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Prototyping Casual Web-Based Educational Game using GDLC method

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Abstract
Traditional Indonesian (Nusantara) cuisine is a vital part of the nation's cultural heritage, yet the interest of the younger generation in local culture continues to decline amid the dominance of global digital media, so more adaptive preservation media are needed. Existing culinary educational games generally rely on a single game mechanic and are distributed as installable Android applications, and most report only usability rather than validated learning gains. This study develops and evaluates a casual web-based educational game, Jajan Nusantara, that integrates two complementary mechanics, Drop & Merge and a cooking-simulation mini-game, to introduce the culinary heritage of four regions (Yogyakarta, Bali, Aceh, and Maluku) to elementary-school students. The game is built with the Game Development Life Cycle (GDLC) and evaluated with 29 fifth-grade students through Pre-test and Post-test instruments, user-acceptance questionnaires, and an additional teacher evaluation. The average score increased from 6.93 in the Pre-test to 9.69 in the Post-test; a Paired Sample T-Test confirmed a statistically significant difference ($t = 10.207$; $p = 6.11 \times 10^{-11}$), and the normalized N-Gain reached 0.917 (High category). The questionnaire instruments obtained Cronbach's Alpha values above 0.88 (high reliability), with student acceptance of 95.52% (Visual Design) and 95.69% (Satisfaction) and teacher acceptance of 97.50%. These results demonstrate that combining Drop & Merge with a cooking simulation in an accessible web game is highly effective as a learning medium and engaging for children, supporting the preservation of local culinary culture in the digital era.

Keywords:
Educational Game, Game Development Life Cycle, Game-Based Learning, Human-Computer Interaction, Cultural Preservation

1. Introduction

Indonesia possesses an enormous wealth of culture, one of which manifests in the form of traditional Nusantara cuisine. Food not only serves as a basic necessity but also represents the history, geographical conditions, social values, and cultural identity of a region, so that preserving traditional cuisine is essentially an important part of preserving the nation's culture as a whole. However, in the current era of globalization and digitalization, the dominance of global digital media has contributed to a declining interest of the younger generation toward local culture, so that more adaptive and relevant preservation approaches are required [1], [2]. Cultural digitalization is viewed as a strategic solution because it enables culture to be presented in a more visual, interactive, and accessible format [1], [3].

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This need has become even more pressing in the present era of generative artificial intelligence (AI), in which children increasingly consume automatically generated digital content. While generative AI can produce cultural material at scale, its output is not guaranteed to be factually accurate, culturally authentic, or age-appropriate, and it may hallucinate details about regional dishes and traditions. A purpose-built educational game with curated content therefore remains highly relevant: it offers verified cultural information, controlled and safe interaction for young learners, and a structured pedagogical flow that unconstrained generative tools do not yet reliably provide. Positioning cultural preservation within a deliberately designed, content-controlled game is thus a meaningful contribution in the generative-AI era [3].

In the context of basic education, the introduction of culture plays an important role in shaping children's identity and character, and learning based on local culture can significantly improve students' cultural literacy, particularly when delivered through interactive and contextual media [4]. Casual games offer a lightweight, attractive, and easily accessible experience, giving them strong potential as an alternative learning medium. Prior studies show that game-based learning improves learning motivation and conceptual understanding more effectively than conventional methods, with moderate-to-large effects on cognitive outcomes [5], and scoping reviews across educational contexts consistently report positive effects on learning achievement [6]. Web-based learning platforms that integrate gamification elements likewise report high usability and strong acceptance among elementary students [7].

Nusantara cuisine is well suited to be packaged into a visual educational game because of its rich shapes, colors, and variety, and an interactive visual approach has been shown to improve users' understanding of and interest in regional specialties [8]. However, existing culinary educational games exhibit two recurring limitations: they generally rely on a single game mechanic, and they are commonly distributed as installable Android applications, which restricts accessibility [8], [9]. This concern for accessibility is not unique to cultural-education media; similar usability-driven prototyping approaches have also been applied to mobile applications for users with limited digital literacy, such as a smart-farming monitoring application evaluated with the System Usability Scale, reinforcing that a simple and user-friendly interface is essential whenever a system targets users who are not digitally sophisticated, including elementary-school children [26]. The Drop & Merge mechanic is chosen as the core gameplay because it is simple, intuitive, and aligned with the cognitive abilities of elementary-school children, requiring no complex analytical processing to be understood [10], [11]. It is paired with a cooking simulation because cooking games form a hybrid genre in which food preparation becomes a central, procedural learning activity, enabling children to grasp how a dish is actually made rather than merely recognizing its appearance [12], [13]. An appropriate game-mechanic design has been shown to influence both the quality of the play experience and learning effectiveness [10], [14].

