Development and Effectiveness of the Snake Adventure Board Game to Enhance Learning Interest and Outcomes in Bhinneka Tunggal Ika Instruction

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Abstract. This study addresses the persistent challenges in fostering student engagement and learning outcomes in Bhinneka Tunggal Ika instruction, highlighting the need for innovative and interactive educational media. The research aims to develop and evaluate the effectiveness of the Snake Adventure board game as a technology-enhanced, pedagogically robust learning tool. Employing a research and development design structured by the ADDIE model, the study involved secondary school students as subjects and utilized both expert validation and classroom implementation. Data were analyzed using descriptive and inferential statistics, supported by qualitative feedback from participants. The findings reveal that the Snake Adventure board game demonstrated high validity and feasibility, with significant improvements observed in both student motivation and academic performance. The intervention resulted in notable increases in learning interest and achievement scores, affirming the efficacy of game-based, multimodal approaches in civic education. In conclusion, the board game offers a practical and empirically supported solution to enhance student engagement and outcomes in multicultural instruction. The originality of this study lies in its integration of TPACK principles and participatory design, distinguishing it from prior research in the field. This research contributes meaningfully to the advancement of educational innovation, providing a replicable model for developing impactful instructional games in diverse learning contexts.

INTRODUCTION

Education remains central to global efforts aimed at fostering social cohesion, critical thinking, and sustainable development. As pedagogical paradigms continue to evolve, there is a growing emphasis on cultivating learning environments that support not only cognitive development but also soft skills, learner motivation, and engagement (Ruiz-Arroyo et al., 2025; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023). Among contemporary strategies, game-based learning—particularly through board games—has gained prominence in addressing the limitations of conventional instruction, which frequently fails to sustain student interest or cater to diverse learning preferences (Othman et al., 2025; Pei-Ching et al., 2023). Board games, characterized by their interactive and collaborative nature, provide learners with opportunities to

engage meaningfully, promote retention, and build agency and creativity (Chukusol & Piriyasurawong, 2022; C.-L. Lin & Chen, 2025; M. D. S. E. Sousa, 2025). Evidence from recent studies indicates that board games have demonstrated pedagogical effectiveness across disciplines such as language, science, and the arts (Aureli et al., 2024; Nascimento et al., 2025; Tonda Ramos et al., 2025), in line with constructivist and active learning theories that underscore the importance of engagement, collaboration, and real-world contextualization (Rosa et al., 2021a, 2021b; Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2021; Wang et al., 2025).

The urgency to transform pedagogical practices is especially acute in the realm of multicultural and civic education, where the fostering of national identity, tolerance, and democratic values is a strategic imperative. In the Indonesian context, the teaching of *Bhinneka Tunggal Ika*—a foundational principle of unity in diversity—poses specific instructional challenges due to its abstract nature and declining student motivation in civics education (C.-L. Lin & Chen, 2025; M. D. S. E. Sousa, 2025). The monotony of traditional teaching methods has prompted educational stakeholders to explore novel strategies and media capable of revitalizing civic instruction (Boonroungrut, 2025; M. D. S. E. Sousa, 2024). Board games have emerged as promising instructional tools to facilitate meaningful learning of complex sociocultural topics in accessible and engaging ways (Chukusol & Piriyasurawong, 2022; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023). Furthermore, the alignment of game-based learning with participatory citizenship education highlights its potential in preparing students for life in a pluralistic society (Kuo et al., 2023; Rana et al., 2025).

Despite this progress, significant challenges remain in implementing educational innovation effectively. A key problem identified in the literature is that conventional classroom practices often lack the capacity to foster sustained learner motivation or deep comprehension, especially in value-laden subjects (Chaleepliam et al., 2023; Pei-Ching et al., 2023; M. D. S. E. Sousa, 2024). Although a variety of media—digital and analog—have been introduced to support instruction, many remain constrained by issues of accessibility, contextual misalignment, and limited adaptability (Gnecco et al., 2024; Othman et al., 2025; Wang et al., 2025). Additionally, mismatches between instructional design and student profiles often result in fragmented learning experiences (Chiang & Hsu, 2023; Sanchiz et al., 2024). Scholars thus advocate for more culturally responsive and learner-centered strategies that integrate seamlessly into curricular frameworks (C. Sousa et al., 2023; M. D. S. E. Sousa, 2024; M. D. S. E. Sousa et al., 2023; Tonda Ramos et al., 2025).

Research has demonstrated that both digital and analog board games support collaborative learning, critical thinking, and disciplinary knowledge acquisition (Chukusol & Piriyasurawong,

2022; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024). Nonetheless, the translation of gameplay into measurable academic gains remains an enduring challenge (Y.-T. Lin & Wang, 2022; Wu et al., 2023; Zhang & Hsu, 2023). Integrating contextual narratives and scaffolding elements has been shown to enhance the relevance and pedagogical efficacy of game-based experiences (Chen & Hsu, 2023; Pei-Ching et al., 2023; Wang et al., 2022). At the same time, individual learner factors—such as personality, prior knowledge, and the quality of facilitation— exert a considerable influence on learning outcomes, thus reinforcing the need for tailored approaches (Y.-Z. Lin & Shih, 2022; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023; Tinterri et al., 2023). The literature further notes a dearth of studies that critically assess board games' effectiveness across a broad range of content domains and student populations (Othman et al., 2025; M. D. S. E. Sousa, 2024).

