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Effectiveness of Board Game–Based Education in Enhancing Knowledge and Intention Toward HPV Vaccination Among Adolescent Girls

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Abstract

Background: Human papillomavirus (HPV) infection is a major cause of cervical cancer, and HPV vaccination is recommended for girls aged 11–12 years. However, HPV vaccination coverage in Indonesia remains low, partly due to limited knowledge and low intention to receive vaccination among preadolescent girls. Innovative educational strategies are needed to improve HPV vaccine acceptance.
Objective: This study aimed to evaluate the effectiveness of board game–based HPV vaccine education in improving knowledge and intention to receive HPV vaccination among adolescent girls.
Methods: A quasi-experimental study was conducted involving 144 girls aged 11–12 years, with 72 participants in the intervention group and 72 in the control group. The intervention group received HPV vaccine education through a board game–based approach, while the control group received conventional education. Knowledge and intention toward HPV vaccination were measured using validated questionnaires before and after the intervention. Data were analyzed using descriptive statistics, paired sample t-tests, and ANCOVA.
Results: After adjustment for baseline scores and age using ANCOVA, the intervention group showed significantly higher post-test knowledge ($F(1,140) = 9.65$, $p = 0.002$, partial $\eta^2 = 0.065$) and intention ($F(1,140) = 8.69$, $p = 0.004$, partial $\eta^2 = 0.058$) compared with the control group, indicating moderate intervention effects.
Conclusion: Board game–based HPV vaccine education was associated with significant improvements in knowledge and intention toward HPV vaccination among adolescent girls after controlling for baseline differences. However, these improvements were comparable to those achieved through conventional education. Interactive educational approaches may therefore serve as viable and engaging alternatives, rather than superior strategies, for supporting HPV vaccination promotion in school-based programs.

Keywords: Adolescent girls; Board game; HPV vaccination; Intention; Knowledge

INTRODUCTION

The human papillomavirus (HPV) vaccine is recommended for routine use among children aged 11–12 years in Indonesia (1,2). Cervical cancer remains a major public health burden, ranking as the second most common cancer among Indonesian women, with 36,633 cases (17.2%) and approximately 21,000 deaths annually (3). In 2023, the government set a target to achieve 90% HPV vaccination coverage among girls by 2030. In line with the global cervical cancer elimination strategy, the Indonesian government has set a target of achieving 90% HPV vaccination coverage among girls by 2030. However, national coverage remains critically low; in 2018, only 1.1% of the target population completed the two-dose HPV vaccination series (4,5). This substantial gap highlights the need for effective, context-appropriate educational interventions to improve vaccine uptake.

A number of factors contribute to Indonesia's low HPV vaccination rate, including preadolescents' lack of information and parents' ongoing worries about the necessity, safety, and perceived risk of HPV infection (6–12). These parental attitudes have consistently been identified as significant barriers to vaccine acceptance (13). Addressing knowledge deficits early in adolescence is therefore essential, as this developmental stage represents a critical window for shaping health-related attitudes and preventive behaviors (7,14–16).

Various educational media have been employed to improve HPV-related knowledge, including leaflets (17,18), videos (19,20), and mobile applications (21,22). Although digital interventions have a wide audience (23,24), their efficacy among preadolescents in low-middle-income environments is hampered by parental screen-use prohibitions and restricted access to personal devices. Due to these contextual obstacles, different teaching strategies that are practical and engaging in both school-based and community settings are required.

Board games represent a promising but underexplored educational strategy. Designed to promote active learning through play, board games facilitate exploration, social interaction, and experiential learning, which are particularly suited to children aged 11–12 years (25,26). Previous studies have shown that board games can improve health knowledge and engagement more effectively than conventional lecture-based education (27–29). When grounded in behavioral theory, game-based interventions may further enhance motivation and decision-making related to health behaviors (30,31).