Based on this background, the main contributions and novelty of this study can be summarized as follows: (1) it integrates two complementary mechanics, Drop & Merge and a cooking-simulation mini-game, within a single layered gameplay for culinary learning, a combination not previously applied to Nusantara cuisine; (2) it delivers the game through an accessible web platform that runs directly in a browser without installation, in contrast to prior Android-only culinary games; (3) it enriches the experience with a Jajanpedia digital encyclopedia and interactive quizzes covering 29 traditional snacks from four regions (Yogyakarta, Bali, Aceh, and Maluku) spanning western to eastern Indonesia; and (4) it empirically validates learning effectiveness through Pre-test/Post-test, normalized-gain,

and paired t-test analyses, complemented by student and teacher acceptance evaluation, rather than usability testing alone.

2. Related Works

The development of games as a medium for culinary and cultural education has been examined in several previous studies, each focusing on a particular mechanic and mode of information delivery. Pranata et al. designed the culinary educational game "Culinary Emerald Equator", which uses a puzzle genre (jigsaw and sliding puzzles) to introduce regional dishes and rewards players with coins to buy hints; the game excels at map-based exploration but focuses purely on assembling visual puzzles without simulating how the food is prepared [8]. Nugroho et al. developed an RPG-based cooking game that presents five traditional recipes with detailed steps such as cutting ingredients, controlling stove temperature, mixing, and frying; although its simulation is highly detailed, its educational coverage is limited to those five recipes and it lacks a freely accessible encyclopedia [9].

Liem et al. proposed "Bakul Rempah", a match-three puzzle in which players collect spices required by a recipe; its notable "spice list" acts as a mini encyclopedia, yet its casual mechanic does not convey how the spices are actually processed into a dish [15]. Thomas et al. designed "CAMILA", a casual-simulation game with a visual-novel narrative and chibi illustrations that follows a character selling Sulawesi snacks; it is strong in narrative and 2D visuals but its educational material is confined to Sulawesi specialties [16]. From a methodological perspective, Deviani built an Android-based regional-food educational game using the Multimedia Development Life Cycle (MDLC), reinforcing that the digital generation requires contextual adaptation of preservation media, though its distribution remains platform-restricted [17]. From the perspective of basic education, Ahyati et al. confirmed that educational online games significantly improve elementary students' cultural-literacy comprehension when delivered through interactive, contextual media [4], while Wibowo and Lestariningsih reported very good usability for a web-based, gamified learning platform for elementary students [7].

Each of these prior games contributes a single dominant mechanic, whether puzzle assembly, technical cooking simulation, spice matching, or narrative-based play, and most are limited to one platform or a narrow set of recipes. In contrast, the proposed Jajan Nusantara game addresses the identified gap by combining a casual Drop & Merge mechanic with a step-by-step cooking simulation and by integrating a Jajanpedia encyclopedia and interactive quizzes across four regions. Unlike the reviewed works, its learning effectiveness is validated empirically through Pre-test/Post-test and normalized-gain analysis rather than usability evaluation alone.

3. Proposed Method

This study employs a prototype development approach through the Game Development Life Cycle (GDLC), a structured framework that guides the creation of a game from initiation through pre-production, production, testing, and release [10]. GDLC is chosen over more general frameworks because, unlike the linear SDLC/Waterfall model, the experience-oriented DPE framework, or the multimedia-oriented MDLC, it is designed specifically for games: it explicitly accommodates the iterative design of game mechanics, interface, and player interaction, and provides two testing phases that allow repeated evaluation before release [10], [18]. GDLC has been widely applied in developing educational games for school-age children [11], [18].