Emerging research on hybrid and augmented board games demonstrates their utility in enhancing learner engagement and outcomes, particularly in STEM and language education (Blazhko & Shtefan, 2023; Fadzli et al., 2024; Li et al., 2024). Positive impacts on motivation and skill acquisition have been reported, especially when digital feedback mechanisms are embedded (Nascimento et al., 2025; Ruiz-Arroyo et al., 2025). In civic and character education, game-based strategies have shown promise in cultivating empathy, social responsibility, and ethical reasoning (C.-L. Lin & Chen, 2025; Rosa et al., 2021a, 2021b; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023). Nevertheless, their classroom integration is often impeded by gaps in teacher training, resource allocation, and curricular coherence (Hanghøj, 2023; Rosa et al., 2021a; M. D. S. E. Sousa, 2021).

Current models of board game design emphasize the importance of scaffolding, formative feedback, and peer collaboration in optimizing learning outcomes (Pei-Ching et al., 2023; Wang et al., 2025; Wu et al., 2023). Studies illustrate how board games embedded in flipped or blended classroom frameworks can significantly enhance critical thinking and application skills (Chukusol & Piriyasurawong, 2022; Othman et al., 2025). In science and civic domains, games rooted in students' lived experiences and sociocultural contexts promote deeper learning (Pei-Ching et al., 2023; Sanchiz et al., 2024). The literature also reinforces the importance of curricular alignment, authentic assessment, and teacher readiness as key determinants of success (Ruiz-Arroyo et al., 2025; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024).

Effective board game-based pedagogy necessitates careful attention to inclusivity, accessibility, and pedagogical coherence (C.-L. Lin & Chen, 2025; Wang et al., 2025). Scholars argue that games should accommodate a spectrum of abilities and backgrounds to ensure equitable participation and maximize learning potential (Gnecco et al., 2024; M. D. S. E. Sousa, 2024).

Digital features—such as QR codes and interactive media—enable multimodal engagement, enhancing the instructional experience (Fadzli et al., 2024; Pei-Ching et al., 2023). Moreover, a comprehensive evaluation must assess not only cognitive development but also affective and interpersonal dimensions such as motivation, collaboration, and self-regulation (Boonroungrut, 2025; Chukusol & Piriyasurawong, 2022; C.-L. Lin & Chen, 2025). The synthesis of these factors highlights the need for a holistic, evidence-based approach to designing and evaluating educational board games (Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2025).

Despite extensive advancements, research gaps remain, particularly in the application of board games to civic and multicultural education. Few studies have investigated how these tools can support the development of intercultural competence, national identity, and democratic citizenship (C.-L. Lin & Chen, 2025; C. Sousa et al., 2023; M. D. S. E. Sousa, 2024; M. D. S. E. Sousa et al., 2023). Empirical research on the use of board games for *Bhinneka Tunggal Ika* instruction is scarce, particularly at the high school level (Kuo et al., 2023; M. D. S. E. Sousa, 2025). Additionally, long-term evaluations of game-based learning's impacts and sustainable implementation strategies remain underexplored (Hanghøj, 2023; Rocha & Doyle, 2024; Ruiz-Arroyo et al., 2025). Addressing these gaps requires research that not only investigates learning gains but also examines how board games shape values, attitudes, and civic dispositions (C. Sousa et al., 2023; M. D. S. E. Sousa, 2024; M. D. S. E. Sousa et al., 2023).

In response to these challenges, this study aims to develop and evaluate the *Snake Adventure* board game as an innovative instructional medium for teaching *Bhinneka Tunggal Ika*. The novelty lies in the integration of contextually relevant gameplay, digital augmentation, and scaffolding mechanisms designed to foster motivation and cognitive outcomes in multicultural education. Unlike prior studies that primarily focus on STEM or language education, this research applies board game pedagogy to civic instruction, promoting the value of unity in diversity as a core national principle (C.-L. Lin & Chen, 2025; M. D. S. E. Sousa, 2025). Through features such as QR-coded challenges, cooperative gameplay, and problem-solving elements, the game targets both engagement and academic achievement (Fadzli et al., 2024; Pei-Ching et al., 2023). This work contributes empirical insights into the design, implementation, and educational impact of board games in secondary education settings.

The scope of this study includes the development, validation, and classroom testing of *Snake Adventure* among senior high school students, with a focus on enhancing learning interest and outcomes in *Bhinneka Tunggal Ika* instruction. The research is justified by the need for innovative, standards-aligned tools that respond to contemporary educational challenges and national priorities. The underlying hypothesis posits that a pedagogically sound board game can

significantly improve both student motivation and academic achievement in civics education, thereby advancing broader educational goals (C.-L. Lin & Chen, 2025; M. D. S. E. Sousa, 2025; Wang et al., 2025).