Despite growing interest in gamification and game-based learning in health education, there is still little data on the application of theory-driven teaching board games for HPV vaccination, especially in low-middle-income countries (32–34). Most existing HPV education studies have focused on digital games or adult and parental populations, with little attention to preadolescent girls who are the primary vaccine recipients.

To address this gap, the present study applies the Theory of Planned Behavior (TPB) (35) to develop an educational board game to improve HPV vaccination knowledge among adolescent girls. By integrating TPB constructs—attitudes, subjective norms, and perceived behavioral control—into a non-digital, school-friendly game format, this study advances HPV education research by offering a scalable, contextually appropriate intervention for low-resource settings. This study aimed to evaluate the effectiveness of an educational board game in improving adolescent girls' knowledge and influencing HPV vaccination decisions, compared with conventional educational methods.

METHODS

Study Design, Population, Sample, and Sampling

This study employed a quasi-experimental design aimed at developing and evaluating a board game-based HPV vaccination education program to improve knowledge and intention of vaccination among adolescent girls.

The study population consisted of preadolescents aged 11–12 years. Students from Elementary School No. 19 Baba, Takalar Regency, were randomly selected as the intervention group, while students from Elementary School No. 219 Batu Taruttu, which is geographically separate, were randomly selected as the control group. Both schools were selected because previous studies reported a high prevalence of preadolescents who had not received HPV vaccination in these settings.

Participants were recruited using convenience sampling. The inclusion criteria were: girls aged 11–12 years, ability to communicate in Indonesian, and written parental consent. The

exclusion criterion was a history of allergy to any component of the HPV vaccine.

Baseline disparities across groups, including age, were conceivable since group allocation was school-based rather than randomized at the individual level. Despite the small age range, this possible cause of non-equivalency is recognized and taken into account when interpreting the results.

Sample Size

The sample size was determined using an a priori power analysis for a quasi-experimental study with two independent groups and pre–post measurements. Assuming a medium effect size (f = 0.25), a statistical power of 0.80, and a two-sided significance level of 0.05, the minimum required sample size was estimated at 128 participants. To account for potential attrition and incomplete data, the sample size was increased by approximately 12.5%. Therefore, a total of 144 participants were recruited, with 72 participants allocated to the intervention group and 72 to the control group.

Board Game–Based HPV Vaccine Education Intervention

Participants in the intervention group engaged in a *Snakes and Ladders* board game developed for HPV vaccine education and grounded in the Theory of Planned Behavior (TPB). The game content was developed based on national HPV vaccination guidelines and relevant literature, reviewed by experts, and pilot-tested among preadolescents outside the study sample to ensure clarity and age appropriateness.

The intervention was delivered over four sessions, conducted once weekly for one month. Each session lasted 30–40 minutes, resulting in a total exposure of 120–160 minutes per participant. Sessions were held during school break time. Participants played in groups of three to encourage interaction and discussion.

The game comprised a board, dice, question cards, and standardized answer cards. Players advanced based on dice rolls and answered questions corresponding to the squares reached, with peers verifying responses. Trained research assistants followed a standardized facilitation guide to ensure consistency, monitored gameplay, and recorded session completion. Small non-monetary rewards were provided to maintain engagement.

To minimize contamination, the intervention and control groups were assigned to different geographically separated schools. The control group continued usual school activities during the study period, with regular follow-up by the research team.

Data Collection Instruments

The study measured participant characteristics, HPV knowledge and intention toward HPV vaccination.

1. HPV Knowledge
   HPV knowledge was measured using the Human Papillomavirus Knowledge Questionnaire (HPV-KQ) developed by Harrison et al. (2021) (36). The HPV-KQ consists of 13 items covering key HPV constructs (transmission, sequelae, prevention), including HPV vaccination and HPV-related cancers. Response options were "True (1)," "False (0)," or "Don't know (0)." The 13-item, two-factor scale demonstrated strong internal consistency and good model fit. The HPV-KQ was translated into Indonesian using a cross-cultural adaptation process, followed by a pilot study involving 30 pre-adolescents to assess the questionnaire's reliability. Regression analyses controlling for key covariates demonstrated that the HPV-KQ was a significant predictor of HPV vaccination among adolescents ($p < .001$).
2. Intention to Receive HPV Vaccination
   Intention to receive HPV vaccination was assessed using three items rated on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicated a stronger intention to receive HPV vaccination.