The development process followed five sequential stages. First, the study identified the primary problem, namely the limited availability of digital media for promoting Indonesian

culinary culture to younger generations. Second, the system requirements were analyzed to define the functional and educational specifications of a web-based game featuring traditional cuisines from Yogyakarta, Bali, Aceh, and Maluku. Third, the pre-production stage designed the gameplay flow, navigation structure, and initial 2D visual assets. Fourth, the production stage implemented the prototype using TypeScript, React, and the Phaser 3 game engine by integrating the Drop & Merge gameplay, cooking mini-games, the Jajanpedia digital encyclopedia, a scoring and star mechanism, and a global leaderboard. Visual assets were created with the assistance of generative AI image-generation tools and subsequently reviewed and refined by the development team to ensure stylistic consistency and cultural appropriateness, while all educational content, including dish names, cooking procedures, and cultural information, was manually curated and verified from authoritative references. Finally, the system underwent alpha (black-box) testing to validate functional correctness and beta testing to evaluate its effectiveness as an educational learning medium.

The Drop & Merge mechanic is formalized as a tiered combination rule. Let a snack item of tier n be denoted by I_n. When two identical items of the same tier n come into contact, they are combined into a single item of the next tier, as expressed in Equation (1):

$$I_n \oplus I_n \rightarrow I_{n+1} \tag{1}$$

Each successful merge increases the score, and the process forms an evolution chain from the lowest tier up to the final regional dish. Because the play area is bounded, the game terminates when the current stack height h reaches or exceeds the deadline threshold H before the highest tier is reached and no further valid merge exists, as defined in Equation (2):

$$game\ over \Leftrightarrow h \geq H \tag{2}$$

Once the highest tier is reached, the system unlocks the second phase, the cooking-simulation mini-game, which depicts the procedural preparation stages of the corresponding regional dish. This layered structure lets children first recognize dishes through pattern recognition and then understand their preparation procedurally, so that knowledge transfer occurs through play rather than rote memorization [8], [13].

To quantify the learning effect of the game, we adopt the normalized gain (N-Gain) as the primary effectiveness metric. As described by Sukarelawan et al. [19], the normalized gain expresses the actual improvement of a learner relative to the maximum possible improvement from their initial ability. For each student, the N-Gain is defined as:

$$N - Gain = \frac{Post\text{-}test\ Score - Pre\text{-}test\ Score}{Ideal\ Score - Pre\text{-}test\ Score} \tag{3}$$

The resulting N-Gain value is then categorized according to the interpretation criteria in Table 1, following the gain regions defined by Sukarelawan et al. [19]. The use of N-Gain is consistent with related studies that adopt it to evaluate the effectiveness and real contribution of games to learning [20].

Table 1. Interpretation of N-Gain Values

N-Gain Value (g)	Interpretation
0.70 ≤ g ≤ 1.00	High
0.30 ≤ g < 0.70	Medium
0.00 < g < 0.30	Low
g = 0.00	No improvement
−1.00 ≤ g < 0.00	Decrease

In addition, the N-Gain score is converted into a percentage to measure the effectiveness of the game as a learning medium, interpreted using the criteria in Table 2 [21]. To statistically confirm the difference between the Pre-test and Post-test means, we further apply a Paired Sample T-Test, where the null hypothesis (H0) states that there is no significant difference between the two means.

Table 2. Interpretation of N-Gain Percentage (Effectiveness)

Percentage (%)	Interpretation
< 40	Not Effective
40 – 55	Less Effective
56 – 75	Moderately Effective
> 75	Effective

Before being used as the final evaluation instrument, the questionnaire is tested for validity using the Pearson product-moment correlation and for reliability using Cronbach's Alpha. An item is declared valid when its computed correlation (r-count) exceeds the critical value (r-table) at a 5% significance level. As discussed by Janna and Herianto [22], Cronbach's Alpha values above 0.70 are commonly regarded as acceptable. The qualitative interpretation used in this study is presented in Table 3.