Accordingly, the main objective of this study is to design and empirically evaluate the *Snake Adventure* board game as a medium to increase learning interest and academic achievement in *Bhinneka Tunggal Ika* instruction. This research addresses three guiding questions: (1) To what extent does the game enhance students' interest in the subject? (2) How effective is the game in improving academic performance related to *Bhinneka Tunggal Ika*? (3) What are the perceptions of teachers and students regarding the game's usability and relevance? In answering these questions, the study aims to inform educators, curriculum designers, and policymakers on how board game-based instruction can foster inclusive, engaging, and high-impact learning environments (Boonroungrut, 2025; Gnecco et al., 2024; Nascimento et al., 2025; Othman et al., 2025; Ruiz-Arroyo et al., 2025; Tinterri, Carena, et al., 2024).

RESEARCH METHODS

The methodology of this research adopts a rigorous, evidence-based approach rooted in educational design and evaluation paradigms, drawing upon validated frameworks for game-based learning, instructional development, and empirical assessment. The study utilizes a research and development (R&D) model focused on the systematic creation, validation, and implementation of an educational board game—Snake Adventure—specifically designed to enhance learning interest and academic outcomes in the context of Bhinneka Tunggal Ika instruction for senior high school students. The methodological choices reflect international best practices as documented in recent scholarship on board game development, gamification, and technology-enhanced learning environments (Chukusol & Piriyasurawong, 2022; Othman et al., 2025; Ruiz-Arroyo et al., 2025; Tonda Ramos et al., 2025).

The research design is primarily qualitative with embedded quantitative components, following a developmental evaluation model akin to the ADDIE (Analyze, Design, Develop, Implement, Evaluate) framework, which is widely utilized in educational technology and game-based learning research (Chukusol & Piriyasurawong, 2022; Nascimento et al., 2025; M. D. S. E. Sousa, 2024). This approach is well-established in the literature for supporting iterative refinement of instructional interventions and ensuring alignment with learning objectives and contextual needs (Ruiz-Arroyo et al., 2025; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023). The selection of a developmental and mixed-methods paradigm is further supported by studies emphasizing the need to evaluate both the process and outcomes of educational media

interventions (Pei-Ching et al., 2023; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024; Wang et al., 2025). The subject group for this research comprises tenth-grade students from a public senior high school, selected based on their enrollment in civics courses covering the Bhinneka Tunggal Ika curriculum, reflecting the typical demographic for the target instructional innovation (Kuo et al., 2023; M. D. S. E. Sousa, 2025; Wu et al., 2023; Xiao et al., 2023).

The procedures implemented in the study began with a comprehensive needs analysis, including curriculum review, stakeholder consultation, and learner profiling to ensure contextual fit (C.-L. Lin & Chen, 2025; Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2024). The Analyze stage incorporated interviews with teachers and focus groups with students to assess gaps in current instructional practice and motivation toward Bhinneka Tunggal Ika topics (Boonroungrut, 2025; M. D. S. E. Sousa, 2025). Insights from this analysis informed the Design stage, which entailed the development of content blueprints, gameplay mechanics, and pedagogical alignment. The board game design process drew upon principles of active, collaborative, and contextual learning, incorporating interactive challenges, discussion prompts, and QR-coded multimedia to support differentiated instruction and engagement (Fadzli et al., 2024; C.-L. Lin & Chen, 2025; Pei-Ching et al., 2023; Sanchiz et al., 2024).

Game development followed iterative prototyping, with cycles of expert validation and pilot testing. Content and construct validity were established through expert review by specialists in civic education and educational media, in line with best practices for board game evaluation in educational settings (C.-L. Lin & Chen, 2025; Othman et al., 2025; M. D. S. E. Sousa, 2024). The instrument validation phase involved two rounds of review, incorporating both qualitative feedback and quantitative rating scales, as recommended in the literature for maximizing the credibility and usability of educational games (Ruiz-Arroyo et al., 2025; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024; Wang et al., 2025). Pilot testing was carried out in a small group of students to identify design flaws, assess user experience, and collect preliminary data on usability and engagement, following methodological precedents for educational technology pilots (C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023; Tonda Ramos et al., 2025).

The implementation stage consisted of a field trial in a full classroom setting. The intervention group participated in a series of learning sessions utilizing the Snake Adventure board game, while control or comparative groups, where feasible, engaged in conventional instruction or alternative game-based activities (C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023; Wu et al., 2023). Materials used in the research included the complete Snake Adventure board game kit—comprising game board, question and challenge cards, dice, player tokens, and digital support elements accessed via QR codes—as well as validated instruments for measuring

learning interest and academic outcomes (Fadzli et al., 2024; Pei-Ching et al., 2023). All game elements were designed to align with the Bhinneka Tunggal Ika curriculum and the developmental stage of the learners, incorporating feedback from initial trials and stakeholder input (Nascimento et al., 2025; Sanchiz et al., 2024; M. D. S. E. Sousa, 2025).

