasar [Internet]. 2023 July 3 [cited 2025 Jan 15];11(6). Available from: https://ejournal.unesa.ac.id/index.php/jurnal-penelitian-pgsd/article/view/53720

13. Nababan SA, Tanjung HS. Analisis Kemampuan Siswa Dalam Memahami Konsep Matematika Pada Materi Sistem Persamaan Linear Tiga Variabel. J Genta Mulia [Internet]. 2022 July 11 [cited 2025 Jan 23];13(2). Available from: https://ejournal.uncm.ac.id/index.php/gm/article/view/143

14. Swamilaksita PD, Sari IP, Ronitawati P. Media Ular Tangga Meningkatkan Pengetahuan dan Sikap Tentang Keamanan Makanan Jajanan Anak Sekolah. J Pengabdi Masy AbdiMas [Internet]. 2021 Jan 30 [cited 2025 Jan 23];7(02). Available from: https://ejurnal.esaunggul.ac.id/index.php/ABD/article/view/3963

15. Binsasi E, Bano EN, Salsinha CN. Permainan Matematika Sudoku di Sekolah Menangah Atas Katolik (SMAK) Warta Bhakti Kefamenanu. Dedication J Pengabdi Masy. 2019 Mar 20;3(1):1–6.

16. Deby Erdriani, Dewi Devita, Laila Marhayati. Sosialisasi Permainan Sudoku pada Pembelajaran Matematika untuk Siswa SMP Negeri 8 Padang. SAMBARA J Pengabdi Kpd Masy. 2023 Mar 4;1(1):1–6.

17. Rahayu DS, Suryapratama A, Amongsaufa AZ, Koloay BIK. Evaluasi Algoritma Runut Balik dan Simulated Annealing pada Permainan Sudoku. J Tek Inform Dan Sist Inf [Internet]. 2017 Apr 8 [cited 2025 Jan 23];3(1). Available from: https://journal.maranatha.edu/index.php/jutisi/article/view/662

18. Faruq DJ. Pengaruh Penggunaan Metode Permainan Kartu Bilangan Terhadap Motivasi Dan Hasil Belajar Siswa Materi Pecahan. Auladuna J Prodi Pendidik Guru Madrasah Ibtidaiyah. 2019 Dec 5;1(2):83–93.

19. Tansya T, Utami NA, Nababan EB, Susilo BE. Media Pembelajaran Matematika Dalam Permainan Sudoku: Systematic Literature Review. PRISMA Pros Semin Nas Mat. 2024 Feb 10;489–95.

20. Putra FP, Ariana RD, Masruhim MA, Najmiah S. Penggunaan Media Interaktif Canva dalam Pembelajaran Matematika untuk Meningkatkan Motivasi Belajar Peserta Didik di Kelas VII SMP Negeri 4 Samarinda. J Inov Refleksi Profesi Guru. 2024 Mar 6;1(1):21–7.

21. Nafiati DA. Revisi taksonomi Bloom: Kognitif, afektif, dan psikomotorik. Humanika Kaji Ilm Mata Kuliah Umum. 2021 Dec 31;21(2):151–72.

Jurnal Kesehatan Ibu dan Anak Vol.19, No.1, July 2025, pp. 22~32
ISSN: 2599-3224 (Online), ISSN: 2302-6014 (Print)

22. Dimyati M, Sutikno S, Masturi M. Pengaruh Penugasan Proyek Pembuatan Mikroskop Sederhana dari Barang Bekas terhadap Kreativitas Siswa SMK. Jt Pros IPS Dan Semin Nas Fis. 2015 Oct 30;4:SNF2015-47.

23. Kurniawan DA, Astalini A, Kurniawan N, Pathoni H. Analisis korelasi sikap siswa dan disiplin siswa terhadap IPA pada Siswa SMP Provinsi Jambi. J Pendidik Fis Dan Keilmuan JPFK. 2019 Sept 15;5(2):59–71.

24. Pakpahan M, Siregar D, Susilawaty A, Tasnim T, Ramdany R, Manurung EI, et al. Promosi Kesehatan Dan Perilaku Kesehatan. yayasan kita menulis; 2021.