Table 3. Interpretation of Cronbach's Alpha Values

Cronbach's Alpha (α)	Interpretation
α > 0.90	Perfect reliability
0.70 < α ≤ 0.90	High reliability
0.50 < α ≤ 0.70	Medium reliability
α ≤ 0.50	Low reliability

User acceptance is measured through a five-point Likert scale (0 = Strongly Disagree to 4 = Strongly Agree) [23], following the black-box user-acceptance approach in which the system is judged from its inputs and outputs without inspecting the source code [24]. The data are processed by first computing the minimum and maximum total scores, the range, and the class-interval length (ρ):

$$Total\ Minimum\ =\ Minimum\ Likert\ Score\ \times\ Number\ of\ Items \tag{4}$$

$$Total\ Maximum\ =\ Maximum\ Likert\ Score\ \times\ Number\ of\ Items \tag{5}$$

$$Range\ =\ Total\ Maximum\ -\ Total\ Minimum \tag{6}$$

$$\rho\ =\ \frac{Range}{Number\ of\ Categories} \tag{7}$$

The average score for each aspect is then converted into a percentage to determine the level of user satisfaction and content quality. With a 0–4 scale (minimum score 0, maximum score 4), Equation (8) reduces to (mean Likert ÷ 4) × 100:

$$Percentage\ =\ \frac{Mean\ Score\ -\ Minimum\ Score}{Maximum\ Score\ -\ Minimum\ Score}\ \times\ 100 \tag{8}$$

The resulting percentage is interpreted using the category criteria in Table 4. The closed-questionnaire items are designed around the cognitive and affective domains of Bloom's taxonomy of learning-outcome evaluation [25].

Table 4. Categories of Satisfaction and Content Quality

Percentage	Category
81 – 100%	Very Good
61 – 80%	Good
41 – 60%	Adequate
21 – 40%	Poor
0 – 20%	Very Poor

4. Experimental Setup

The subjects of this study are 29 fifth-grade elementary students at SD Negeri Ngemplak 2, consisting of 16 male and 13 female students aged 11–12 years. The game is developed in a web-based format and specifically optimized to run smoothly on mobile devices and laptops through a browser. The gameplay is divided into two phases. In the first phase, players use the Drop & Merge mechanic, practicing pattern recognition by combining similar objects into new objects. Once the basic ingredients are collected, the system unlocks the second phase, the cooking-simulation mini-game, which provides a concrete depiction of the culinary preparation stages of the corresponding region. The dishes are visualized as 2D assets accompanied by short pop-up information, so that children can recognize them realistically while the digital illustrations preserve the authentic shape and texture of each original Nusantara snack.

The research instruments comprise 10 multiple-choice Pre-test and Post-test questions, and a 20-item Likert-scale (0–4) questionnaire divided into a Visual Design aspect (10 items) and a Satisfaction aspect (10 items). In addition, a 10-item teacher-evaluation questionnaire is administered to the fifth-grade class teacher. The experimental procedure follows a sequential user interaction: students first complete the Pre-test to measure their prior knowledge, then use the Jajan Nusantara web game, and finally complete the Post-test using identical questions to ensure measurement consistency, followed by the user-acceptance questionnaire. Before the effectiveness analysis, the game passed black-box functionality testing on 39 indicators covering initialization, Jajanpedia, the leaderboard, region selection, the Drop & Merge phase, the cooking mini-game, and progress storage, all of which behaved as designed, consistent with black-box testing approaches that have been shown to validate complete functional coverage in other web-based systems, such as a chess-game database management platform that achieved a 100% pass rate across all tested features [27].

5. Result and Analysis

This section presents the results of the cognitive evaluation, instrument testing, and user-acceptance measurement. Fig. 1 illustrates the main gameplay interface of the Jajan Nusantara web game as used by students during the evaluation.

Fig. 1 Main Gameplay Interface of Jajan Nusantara

The Pre-test was administered before students used the game to measure their prior knowledge of traditional Indonesian cuisine, while the Post-test measured the improvement afterward. Table 5 summarizes the aggregate results of both tests, and Fig. 2 visualizes the change in mean score.