Ethical Considerations

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board (IRB) of Muhammadiyah Purwokerto University No. KEPK/UMP/15/VII/2025 prior to data collection. Permission was also secured from the relevant school authorities. Written informed consent was obtained from parents or legal guardians, and assent was obtained from all participating adolescents before enrolment. Participation was voluntary, and participants were informed of their right to withdraw from the study at any time without any academic or personal consequences. Confidentiality and

anonymity were strictly maintained by using coded identifiers, and all data were stored securely and accessed only by the research team.

Data Collection Procedure

Data collection was conducted by the principal investigator and five research assistants, all of whom were registered nurses. Prior to data collection, research assistants completed training on instrument use and study procedures.

Following approval from the Institutional Review Board (IRB) of Muhammadiyah Purwokerto University, permission was obtained from school principals. The research team explained study procedures to eligible participants. Preadolescents meeting the inclusion criteria and agreeing to participate were provided with informed consent forms for parental approval and subsequently completed the pre-test questionnaire.

Participants in the intervention group played the Snakes and Ladders board game during school break time. The board game sessions were conducted regularly over one month. After one month, all participants completed the post-test questionnaire.

Data Analysis

Data analysis was performed using SPSS version 23 for Windows. Descriptive statistics were presented using means, standard deviations, frequencies, and percentages.

Baseline equivalence between the intervention and control groups was examined using independent samples t-tests. To evaluate within-group changes over time, paired samples t-tests were conducted to compare pre-test and post-test scores for knowledge and intention in both the intervention and control groups. To assess the comparative effectiveness of the intervention, Analysis of Covariance (ANCOVA) was performed. The post-test score was entered as the dependent variable, and the group (intervention vs. control) was entered as the fixed factor. To control for baseline differences and confounding factors, pre-test scores and age were included as covariates in the model. The level of significance was set at $p < 0.05$.

RESULTS

Baseline characteristics

Table1. Descriptive Statistics of Study Variables by Group (n=144)

Variable	Group	Mean	SD	Median	t	p
Age (years)	Intervention	11.21	0.409	11	3.998	.000*
	Control	11.51	0.503	12		

Note: Independent samples *t*-test was used. *Significant difference at p < .05.

Pre–Post Outcomes in Intervention and Control Groups

Table 2. Paired Sample t-test Results for Pre–Post Outcomes in Intervention and Control Groups (n=144)

Variable	Group	Mean Difference	SD	SE	95% CI	t	df	p
Knowledge	Intervention	5.153	6.831	0.805	3.548, 6.758	6.400	71	.000
	Control	6.917	4.024	0.474	5.971, 7.862	14.586	71	.000
Intention	Intervention	1.750	2.700	0.318	1.116, 2.384	5.500	71	.000
	Control	1.278	1.540	0.182	0.916, 1.640	7.039	71	.000

Note. Mean difference = post-test score minus pre-test score

Results for Knowledge and Intention Outcomes

Table 3. Comparison of post-test knowledge and intention scores between intervention and control groups (n=144)

Variable	Group	Pretest Mean (SD)	Posttest Mean (SD)	Adjusted mean (SE)	95% CI	F	p	Partial η^2
Knowledge	Intervention	15.57 (7.43)	20.97 (4.72)	20.21 (0.48)	19.19, 21.22	9.65	.002	.065
	Control	10.26 (3.35)	17.18 (3.73)	17.95 (0.48)	16.91, 18.98			
Intention	Intervention	5.33 (2.13)	6.99 (1.67)	6.12 (0.18)	6.54, 7.25	8.69	.004	.058
	Control	4.75 (1.96)	6.03 (1.42)	6.89 (0.18)	5.77, 6.48			

Note. SD = Standard Deviation; SE = Standard Error; CI = Confidence Interval; Partial η^2= Partial Eta Squared. Adjusted for baseline scores (pre-test) and age. *Statistically significant at $p < 0.05$.