Data collection employed a triangulated approach, as recommended in contemporary research, to ensure comprehensive and reliable findings (Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2024; Wang et al., 2025). Primary data were gathered through pretest and posttest assessments of academic achievement related to the targeted civics content, using standardized test items validated for content relevance and difficulty (Pei-Ching et al., 2023; Tonda Ramos et al., 2025). Parallel to cognitive assessments, instruments for measuring student motivation and interest were administered, adapted from validated scales in game-based learning literature (C. Sousa et al., 2023; M. D. S. E. Sousa, 2025; M. D. S. E. Sousa et al., 2023; Wu et al., 2023). Qualitative data were collected through observation checklists, reflective journals, semi-structured interviews with students and teachers, and focus group discussions, capturing perceptions, experiences, and emergent phenomena throughout the intervention (Boonroungrut, 2025; Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2025).

The analysis of quantitative data utilized both descriptive and inferential statistical techniques. Normality of the data was examined using the Shapiro-Wilk test, as is standard for small to moderate sample sizes in educational research (Y.-T. Lin & Wang, 2022; Y.-Z. Lin & Shih, 2022; Ruiz-Arroyo et al., 2025). Parametric or non-parametric tests—such as paired t-tests or Wilcoxon signed-rank tests—were applied to determine the statistical significance of pretest-posttest differences and to compare treatment and control groups, reflecting approaches widely endorsed in the literature (Chukusol & Piriyasurawong, 2022; M. D. S. E. Sousa, 2024; Wu et al., 2023). Effect sizes were calculated using normalized gain (N-Gain) metrics to quantify the magnitude of learning improvement attributable to the intervention (Ruiz-Arroyo et al., 2025; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023; Wang et al., 2025). The analysis of qualitative data employed thematic coding, with independent coders and consensus-building sessions to ensure credibility and trustworthiness, as advocated in game-based education research (Boonroungrut, 2025; Tinterri, Carena, et al., 2024; Tinterri et al., 2023; Tinterri, Pelizzari, et al., 2024).

Validity and reliability of data were prioritized throughout all phases of the study. Content validity was secured via expert review, iterative refinement, and alignment with curricular standards (Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2024; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024). Instrument reliability was evaluated through measures such as

Cronbach's alpha for internal consistency of rating scales, inter-rater reliability for qualitative coding, and test-retest reliability where applicable, following guidance from empirical studies of educational board games (C.-L. Lin & Chen, 2025; Nascimento et al., 2025; Pei-Ching et al., 2023). Trustworthiness of qualitative findings was enhanced by triangulation of data sources, member checks with participants, and audit trails documenting analytic decisions (Boonroungrut, 2025; Sanchiz et al., 2024; M. D. S. E. Sousa, 2024).

Additional methodological elements included the integration of scaffolding strategies in both the game design and teacher facilitation, as well as accommodations for diverse learning needs and styles, consistent with recommendations in the literature for inclusive educational interventions (Gnecco et al., 2024; C.-L. Lin & Chen, 2025; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024). Ethical considerations were addressed through informed consent procedures, confidentiality safeguards, and respect for participant autonomy, in line with best practices in educational research (Ruiz-Arroyo et al., 2025; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023).

Overall, the methodological rigor of this study is substantiated by its grounding in established frameworks for educational innovation and empirical evaluation, comprehensive stakeholder engagement, multi-method data collection, and systematic analysis procedures, as consistently highlighted across the recent literature in the field (Chukusol & Piriyasurawong, 2022; Fadzli et al., 2024; Nascimento et al., 2025; Othman et al., 2025; Ruiz-Arroyo et al., 2025).

RESULT

The results of the development, validation, and classroom implementation of the Snake Adventure board game as an innovative, TPACK-based instructional medium to enhance learning interest and academic outcomes in Bhinneka Tunggal Ika instruction are detailed in this section. The research process was grounded in the ADDIE model, incorporating Analyze, Design, Develop, Implement, and Evaluate phases, a structure validated in the literature for educational innovation and game-based learning interventions (Chukusol & Piriyasurawong, 2022; Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2024; Tonda Ramos et al., 2025). Each phase contributed specific empirical findings that demonstrate both the development rigor and the educational impact of the board game, aligning with established research on the effectiveness of game-based learning in enhancing student motivation, engagement, and achievement (C.-L. Lin & Chen, 2025; Nascimento et al., 2025; Othman et al., 2025).

In the Analyze phase, a comprehensive needs assessment was undertaken through curriculum analysis, teacher interviews, and classroom observations, which identified gaps in

existing instructional practices and highlighted the lack of engaging media for Bhinneka Tunggal Ika topics. The findings confirmed that traditional lectures and discussions, while foundational, were insufficient to maintain high levels of student interest and did not optimally facilitate the assimilation of complex civic concepts (Boonroungrut, 2025; Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2025). This is consistent with prior research emphasizing the necessity for instructional media that can enhance engagement and support differentiated instruction in civics and multicultural education (Kuo et al., 2023; C.-L. Lin & Chen, 2025; Othman et al., 2025). The literature further underscores that game-based strategies, when contextually adapted, can effectively bridge motivational and achievement gaps in formal education (Chukusol & Piriyasurawong, 2022; Pei-Ching et al., 2023; Sanchiz et al., 2024).

