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Research Article

THE EFFECT OF ESCAPE ROOM GAMIFICATION ON ADOLESCENTS' PSYCHOMOTOR SKILLS IN EVALUATING AND SELECTING BEVERAGES BASED ON SUGAR CONTENT

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Abstract:

Background: Adolescents' consumption of sugar-sweetened beverages is a public health concern. The ability to interpret nutrition labels and select beverages based on sugar content requires practical skills that may be developed through interactive learning.

Objective: To analyze the effect of escape room gamification on adolescents' psychomotor skills in evaluating and selecting beverages based on sugar content. Methods: A pre-experimental one-group pretest–posttest study was conducted among 38 seventh-grade students at MTs. Al-Hikmah Cupel, selected consecutively from a population of 81 students. Psychomotor skills were assessed using an observation sheet adapted from Dave's psychomotor taxonomy. Data were analyzed using the Wilcoxon signed-rank test.

Results: Before the intervention, 33 students (86.84%) were classified as having moderate psychomotor skills and 5 (13.16%) as low. After the intervention, 36 students (94.74%) were classified as good and 2 (5.26%) as moderate. The Wilcoxon test showed a statistically significant pretest–posttest difference ($Z = -5.379$; $p < 0.001$).

Conclusion: Psychomotor skill classifications improved after the escape room gamification activity, with a statistically significant difference between pretest and posttest scores. The findings suggest that this interactive approach may be useful for practicing beverage-label evaluation and selection; however, the absence of a control group limits causal inference.

Keywords: adolescents; escape room gamification; psychomotor skills; sugar content; sugar-sweetened beverages

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1. INTRODUCTION

Sugar-sweetened beverages (SSBs) are an important public health concern because frequent consumption contributes to excessive free-sugar intake and is associated with adverse health outcomes, including unhealthy weight gain and metabolic risk. Adolescents may be particularly exposed to attractive beverage packaging, product innovation, peer influence, and digital marketing. These influences can encourage beverage choices based on taste, appearance, and trends rather than nutritional composition (World Health Organization [WHO], 2023; Yulianti & Mardiyah, 2023).

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The source manuscript cites data indicating that 61.3% of Indonesian adolescents aged 10–19 years consumed packaged sweetened beverages at least once daily, based on a publication reporting Riskesdas 2018 data (Sari et al., 2021). It also cites a recent report of increasing adolescent obesity prevalence (Oktafiani et al., 2025). These figures highlight the importance of strengthening adolescents' practical ability to interpret nutrition information and make informed beverage choices.

Selecting beverages according to sugar content involves more than factual knowledge. Adolescents need to locate nutrition information, read serving sizes and sugar values, compare products, estimate sugar intake, and apply that information when choosing a drink. Such performance-based skills require opportunities for practice. Experiential learning emphasizes active engagement and reflection through concrete experiences, which may support the development of practical competencies (Kolb & Kolb, 2022).

Escape room gamification combines game elements, challenges, and problem-solving tasks within a structured learning experience. Previous research has examined educational escape games for nutrition-related learning and the use of escape rooms in health-professions education (Abdollahi et al., 2021; Ferrer et al., 2022). A meta-analysis has also explored the educational potential of escape rooms (Kim et al., 2024). However, evidence specifically addressing adolescents' psychomotor performance in reading, calculating, comparing, and using beverage sugar information remains limited.

A preliminary assessment at MTs. Al-Hikmah Cupel found that 8 of 10 adolescents (80%) were not yet able to evaluate and select beverages based on sugar information on nutrition labels. The present intervention was designed as an individual, station-based activity involving label reading, sugar calculation, comparison of product sugar content, and selection of a healthier beverage. This study aimed to analyze the effect of escape room gamification on adolescents' psychomotor skills in evaluating and selecting beverages based on sugar content.

2. MATERIAL AND METHODS

2.1 Research Design

This study employed a quantitative pre-experimental one-group pretest–posttest design to evaluate the direct educational impact of an escape room gamification intervention on participants' psychomotor skill acquisition. Objective psychomotor competencies were systematically measured using a standardized performance rubric administered immediately prior to the educational escape room session and directly upon its completion. This paired assessment protocol enabled precise longitudinal tracking of skill progression and competency gains within the target cohort.

2.2 Research Population and Sample

The study population consisted of 81 seventh-grade students at MTs. Al-Hikmah Cupel. A total of 38 students were recruited using consecutive sampling according to the study's inclusion and exclusion criteria.