Table 5. Summary of Pre-test and Post-test Results (n = 29)

Indicator	Pre-test	Post-test	Change
Mean score	6.93	9.69	+2.76
Total score	201	281	+80
Minimum score	4	8	+4
Maximum score	10	10	0
Students with perfect score	1	22	+21

The results show a substantial improvement. The overall total score increased from 201 to 281, and the mean score rose from 6.93 to 9.69, corresponding to an increase from 69.31% to 96.90% of the ideal score. Notably, 22 of 29 students (75.86%) achieved a perfect score of 10 in the Post-test, while the minimum score increased from 4 to 8, indicating that even the lowest-performing students improved considerably after using the game.

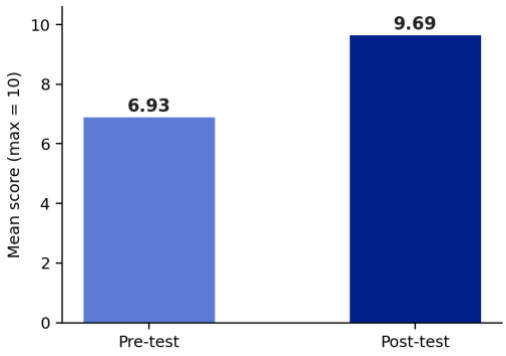

Fig. 2 Comparison of Mean Pre-test and Post-test Scores

To confirm that this improvement is statistically significant rather than incidental, a Paired Sample T-Test was conducted on the Pre-test and Post-test scores of the 29 students, with the null hypothesis (H0) stating that there is no significant difference between the two means. The results are presented in Table 6. The t Stat of 10.207 far exceeds the t Critical two-tail value of 2.048, and the two-tail P-value of 6.11×10^{-11} is far below the significance level $\alpha = 0.05$. Consequently, H0 is rejected, statistically proving that the use of the Jajan Nusantara web game has a positive and significant effect on students' understanding.

Table 6. Paired Sample T-Test Results

Indicator	Pre-test	Post-test
Mean	6.931	9.689
Variance	2.281	0.436
Observations	29	29
Pearson Correlation	0.300	—
df	28	—
t Stat	10.207	—
P(T≤t) two-tail	6.11×10^{-11}	—
t Critical two-tail	2.048	—

The N-Gain test measures the magnitude of the normalized improvement. One student who already obtained a perfect Pre-test score (10) was excluded, so the valid N-Gain was computed from 28 students. Of these, 23 students (82.14%) fall into the High category and 5 students (17.86%) into the Medium category, with no student in the Low category, as summarized in Table 7. The average valid N-Gain is 0.917, which belongs to the High category (≥ 0.70); expressed as a percentage, the average N-Gain of 91.7% is classified as Effective (> 75%).

Table 7. N-Gain Category Distribution (valid n = 28)

Category	Range	Students	Percentage
High	≥ 0.70	23	82.14%
Medium	0.30–0.70	5	17.86%
Low	< 0.30	0	0.00%
Average N-Gain	—	0.917	High

These effectiveness figures compare favorably with related work. Azhari et al. reported a cooking-simulation game achieving 88.70% on the simulation aspect and 84.87% on the knowledge aspect [13], while meta-analytic evidence attributes only moderate-to-large cognitive effects to game-based learning in general [5]. The 0.917 average N-Gain obtained here, together with a near-ceiling Post-test mean, indicates that layering the Drop & Merge mechanic with a procedural cooking simulation yields a learning gain at the upper end of what comparable single-mechanic educational games report. A plausible explanation is that the two-phase design engages students both in pattern recognition (merging) and in procedural understanding (cooking), reinforced by the quiz, NPC fun facts, and Jajanpedia, so that knowledge is acquired through active play rather than memorization.

The questionnaire instruments were then examined. Validity testing used the Pearson correlation with an r-table threshold of 0.367 (n = 29, α = 5%); for the Visual Design aspect, 7 of 10 items were valid, and for the Satisfaction aspect, 9 of 10 items were valid, with the remaining items retained after review because they did not materially affect overall reliability. Reliability testing produced Cronbach's Alpha values of 0.884 for Visual Design and 0.880 for Satisfaction, as shown in Table 8, both of which fall in the high-reliability category ($0.70 < \alpha \leq 0.90$) [22], confirming that the instrument is consistent and dependable.

