QUANTUM: Jurnal Inovasi Pendidikan Sains, Vol. 17, No. 1, 22-40
p-ISSN : 2086-7328 e-ISSN : 2550-0716
Website: https://ppjp.ulm.ac.id/journal/index.php/quantum/index
DOI: http://dx.doi.org/10.20527/quantum.v17i1.25493

DEVELOPMENT OF INTERACTIVE EDUCATIONAL SNAKES AND LADDERS MEDIA (LANTERA) TO IMPROVE SCIENCE AND SOCIAL STUDIES (IPAS) LEARNING OUTCOMES ON HUMAN DIGESTIVE SYSTEM MATERIAL

Lailatun Ni'mah*, Aan Widiyono
Elementary School Teacher Education, Faculty of Tarbiyah and Teacher Training, Nahdlatul Ulama Islamic University Jepara
Jalan Taman Siswa Pekeng, Tahunan, Kota Jepara 59427, Jawa Tengah, Indonesia
*corresponding author: 221330000950@unisnu.ac.id

Abstract: Teaching IPAS material on the human digestive system in grade V of elementary school (SD) faces obstacles because the abstract concept of digestive organs is difficult for students to understand without concrete media. This research developed the Interactive Educational Snakes and Ladders (LANTERA) media that meets the criteria of being feasible, practical, and capable of improving students' cognitive learning outcomes based on Bloom's Taxonomy (C3–C6). The method used is Research and Development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The research subjects were 33 grade V students of SDN 1 Purwogondo using a total sampling technique. Research instruments included observation guidelines, interviews, expert validation sheets, pre-test and post-test questions, as well as teacher and student response questionnaires. Validation results showed the media met the feasibility criteria with a score of 96.43% from media experts and 84.5% from material experts. The increase in learning outcomes was measured using N-Gain with an average of 0.6187 (medium category), with a distribution of 48.5% of students in the high category, 39.4% medium, and 12.1% low. Teacher responses reached 98% and student responses 92.6%, indicating very high practicality. LANTERA media is proven to be able to improve cognitive learning outcomes through the integration of visualization, gamification, and collaborative learning, so it can be an alternative for game-based learning for abstract material in elementary schools.

Keywords: Learning outcomes, LANTERA, Human digestive system

INTRODUCTION

Mastery of the human digestive system material is an essential competence in the Science and Social Studies (IPAS) curriculum at the elementary school level. Internationally, understanding basic biological concepts is a demand for scientific literacy that must be mastered from an early age (Tavares et al., 2022). The Merdeka Curriculum in Indonesia specifically places human digestive system material in grade V SD as part of the learning outcomes that demand deep cognitive understanding. Various studies show that student learning outcomes in this material are still low due to its abstract nature and the fact that it cannot be observed directly (Mutaalimah et al., 2024). A phenomenon often encountered in the field is learning that tends to place the teacher as the center of learning and lacks the use of innovative media, resulting in low active student involvement and suboptimal learning achievements. In line with this, the selection of the appropriate media is an important factor that determines the maximum improvement in learning outcomes (Syalfirah et al., 2024).

Current field conditions corroborate these issues. Observations and field studies at SDN 1 Purwogondo indicate that the average score for grade V in the human

Published by: Program Studi Pendidikan Kimia FKIP Universitas Lambung Mangkurat
How to Cite: Ni'mah, L., Widiyono, A. (2026). Development of Interactive Educational Snakes And Ladders Media (LANTERA) to Improve Science And Social Studies (IPAS) Learning Outcomes on Human Digestive System Material. *QUANTUM: Jurnal Inovasi Pendidikan Sains*, *17*(1), 22–40. http://dx.doi.org/10.20527/quantum.v17i1.25493.

Article History:
Received : 08-02-2026, *Accepted* : 15-04-2026, *Published* : 30-04-2026

digestive system material is merely 65.93, which remains below the established Learning Objective Achievement Criteria (KKTP) of 75. Approximately 72.73% of students have not attained mastery in learning. Students struggle to comprehend the role of each organ and connect the content to daily experiences. The teachers encounter constraints in tangible resources to illustrate the digestion process. The education system is required to continue innovating through the development of quality and adaptive learning media to enable teachers to convey material effectively (Vuk, 2023).