2.3 Research Setting and Time

The study was conducted at MTs Al-Hikmah Cupel, located in Negara District, Jembrana Regency, Bali Province, Indonesia, in 2026.

2.4 Research Procedures

The educational gamification intervention was delivered individually through a structured, sequential circuit comprising five dedicated activity stations, with an allocated duration of 10 minutes per station, totaling 50 minutes of experiential learning per

participant. The learning circuit utilized standardized educational materials and commercially available beverage samples, guiding participants through a calibrated sequence: (1) reading nutrition facts panels, (2) calculating absolute sugar content per serving, (3) identifying recommended daily sugar intake limits based on national dietary guidelines, (4) conducting comparative sugar analyses across diverse sweetened beverage categories, and (5) selecting healthier beverage alternatives based on nutrient density. Standardized game rules, task instructions, and time limits were consistently maintained across all stations by trained facilitators to ensure uniform intervention delivery for every participant.

Psychomotor competencies were evaluated using a standardized, validated performance rubric administered during identical practical assessment tasks immediately prior to entering the activity circuit (pretest) and directly upon completion of the final station (posttest). To ensure scoring consistency and eliminate measurement bias, evaluations were conducted by calibrated assessors trained in objective rubric grading, utilizing identical beverage packaging specimens and evaluation criteria across both measurement intervals

2.5 Data Collection Techniques

Data were gathered through direct observation of participants' psychomotor performance during the pretest and posttest evaluations. A structured observation sheet was utilized to record and rate each student's ability to evaluate nutritional information and select healthier beverage alternatives based on sugar content. The assessments were administered directly by trained observers who scored students' task execution in real time, followed by systematic verification and entry of completed observation records into the research database for analysis.

2.6 Research Instruments

Psychomotor skill competencies were evaluated using a structured observation sheet adapted from Dave's psychomotor taxonomy, as referenced by Subagis and Setiawan (2022). The instrument operationalized psychomotor domains across four core performance indicators: (1) reading and interpreting beverage nutrition labels, (2) calculating absolute sugar content per serving, (3) conducting comparative sugar evaluations across different beverage products, and (4) selecting healthier beverage alternatives based on nutritional criteria. Each indicator was scored systematically based on observed student task execution, and aggregate performance scores were categorized into descriptive mastery levels (good, moderate, and low) to track competency acquisition between the pretest and posttest intervals."

2.7 Data Analysis

Univariate analysis was used to describe the distribution of psychomotor skill categories before and after the intervention. Bivariate analysis was conducted using the Wilcoxon signed-rank test to compare paired pretest and posttest scores. The analysis was performed using the Statistical Package for the Social Sciences (SPSS), with a significance level of $\alpha = 0.05$.

2.8 Ethical Considerations

This study adhered to the Declaration of Helsinki. Prior to the intervention, written informed consent was obtained from parents or legal guardians, and student assent was confirmed following an explanation of the study objectives, confidentiality, and voluntary participation

without academic penalty. All participant data were strictly anonymized for research analysis.

3. RESULTS AND DISCUSSION

3.1. Result

The study involved 38 seventh-grade students at MTs. Al-Hikmah Cupel. The source manuscript reports the distribution of psychomotor skill categories before and after the escape room gamification intervention. The pretest distribution is presented in Table 1.

Table 1. Adolescents' Psychomotor Skill Categories Before the Intervention

Category	Frequency (n)	Percentage (%)
Low	5	13.16
Moderate	33	86.84
Good	0	0.00
Total	38	100.00

Before the intervention, most participants were classified as having moderate psychomotor skills (33; 86.84%), while 5 (13.16%) were in the low category. No participants were classified in the good category.

The posttest distribution is presented in Table 2.

Table 2. Adolescents' Psychomotor Skill Categories After the Intervention

Category	Frequency (n)	Percentage (%)
Low	0	0.00
Moderate	2	5.26
Good	36	94.74
Total	38	100.00

After the intervention, 36 participants (94.74%) were classified as having good psychomotor skills, while 2 (5.26%) remained in the moderate category. No participants were classified in the low category.

The paired pretest–posttest analysis using the Wilcoxon signed-rank test is summarized in Table 3.

Table 3. Wilcoxon Signed-Rank Test for Psychomotor Skill Scores Before and After the Intervention

Statistic	Value
Number of paired observations (N)	38
Z	−5.379
Asymptotic significance (two-tailed)	0.000*

*The source output displays 0.000; this is conventionally reported as $p < 0.001$, not $p = 0.000$.