Table 8. Summary of Cronbach's Alpha Reliability Test

Aspect	Cronbach's Alpha	Interpretation
Visual Design	0.884	High reliability
Satisfaction	0.880	High reliability

User acceptance was measured on a 0–4 Likert scale and converted to a percentage using (mean Likert ÷ 4) × 100. Based on responses from all 29 students, the Visual Design aspect obtained a mean Likert score of 3.82 (95.52%) and the Satisfaction aspect obtained 3.83 (95.69%), both in the Very Good category (81–100%). To triangulate these student ratings, the fifth-grade class teacher completed a 10-item evaluation covering the same aspects; the teacher rated Visual Design at 100% and Satisfaction & Benefit at 95%, for an overall 97.50%. Table 9 summarizes the acceptance results, and Fig. 3 visualizes them.

Table 9. Summary of User Acceptance (Students and Teacher)

Aspect	Respondent	Mean Likert (/4)	Percentage	Category
Visual Design	Students (n = 29)	3.82	95.52%	Very Good
Satisfaction	Students (n = 29)	3.83	95.69%	Very Good
Visual Design	Teacher (n = 1)	4.00	100%	Very Good
Satisfaction & Benefit	Teacher (n = 1)	3.80	95%	Very Good
Overall (teacher)	Teacher (n = 1)	3.90	97.50%	Very Good

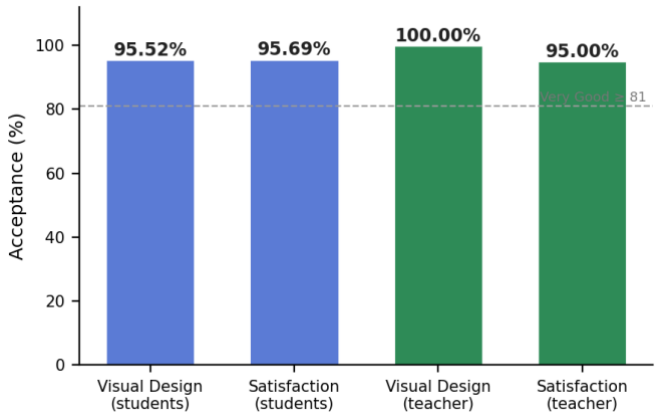

Fig. 3 User Acceptance by Aspect (Students and Teacher)

The consistently high acceptance across both students and the teacher, all in the Very Good category, indicates strong satisfaction with the game. The teacher specifically noted that the gameplay trains students' accuracy and memory, that the combination of merging and cooking sustains learning enthusiasm, and that the quiz and fun-fact features effectively add cultural knowledge, making the game suitable as a companion medium for digital culinary-culture preservation.

6. Conclusion

This study developed and evaluated Jajan Nusantara, a casual web-based educational game that integrates the Drop & Merge mechanic with a cooking-simulation mini-game, together with a Jajanpedia encyclopedia and interactive quizzes, to introduce 29 traditional snacks from four Indonesian regions to elementary-school children. Developed with the GDLC method and released as an installation-free web application, the game passed black-box testing on all 39 functionality indicators, confirming its technical readiness.

The most valuable finding is that combining two complementary mechanics in a single layered gameplay produces a learning gain at the high end of comparable educational games. The average cognitive score rose from 6.93 (Pre-test) to 9.69 (Post-test), the average N-Gain reached 0.917 (High category, 91.7% Effective), and a Paired Sample T-Test confirmed a statistically significant difference ($t = 10.207$; $p = 6.11 \times 10^{-11}$). The questionnaire instruments were reliable (Cronbach's Alpha of 0.884 and 0.880), and acceptance was very high, reaching 95.52% (Visual Design) and 95.69% (Satisfaction) among students and 97.50% overall from the teacher. Jajan Nusantara is therefore recommended as an effective and engaging companion learning medium for recognizing and appreciating Indonesia's culinary heritage, at school or at home.

This study has limitations that motivate future work. The evaluation involved a single class at one school, and the game currently covers four regions with 29 snacks and offers a fixed difficulty. Future work may expand the coverage to more regions and dishes, add adaptive difficulty so that both novice and advanced players are appropriately challenged, broaden testing to more schools and grade levels for greater generalizability, and conduct longitudinal studies to measure knowledge retention over time. Investigating how curated educational games can be combined responsibly with generative-AI content generation, while preserving cultural accuracy and child safety, is another promising direction.