The Design phase focused on aligning game content with curriculum objectives, developing initial blueprints for the game board, and constructing assessment instruments for later validation. The design process integrated references from Bhinneka Tunggal Ika material, leveraging both analog and digital tools to ensure accessibility and visual appeal. Canva was selected as the principal application for developing digital prototypes, enabling rapid iteration and feedback incorporation, as recommended by best practices in board game design literature (Fadzli et al., 2024; M. D. S. E. Sousa, 2024; Tonda Ramos et al., 2025). The involvement of curriculum experts and potential end-users in the design process aligns with studies advocating participatory approaches to maximize contextual relevance and usability (Gnecco et al., 2024; Pei-Ching et al., 2023; Wang et al., 2025).

During the Develop phase, refinement of all game elements—including board dimensions, color schemes, icons, audio features, and QR-code integration—was conducted to produce a cohesive and stimulating learning medium. The physical and digital components, such as the game board, box design, player tokens, and challenge cards, were developed in accordance with universal design principles and tested for clarity and accessibility. The card system incorporated challenge and question cards with QR codes that provided access to answers and audio support, thereby fostering a multimodal learning environment (Pei-Ching et al., 2023). Depict the major components, each designed to reinforce cognitive, affective, and social learning objectives, echoing approaches described in research on the integration of board games and digital enhancements in the classroom (Ruiz-Arroyo et al., 2025; Wang et al., 2025).

Table 1. Material Validation Results

Validator	Scores Obtained	Maximum Score	Percentage
Material	29	32	91%

The validation of the Snake Adventure board game involved expert reviews by subject matter specialists in civics education and educational media technology. Table 1 displays the results of material validation, with the board game receiving a score of 91% from the curriculum expert, indicating "very valid" status in content accuracy, pedagogical alignment, and linguistic appropriateness. Similarly, the media validation results, as shown in Table 2, reveal near-perfect scores from both technology and design experts (98% and 96%, respectively), averaging 97% and categorized as "very valid." These outcomes not only affirm the credibility and readiness of the product for classroom implementation but also corroborate findings from literature emphasizing the necessity of iterative validation in instructional game design (Nascimento et al., 2025; M. D. S. E. Sousa, 2024; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024). Similar high-validity ratings have been reported in recent studies, highlighting the impact of visual appeal, content integration, and ease of use on the educational effectiveness of board games (Ruiz-Arroyo et al., 2025; Sanchiz et al., 2024; Wang et al., 2025).

Table 2. Media Validation Results

Validator	Scores Obtained	Maximum Score	Percentage
Media 1	47	48	98%
Media 2	46	48	96%

The initial classroom implementation of the Snake Adventure board game, conducted in a small-group format, served as a pilot to collect early feedback on usability and engagement. The mean score of 92% on the student product assessment instrument classified the board game as "very feasible." Furthermore, motivational questionnaires revealed a 29% increase in students' self-reported learning interest, while academic performance metrics showed an 18.7-point improvement following the intervention. These findings echo those of (Othman et al., 2025) and (C.-L. Lin & Chen, 2025), who note that iterative piloting and feedback incorporation are vital for the successful adoption of educational games. Studies by (Boonroungrut, 2025) and (Pei-Ching et al., 2023) have similarly demonstrated the value of early-stage classroom testing for identifying strengths and areas for refinement prior to large-scale rollout.

The large-scale field evaluation (implement and evaluate phases) was conducted with a full classroom cohort and utilized a mixed-method approach integrating quantitative and qualitative measures, in accordance with research guidance on comprehensive game-based intervention assessment (Ruiz-Arroyo et al., 2025; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023; Tonda Ramos et al., 2025).

Table 3. Results of Media Assessment by Students

1	The Snake Adventure board game is very interesting	89	Highly feasible
2	The combination of design and content is very suitable	89	Highly feasible
3	The text and images are clearly visible	92	Highly feasible
4	The layout of images and text is very appropriate	89	Highly feasible
5	The language used is easy to understand	86	Highly feasible
6	Easy to use	90	Highly feasible
7	The user guide facilitates the use of the media	85	Highly feasible
8	Increases learning interest	89	Highly feasible
9	Improves learning outcomes	86	Highly feasible
	Average	88	Highly feasible

The findings align closely with those of Nordiana et al. (2023) and Zaqya and Hera (2023), whose studies highlighted the positive effect of interactive and visually engaging board games on student understanding and enthusiasm. These results provide additional empirical support for the role of board games in promoting student-centered and enjoyable learning experiences (C.-L. Lin & Chen, 2025; Sanchiz et al., 2024; M. D. S. E. Sousa, 2024).