Table 1 shows a statistically significant difference in age between the intervention and control groups. Participants in the intervention group were younger (mean = 11.21 years; SD = 0.41; median = 11) compared with those in the control group (mean = 11.51 years; SD = 0.50; median = 12). The independent samples t-test confirmed that this difference was significant (t = 3.998; p < .001), indicating a non-homogeneous age distribution between groups at baseline.

Table 2 shows statistically significant pre–post improvements in both knowledge and intention scores in the intervention and control groups. In the intervention group, knowledge scores increased significantly after the intervention (mean difference = 5.53; 95% CI 3.548 to 6.758; t = 6.400; p < .001), accompanied by a significant improvement in intention scores (mean difference = 1.750; 95% CI 1.116 to 2.384; p < .001).

Similarly, the control group demonstrated significant pre–post changes, with knowledge scores showing a significant increase (mean difference = 6.917; 95% CI 5.971 to 7.862; p < .001) and intention scores also improving significantly (mean difference = 1.278; 95% CI 0.916 to 1.640; p < .001). Overall, all measured outcomes exhibited statistically significant improvements from pre-test to post-test.

Table 3 presents the comparison of post-test knowledge and intention scores between the intervention and control groups after adjustment for baseline (pre-test) scores and age using ANCOVA. The results indicate a significant group effect for both outcomes. For **knowledge**, participants in the intervention group demonstrated significantly higher adjusted post-test scores compared with the control group ($F(1,140) = 9.65$, $p = 0.002$, partial $\eta^2 = 0.065$). Similarly, for **intention**, the intervention group showed significantly higher adjusted post-test scores than the control group ($F = 8.69$, $p = 0.004$, partial $\eta^2 = 0.065$)

Overall, these findings indicate that the intervention had a significant positive effect on both knowledge and intention outcomes after controlling for baseline scores and age.

DISCUSSION

The findings of this study indicate that both the board game-based HPV vaccine education and the conventional educational approach used in the control group were effective in improving knowledge and intention toward HPV vaccination among adolescent girls; however, the magnitude of improvement did not differ significantly between the two groups. In other words, while the board game intervention successfully enhanced participants' understanding and intention, it was not statistically superior to conventional education methods.

The board game intervention did not outperform traditional education largely because both approaches delivered structured, age-appropriate information addressing HPV and vaccination benefits, thereby strengthening attitudes toward vaccination in both groups. This

is consistent with earlier research showing that a variety of creative teaching mediums, such as games, films, and comics, can produce comparable increases in HPV-related knowledge and intention (37,38). Moreover, recent systematic reviews have concluded that serious games generally improve vaccine-related knowledge among young populations; however, evidence regarding their impact on actual vaccination uptake remains limited (39).

From the perspective of the Theory of Planned Behavior (TPB), the comparable improvements in intention suggest that attitudinal change was achieved regardless of intervention format. However, TPB implies that behavior is also shaped by subjective norms and perceived behavioral control. The absence of between-group differences indicates that the board game intervention, as implemented, may not have sufficiently influenced these additional determinants beyond what was achieved through conventional education. Specifically, factors that are known to significantly influence HPV vaccination decisions—parental approval, peer endorsement, and perceived access to vaccination services—were not specifically addressed. Previous TPB-based interventions have demonstrated the value of specifically addressing subjective norms and perceived behavioral control. An educational program grounded in TPB among women in Iran demonstrated significant improvements in these constructs, alongside increased willingness to receive HPV vaccination in the intervention group, while no comparable changes were observed in the control group (40). Similarly, a study conducted in China by Naiyang Shi et al. (2025) found that subjective norms and perceived behavioral control exerted a stronger influence on HPV vaccination decisions among adolescent girls than attitudes alone, and that high intention did not consistently translate into vaccination behavior in the absence of social support and reduced external barriers (41).