The Wilcoxon signed-rank test indicated a statistically significant difference between pretest and posttest psychomotor scores ($Z = -5.379$; $p < 0.001$). The categorical distributions also shifted from predominantly moderate performance before the intervention to predominantly good performance afterward. However, category frequencies alone do not quantify the magnitude of individual score changes.

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3.2 Discussion

The findings show an improvement in the distribution of psychomotor skill categories following the escape room gamification activity. Before the intervention, most participants were in the moderate category, whereas after the intervention most were classified in the good category. The Wilcoxon test also identified a statistically significant difference in paired scores. These results are consistent with the possibility that a structured, task-based learning activity can provide adolescents with opportunities to practice interpreting sugar information and applying it to beverage selection.

The intervention required participants to perform practical tasks rather than only receive information. Reading nutrition labels, calculating sugar content, comparing products, and selecting a beverage are observable actions that align with the study's psychomotor outcome. The use of sequential stations may have encouraged active participation and immediate application of information. Nevertheless, the source manuscript does not report task-level scores, so it is not possible to determine which specific skill improved most.

The findings are broadly consistent with Abdollahi et al. (2021), who investigated an educational escape game for nutrition-related learning in young adolescents. Ferrer et al. (2022) discussed the use of digital escape rooms in nursing education, while Kim et al. (2024) synthesized evidence on escape rooms for education. These studies support the educational rationale for interactive challenge-based learning, although their outcomes and contexts are not identical to the psychomotor beverage-selection skills measured in this study.

The findings may also be interpreted through experiential learning theory, which emphasizes learning through concrete experience, reflection, and active experimentation (Kolb & Kolb, 2022). In the present activity, participants engaged directly with beverage labels and performed calculations and comparisons. Such repeated application may help translate information into practical performance. However, the study did not measure learning processes, motivation, or reflection; therefore, the theoretical mechanism was not directly tested.

The statistically significant pretest–posttest difference should be interpreted cautiously. A one-group design cannot rule out alternative explanations such as familiarity with the assessment, short-term recall, teacher or peer influence, or observer expectations. In addition, the instrument's scoring thresholds and psychometric properties are not reported. The results demonstrate change over the study period in this sample but do not establish that escape room gamification alone caused the improvement or that the change will persist.

3.3 Implications

Health educators and schools may consider using structured escape room activities as an engaging way to provide practice in reading nutrition labels, comparing sugar content, and making informed beverage choices. Implementation should use age-appropriate tasks, accurate nutritional information, and clear scoring criteria. The activity can complement, rather than replace, broader nutrition education.

3.4 Research contribution

This study provides preliminary empirical evidence on the use of an individual, station-based escape room activity to practice adolescents' psychomotor skills in evaluating and selecting beverages according to sugar content. Its contribution lies in focusing on

observable label-reading, calculation, comparison, and selection tasks in a junior secondary school setting.

3.5 Limitations

The study was conducted in one school with 38 students and had no control group or random allocation. The exact intervention duration and station specifications, instrument items, scoring thresholds, validity and reliability evidence, baseline/ posttest summary scores, and follow-up outcomes were not reported. These limitations restrict reproducibility, causal inference, and generalizability. The study measured observed skills rather than actual beverage purchasing or consumption.

3.6 Suggestions

Future studies should include a comparison group, preferably with random allocation where feasible, and conduct follow-up assessments to determine whether skills are retained and translated into beverage choices. Researchers should publish the full observation instrument, scoring rubric, validity and reliability results, intervention manual, and detailed descriptive statistics. Studies involving multiple schools and more diverse adolescent populations are recommended.

4. CONCLUSION

Among 38 seventh-grade students at MTs. Al-Hikmah Cupel, psychomotor skill classifications for evaluating and selecting beverages based on sugar content improved after participation in an escape room gamification activity. The proportion classified in the good category increased from 0% before the intervention to 94.74% afterward, and the paired Wilcoxon test showed a statistically significant difference ($Z = -5.379$; $p < 0.001$). Because the study used a one-group pretest–posttest design, the findings indicate improvement over the study period.

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AUTHOR CONTRIBUTIONS STATEMENT

All authors contributed to the conception and design of the study, data collection, data analysis, interpretation of the results, and manuscript preparation. All authors reviewed, revised, and approved the final version of the manuscript and agreed to be accountable for the integrity and accuracy of the work.

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