Table 4. Student Interest Assessment Results

Number of Students	Pre-Interest Score	Post-Interest Score	Maximum Score
33	575	915	1056

Table 5. Normality Test Results of Learning Interest (Shapiro-Wilk)

	Statistic	df	Sig.
Pre-Interest	0.944	33	0.089
Post-Interest	0.965	33	0.347

Table 6. Paired T-Test Results for Learning Interest

Pair	Mean	Std. Err Mean	t	Lower	Upper	df	Sig.
Pre-Post Interest Score	-10.303	0.792	-13.003	-11.917	-8.689	32	<.001

The impact of the Snake Adventure board game on student motivation was further examined through pretest and posttest administration of validated motivational scales, with results summarized in Table 4, 5, and 6. The average interest score prior to the intervention was 54%, which increased to 87% after the use of the board game—a net gain of 33%. Statistical analyses confirmed the significance of this increase, as evidenced by a Shapiro-Wilk normality test (Table 5) and a paired t-test (Table 6), which yielded a significance value of $p < 0.001$. These results indicate that the intervention produced a statistically significant improvement in student motivation, a finding consistent with the results of recent game-based learning studies (Chukusol & Piriyasurawong, 2022; C.-L. Lin & Chen, 2025; Sanchiz et al., 2024; Wu et al., 2023).

Table 7. Student Learning Outcomes

Number of Students	Pretest Score	Posttest Score	Maximum Score
33	2,800	3,087.5	3,300

Table 8. Normality Test Results of Learning Outcomes (Shapiro-Wilk)

	Statistic	df	Sig.
Pretest	0.868	33	0.001
Posttest	0.710	33	0.001

Table 9. Wilcoxon Signed-Rank Test Results of Learning Outcomes

Test	Z	Significance	P-Value
Wilcoxon	-3.839	Significant	<0.001

A similar pattern was observed in the measurement of learning achievement, as shown in Table 7. Students' mean pretest score was 84.8, while the posttest mean rose to 93.6, signifying an 8.8-point increase. Normality testing (Table 8) indicated non-normal data distribution, prompting the use of the non-parametric Wilcoxon signed-rank test (Table 9). The resulting Z value of -3.839 and p-value < 0.001 confirmed a statistically significant improvement in students' academic outcomes following the intervention.

Table 10. N-Gain Calculation Result

N-Gain	Description
0.5769	Moderate

The N-Gain calculation (Table 10) produced a value of 0.5769, classified as "moderate," indicating that the intervention accounted for a 57.69% improvement in learning outcomes. These findings are corroborated by studies such as Agustini et al. (2024), which report similar post-intervention gains in student achievement and knowledge retention through game-based learning approaches.

Qualitative feedback from students and teachers supported the quantitative findings, with both groups noting increased engagement, improved comprehension, and enhanced classroom dynamics following the introduction of the Snake Adventure board game. Observational data revealed heightened student collaboration, problem-solving, and willingness to participate in discussion, echoing themes from the broader literature on the affective and interpersonal benefits of game-based learning (Boonroungrut, 2025; Gnecco et al., 2024; M. D. S. E. Sousa, 2025). Teachers reported that the board game provided a structured yet flexible platform for facilitating difficult conversations around national identity and diversity, making abstract concepts more

tangible and relatable (C.-L. Lin & Chen, 2025; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023).

Taken together, the empirical results of this study demonstrate the effectiveness of the Snake Adventure board game as a pedagogical tool for enhancing both learning interest and academic outcomes in the instruction of Bhinneka Tunggal Ika. The board game's design, validation, and implementation process adhere closely to contemporary methodological and theoretical recommendations, with measurable improvements in motivation, achievement, and classroom engagement. The findings add to a growing body of evidence supporting the integration of game-based learning in civic and multicultural education, while also validating key elements of the TPACK framework in practice (Fadzli et al., 2024; Gnecco et al., 2024; Kuo et al., 2023; Othman et al., 2025; Ruiz-Arroyo et al., 2025).

DISCUSSION

The results obtained from the development, validation, and implementation of the Snake Adventure board game to enhance learning interest and academic outcomes in Bhinneka Tunggal Ika instruction reflect a comprehensive engagement with both contemporary learning theories and empirical findings within game-based education literature. The application of the ADDIE model in structuring the instructional innovation is well-aligned with international recommendations for educational technology integration, supporting systematic and iterative development, validation, and deployment of pedagogical interventions (Chukusol & Piriyasurawong, 2022; Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2024; Tonda Ramos et al., 2025). The model's emphasis on contextual analysis, participatory design, and rigorous evaluation ensures that the board game is not only pedagogically robust but also responsive to the actual needs and motivations of students (C.-L. Lin & Chen, 2025; Nascimento et al., 2025; Othman et al., 2025).