Contextual factors in the Indonesian setting may further explain these findings. HPV vaccination for preadolescent girls remains highly dependent on parental consent and school-based program availability. Consequently, even when adolescents demonstrate increased knowledge and intention, their ability to act on this intention is constrained by external factors beyond individual motivation. This may attenuate the observable impact of innovative educational formats when compared with conventional methods that convey similar information content.

Despite the absence of statistical superiority, the board game approach retains practical relevance. Interactive, non-digital formats may enhance engagement, facilitate peer interaction, and create a more comfortable environment for discussing sensitive health topics. Such attributes may support indirect benefits, including improved communication with parents and teachers, which have been identified as facilitators of HPV vaccine acceptance (37). These potential advantages may not be fully captured through short-term quantitative outcomes.

Future refinements of board game–based HPV education should therefore move beyond knowledge transmission alone. Integrating parental involvement, peer modeling, and explicit guidance on accessing vaccination services may strengthen subjective norms and perceived behavioral control, aligning the intervention more closely with TPB mechanisms. By addressing these contextual and structural barriers, board game–based interventions may evolve into more comprehensive behavior change strategies capable of influencing not only intention but also vaccination uptake.

Limitations

This study has several limitations. First, the sample was relatively homogeneous, consisting of early adolescent girls from a single geographic area, which may limit the generalizability of the findings to other age groups or cultural contexts. Second, the study compared the board game intervention with a control group that still received educational exposure, rather than with a control group; consequently, both groups experienced knowledge gains, reducing the likelihood of detecting between-group differences. Third, outcomes were measured shortly after the intervention, preventing assessment of long-term retention of knowledge, intention, or actual vaccination uptake. As previous research has indicated, increased intention does not always lead to increased vaccination behavior without sustained support. Fourth, external factors such as parental influence, access to vaccination services, and peer norms were not explicitly addressed in the intervention, despite their known importance in adolescent vaccination decisions. Fifth, although randomization was applied, a significant difference in mean age between groups was

observed, which may have influenced baseline comprehension or responsiveness to the intervention, even though both groups showed improvement.

CONCLUSION

This study aimed to evaluate the effectiveness of a board game–based educational intervention in improving knowledge, intention, and vaccination-related behavior toward the human papillomavirus (HPV) vaccine among adolescent girls. The primary objective was to determine whether an interactive, theory-driven educational approach could enhance adolescents' understanding of HPV and strengthen their intention to receive vaccination compared with conventional educational methods. Overall, the findings indicate that both educational approaches were effective in increasing knowledge and intention, highlighting the potential role of innovative and engaging educational strategies in supporting HPV vaccination promotion among early adolescents.

These findings imply that board game-based education is a more engaging and realistic alternative to standard educational approaches for delivering HPV vaccine information in schools, rather than a superior intervention. Given that vaccination behavior was not directly examined, future research should include behavioral outcomes, such as vaccine uptake, and use longitudinal designs to examine whether gains in knowledge and intention translate into maintained vaccination practice over time.

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None

Author Contribution

HH conceptualized and designed the study, supervised data collection, and drafted the original manuscript.
DE contributed to the study design, conducted data collection, and assisted in data interpretation.
DD performed data analysis, interpreted the results, and contributed to manuscript drafting.
GKAWP contributed to the development of the educational intervention, literature review, and manuscript revision.
SS critically reviewed the manuscript, provided methodological guidance, and approved the final version for publication

Conflict of Interest

There is no conflict of interest for this research.

Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request

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