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References

[1] L. N. Amali, M. R. Katili, and W. Ismail, "Preservation of Intangible and Tangible Cultural Heritage Using Digital Technology," Indonesian Journal of Electrical Engineering and Computer Science, vol. 28, no. 2, pp. 980–986, 2022, doi: 10.11591/ijeecs.v28.i2.pp980-986.

[2] Y. Wisman and C. Cukei, "The Role of Digital Learning Media in Maintaining Indonesian Local Culture in the Globalization Era," Meretas: Jurnal Ilmu Pendidikan, vol. 10, no. 1, pp. 38–48, 2023, doi: 10.52947/meretas.v10i1.375.

[3] C.-H. Wu, Y.-L. Chao, J.-T. Xiong, and D.-B. Luh, "Gamification of Culture: A Strategy for Cultural Preservation and Local Sustainable Development," Sustainability, vol. 15, no. 1, p. 650, 2023, doi: 10.3390/su15010650.

[4] A. I. Ahyati, D. A. Dewi, and R. S. Hayat, "The Role of 'Educational' Online Games in Local Culture-Based Learning on Cultural Literacy Comprehension of Elementary School Students," ELSCHO: Jurnal Pendidikan Guru Sekolah Dasar, vol. 2, no. 2, pp. 1–8, 2024, doi: 10.25299/elscho.2024.15570.

[5] M. S. Alotaibi, "Game-Based Learning in Early Childhood Education: A Systematic Review and Meta-Analysis," Frontiers in Psychology, vol. 15, p. 1307881, 2024, doi: 10.3389/fpsyg.2024.1307881.

[6] M. Videnovik, T. Vold, L. Kiønig, A. Madevska Bogdanova, and V. Trajkovik, "Game-Based Learning in Computer Science Education: A Scoping Literature Review," International Journal of STEM Education, vol. 10, no. 1, 2023, doi: 10.1186/s40594-023-00447-2.

[7] A. Wibowo and F. E. Lestariningsih, "Model of Web-Based Learning for Elementary Students Using Gamification Technique," International Journal of Informatics and Computation (IJICOM), vol. 8, no. 1, 2026, doi: 10.35842/ijicom.v8i1.219.

[8] M. I. B. Pranata, N. N. Dewa, and A. R. Prasetyo, "Nusantara Culinary Educational Game: Culinary Emerald Equator," STAINS (Seminar Nasional Teknologi dan Sains), vol. 2, no. 1, pp. 195–202, 2023, doi: 10.29407/stains.v2i1.2899.

[9] S. M. S. Nugroho, S. Sumpeno, and M. Liudyvia, "Educational Game for Recognizing Indonesian Traditional Snacks Based on Role-Playing Game (RPG)," Jurnal Teknik ITS, vol. 10, no. 2, pp. A450–A456, 2021, doi: 10.12962/j23373539.v10i2.75320.

[10] A. A. Saputra, F. Nonggala Putra, and R. D. Rusdian Yusron, "Development of an Android-Based Educational Game for Introducing Indonesian Culture Using the Game Development Life Cycle (GDLC) Method," JACIS: Journal Automation Computer Information System, vol. 2, no. 1, pp. 66–73, 2022, doi: 10.47134/jacis.v2i1.43.

[11] Y. Li, "Exploring the Mechanics Design of Casual Games," in Proc. 3rd Int. Conf. Art Design and Digital Technology (ADDT 2024), 2024, doi: 10.4108/eai.24-5-2024.2350040.

[12] K. Sun and J. Li, "The Casual Games Discussion: Define, Design, Players and Benefits," in Proc. 2021 Int. Conf. Advanced Education and Information Management (AEIM 2021), 2021, doi: 10.12783/dtssehs/aeim2021/35980.

[13] A. Azhari, R. Yuniarti, and A. Komarudin, "Designing a Cooking Procedure Simulation Game During the Pandemic in the Food and Beverage Industry Using the Design Play Experience Method," International Journal Software Engineering and Computer Science (IJSECS), vol. 4, no. 1, pp. 358–366, 2024, doi: 10.35870/ijsecs.v4i1.2315.