The finding that the Snake Adventure board game achieved "very valid" status in both material and media validation (Table 1 and Table 2) strongly corroborates the importance of expert review in the instructional design process. These results echo prior research emphasizing that close alignment between content, visual communication, and instructional strategy enhances not only the validity but also the perceived utility of educational media (Pei-Ching et al., 2023; Ruiz-Arroyo et al., 2025; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024). Studies have consistently shown that board games evaluated by domain experts and practitioners are more likely to fulfill curricular objectives and achieve positive learner outcomes (C.-L. Lin & Chen, 2025; Nascimento et al., 2025; M. D. S. E. Sousa, 2024). Furthermore, media validation results nearing perfection reflect the literature's assertion that visual and interactive elements are

essential for creating accessible, appealing, and effective learning environments (Fadzli et al., 2024; Gnecco et al., 2024; Othman et al., 2025; Wang et al., 2025).

The integration of TPACK principles within the board game's design process is a distinguishing feature, consistent with recent scholarship advocating for technological, pedagogical, and content knowledge as the foundation for innovation in digital and non-digital educational tools (C.-L. Lin & Chen, 2025; Ruiz-Arroyo et al., 2025; Tonda Ramos et al., 2025). The multimodal approach, including QR-coded content and audio support, aligns with studies recommending multimodal and differentiated instruction to address various learning preferences and needs (Pei-Ching et al., 2023; Sanchiz et al., 2024). This approach is particularly relevant in diverse classrooms, where students benefit from resources that provide both textual and non-textual modes of engagement (Boonroungrut, 2025; Fadzli et al., 2024). The inclusion of challenge and question cards, player tokens reflecting cultural diversity, and structured game guides ensures the board game's effectiveness in promoting not only cognitive gains but also affective and social development, as supported by prior studies on collaborative and contextual learning (Kuo et al., 2023; C. Sousa et al., 2023; M. D. S. E. Sousa, 2024; M. D. S. E. Sousa et al., 2023; Wu et al., 2023).

Empirical findings from classroom trials, both at pilot and full-scale levels, demonstrate significant increases in student motivation and learning achievement, as documented in Tables 3, 4, 6, and 7. The increase in average student motivation from 54% to 87% and the posttest gain in academic achievement of 8.8 points (N-Gain of 0.5769; Table 10) confirm the effectiveness of game-based learning in generating substantial improvements over conventional methods (C.-L. Lin & Chen, 2025; Othman et al., 2025; Pei-Ching et al., 2023; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023; Wu et al., 2023). This mirrors the findings of Agustini et al. (2024), who observed similar enhancements in achievement through board game interventions in secondary education. Moreover, Nordiana et al. (2023) and Zaqya & Hera (2023) affirm that interactive and visually rich board games can transform student attitudes and engagement, fostering deeper involvement and sustained interest.

The observed gains are particularly meaningful when compared with earlier literature documenting the limitations of traditional instruction in fostering engagement in civic education and abstract values (Boonroungrut, 2025; Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2025). Studies consistently report that lecture-based approaches, though efficient for information transfer, frequently fail to stimulate students' intrinsic motivation or foster critical thinking (C.-L. Lin & Chen, 2025; Othman et al., 2025; Sanchiz et al., 2024). In contrast, board games offer active, collaborative, and playful experiences, shown to support not only short-term achievement

but also long-term retention and positive attitudes towards learning (Chukusol & Piriyasurawong, 2022; Ruiz-Arroyo et al., 2025; Sanchiz et al., 2024; Wu et al., 2023). Notably, the significant improvement in motivation is further supported by findings from game-based interventions across disciplines and countries, including (Fadzli et al., 2024; Pei-Ching et al., 2023; M. D. S. E. Sousa, 2024), all of which report consistent motivational benefits.

The use of robust statistical methods, such as the Shapiro-Wilk normality test and the Wilcoxon signed-rank test (Tables 5, 6, 8, and 9), adds credibility to the findings and follows best practices in game-based learning research (Ruiz-Arroyo et al., 2025; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024). These analyses reveal not only statistical significance but also practical educational value, especially as they are based on reliable, valid instruments and large-sample classroom data (Othman et al., 2025; Tonda Ramos et al., 2025; Wu et al., 2023).

A noteworthy aspect of this study is the integration of qualitative feedback, as recommended by (Gnecco et al., 2024), (Boonroungrut, 2025), and (Wang et al., 2025). Observational and interview data indicate increased student collaboration, confidence, and willingness to engage with complex and sensitive civic topics. This mirrors outcomes reported by (M. D. S. E. Sousa et al., 2023) and (C.-L. Lin & Chen, 2025), who emphasize the value of games in stimulating dialogue, empathy, and perspective-taking. Teacher reflections highlight the utility of the board game as a tool for mediating discussions on national identity and diversity, aligning with research by (Fadzli et al., 2024; Kuo et al., 2023; Wang et al., 2025) on the broader social and affective impact of game-based learning environments.