[14] V. S. de Abreu and T. M. de Classe, "EndGame for Corruption — A DPE-Based Framework to Support the Design of Serious Games for Fight Against Corruption," Journal on Interactive Systems (JIS), vol. 14, no. 1, pp. 215–230, 2023, doi: 10.5753/jis.2023.3165.

[15] L. V. Liem, A. L. Sekarasri, and C. Astabrata, "Designing an Educational Game to Introduce the Richness of Indonesian Spices," DeKaVe, vol. 16, no. 1, pp. 49–66, 2023, doi: 10.24821/dkv.v16i1.8185.

[16] J. R. Thomas, M. Tjandra, and D. I. Aryani, "Design of a Digital Game on Sulawesi Traditional Snacks as an Educational Medium for Teenagers," DIVAGATRA: Jurnal Penelitian Mahasiswa Desain, vol. 4, no. 1, pp. 33–46, 2024, doi: 10.34010/divagatra.v4i1.12306.
[17] D. Deviani, "Android-Based Regional Food Educational Game Using the Multimedia Development Life Cycle Method," Jurnal Informatika (JIFT), vol. 1, no. 2, pp. 62–68, 2022.
[18] Y. C. Oktaviani, Y. Wahyuningsih, and R. P. Kristianto, "Application of the Game Development Life Cycle (GDLC) Model in Design and Development of Educational Games for Dyslexic Children," Social Science and Humanities Journal, vol. 9, no. 1, pp. 6477–6487, 2025, doi: 10.18535/sshj.v9i01.1442.
[19] M. I. Sukarelawan, T. K. Indratno, and S. M. Ayu, N-Gain vs Stacking: Analysis of Changes in Students' Ability in a One-Group Pretest-Posttest Design. Yogyakarta: Suryacahya, 2024.
[20] M. R. Harianja, M. Yusup, and S. M. Siahaan, "N-Gain Test on the Effectiveness of Using Games with the SGQ Strategy to Improve Computational Thinking in Energy Literacy," Jurnal Intelektualita: Keislaman, Sosial dan Sains, vol. 13, no. 2, pp. 303–310, 2024, doi: 10.19109/intelektualita.v13i2.25168.
[21] A. Jariyah, D. Wahyudiati, and B. Amelia Riyandari, "The Effect of the Creative Problem Solving Learning Model on Students' Critical Thinking Skills in Acid-Base Material," SPIN: Jurnal Kimia & Pendidikan Kimia, vol. 4, no. 2, pp. 110–120, 2022, doi: 10.20414/spin.v4i2.5260.
[22] N. M. Janna and H. Herianto, "Concept of Validity and Reliability Testing Using SPSS," OSF Preprints, 2021, doi: 10.31219/osf.io/v9j52.
[23] A. A. Santika, T. H. Saragih, D. Kartini, and R. Ramadhani, "Application of the Likert Scale in Classifying the Satisfaction Level of BRILink Agent Customers Using Random Forest," JUSTIN (Jurnal Sistem dan Teknologi Informasi), vol. 11, no. 3, pp. 405–411, 2023, doi: 10.26418/justin.v11i3.62086.
[24] R. Y. Ariyana, E. Susanti, M. R. Ath-Thaariq, and R. Apriadi, "Functionality Testing Using Black Box Testing on a Yogyakarta Batik Motif Game," JUMINTAL: Jurnal Manajemen Informatika dan Bisnis Digital, vol. 2, no. 1, pp. 33–43, 2023, doi: 10.55123/jumintal.v2i1.2371.
[25] Z. Zainudin and Ubabuddin, "Cognitive, Affective, and Psychomotor Domains as Objects of Students' Learning Outcome Evaluation," ILJ: Islamic Learning Journal, vol. 1, no. 3, pp. 915–931, 2023.
[26] N. S. Adhi and K. D. Irianto, "Evaluation of Smart Agriculture Prototype using SUS Method," International Journal of Informatics and Computation (IJICOM), vol. 8, no. 1, 2026.
[27] M. D. Adrian and F. Wijayanto, "Chesstify: Chess Game Database Management System using Portable Game Notation," International Journal of Informatics and Computation (IJICOM), vol. 8, no. 1, 2026.