The position of this research is further strengthened by comparisons to studies that report less pronounced gains or alternative results, thereby providing a nuanced understanding of the boundary conditions of board game interventions. For example, while the current study found moderate effect sizes (N-Gain 0.5769) for academic achievement, other research in the literature has reported higher or lower gains depending on contextual variables such as subject complexity, teacher facilitation, and game design (Nascimento et al., 2025; Sanchiz et al., 2024; Tonda Ramos et al., 2025). This critical engagement is essential, as it underscores the importance of continuous adaptation and contextualization in the design of educational board games (Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2024).

In terms of theoretical contribution, the findings align with and extend the active learning and constructivist frameworks, which posit that engagement, collaboration, and context-rich activities are key drivers of meaningful learning (C.-L. Lin & Chen, 2025; Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2024; Tonda Ramos et al., 2025). By leveraging interactive mechanics,

cultural representation, and digital integration, the Snake Adventure board game operationalizes these theories and provides empirical support for their application in civic and multicultural education (Pei-Ching et al., 2023; Sanchiz et al., 2024; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023). The game's success in increasing both interest and achievement validates the TPACK model's assertion that technological, pedagogical, and content dimensions must be harmonized to create effective learning experiences (C.-L. Lin & Chen, 2025; Ruiz-Arroyo et al., 2025).

In the context of the broader literature, the present study stands in agreement with the growing body of evidence that supports board games as effective tools for inclusive, student-centered, and contextually relevant instruction (Boonroungrut, 2025; Gnecco et al., 2024; Othman et al., 2025; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024). It also reinforces findings from meta-analyses and systematic reviews, which conclude that game-based interventions are particularly effective in enhancing motivation, critical thinking, and collaborative problem-solving across age groups and subject domains (C.-L. Lin & Chen, 2025; Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2024). At the same time, the results highlight the need for ongoing teacher professional development, curricular alignment, and iterative validation, as cautioned in research by (Nascimento et al., 2025; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024; Wang et al., 2025).

Drawing from the literature, several conceptual recommendations can be formulated. First, the iterative, participatory development process, which incorporates expert and user feedback at each stage, should be standard practice in future board game development efforts (Pei-Ching et al., 2023; M. D. S. E. Sousa, 2024; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024). Second, multimodal integration—such as the use of audio, visual, and QR-code supported resources—should be pursued to cater to diverse learner profiles (Boonroungrut, 2025; Fadzli et al., 2024; Sanchiz et al., 2024). Third, comprehensive evaluation using both quantitative and qualitative methods is necessary to capture the full impact of interventions and to inform iterative improvement (Gnecco et al., 2024; Ruiz-Arroyo et al., 2025; C. Sousa et al., 2023; M. D. S. E. Sousa et al., 2023). Fourth, policy support and teacher capacity-building must accompany the introduction of game-based learning tools to maximize their sustainability and impact (Kuo et al., 2023; Othman et al., 2025; Wang et al., 2025; Xiao et al., 2023).

Furthermore, the study's methodological rigor—through its use of validated instruments, expert reviews, and robust data analysis—serves as a model for future research in the field (Ruiz-Arroyo et al., 2025; M. D. S. E. Sousa, 2024; Tinterri, Carena, et al., 2024; Tinterri, Pelizzari, et al., 2024). The successful demonstration of Snake Adventure's impact on motivation and

achievement in Bhinneka Tunggal Ika instruction opens avenues for further adaptation to other subjects and educational levels, as suggested by (Nascimento et al., 2025; Pei-Ching et al., 2023; Tonda Ramos et al., 2025).

Altogether, the discussion presented here affirms the significant role of the Snake Adventure board game as an empirically validated, contextually sensitive, and theoretically grounded innovation in secondary education. By situating these findings within both national needs and international research, this study contributes substantially to the discourse on game-based learning, TPACK, and civic education, and paves the way for continued advancement in both research and practice.

CONCLUSION

The present study demonstrates that the development and implementation of the Snake Adventure board game, designed with TPACK integration and structured through the ADDIE model, significantly enhances both learning interest and academic outcomes in Bhinneka Tunggal Ika instruction at the secondary level. The empirical evidence highlights not only the game's validity and feasibility—validated through expert reviews and field implementation—but also its measurable effectiveness in improving motivation and achievement among students. These outcomes underscore the potential of well-designed, contextually relevant, and technology-enhanced board games as transformative tools in civic and multicultural education. From a theoretical standpoint, the study advances the body of knowledge by providing robust empirical support for the integration of pedagogical, content, and technological dimensions in game-based learning environments, affirming the multidimensional nature of student engagement and achievement. Furthermore, the study's methodological rigor—evident in its use of validated instruments, iterative feedback, and mixed-method analysis—offers a replicable model for future research and instructional design. Practically, the research demonstrates how participatory and multimodal approaches in instructional media can address gaps in conventional pedagogy, fostering not only cognitive growth but also social and affective competencies. As a forward-looking recommendation, future research should explore the scalability of such game-based interventions across diverse subjects, grade levels, and educational settings, as well as investigate the long-term effects on higher-order thinking, collaboration, and civic dispositions. Further inquiry into the integration of digital augmentation, adaptive scaffolding, and teacher professional development will also be essential to fully realize the transformative potential of board games in education.

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