Science and Social Studies (IPAS) examines natural phenomena along with their forming elements. The goal is to facilitate students in developing a holistic insight into the surrounding environment (Andrianti & Widiyono, 2025). In contemporary learning, teachers are required to construct creative and innovative approaches according to student needs (Kholis & Azmi, 2023). Teachers need to stimulate student enthusiasm and curiosity so that active participation is optimal, especially in materials that are abstract like the human digestive system (Nastiti et al., 2022). The biggest challenge is transforming abstract concepts into real representations that are easily understood by students. Grade V SD students are required to understand digestive organs from the mouth to the anus along with their functions, but this biological process cannot be observed directly (Pratiwi & Hardini, 2022).

Monotonous learning that lacks active engagement renders students passive and diminishes their motivation to learn (Fitriyaningsih et al., 2022). These conditions indicate that the level of student learning outcomes in the human digestive system material still shows a relatively low level. This situation underscores the necessity for learning media that can stimulate the cognitive domain proportionally (Maghfiroh et al., 2024). Learning media plays an important role in facilitating the creation of an engaging learning experience while facilitating the transformation of abstract concepts into concrete representations for students (Noor et al., 2020). Thus, the development of innovative learning media serves as a crucial basis for facilitating a more meaningful learning process and enhancing the quality of student comprehension (Kwangmuang et al., 2021; Seechaliao, 2024).

Diverse media have been created to address learning challenges related to the human digestive system. Fitriyaningsih et al. (2022) developed android-based media for grade V SD digestive organ material. This media is valid, but it requires specific devices and an internet connection, making it less flexible in schools with limited facilities. Permata & Surmilasari (2023) created e-flashcards with identical content and demonstrated their validity; nonetheless, they are passive since they lack integrated game features that promote active student engagement. Neither of these media has succeeded in fostering an interactive and enjoyable learning environment for elementary students.

The integration of media in game-based learning has great potential in improving student learning outcomes because it is able to stimulate various types of intelligence (multiple intelligence) and create an enjoyable learning experience (Hadyansah et al., 2024). Engaging in play activities fosters student interest, creates a supportive learning atmosphere, and enhances active student participation, hence optimising learning results (Yudiyanto et al., 2022). Game-based learning approaches are also considered to be a solution for optimizing student learning achievements (Sun et al., 2024). Games such as snakes and ladders have historically been seen as media that integrate educational components with gameplay (Manrique et al., 2024).

The results of previous research have demonstrated that snakes and ladders media enhances learning outcomes in various subjects. Yudiyanto et al. (2022) proved

that snakes and ladders in general science subjects increased student learning activity with validity reaching 90% in the very feasible category, alongside an increase in student learning activity from an average of 56.66 to 73.33. Furthermore, research conducted by Nastiti et al. (2022) created a snakes and ladders game tailored for grade IV elementary school students, focusing on animal life cycles, which demonstrated high feasibility (86.25% in media aspects; 86.5% in material aspects) and achieved an effectiveness rate of 91% in learning mastery. Additional research demonstrating enhanced learning results through the use of snakes and ladders media is the study by Syalfirah et al. (2024), which indicates that snakes and ladders based on a cultural map for grade IV socio-cultural material had an N-Gain of 56.03%. This indicates the superiority of snakes and ladders media in enhancing students' cognitive learning results.

Research conducted by Fitriani & Insani (2024) affirmed that the use of snakes and ladders media via the game-based learning model is effective in enhancing learning outcomes in Javanese script writing material. Empirical evidence indicates an increase in the average score from 57.04 on the pre-test to 79.33 on the post-test, with an N-gain of 0.5321 (medium category), and a paired sample t-test yielding a significance value of 0.000, thereby confirming a significant enhancement in learning outcomes. Consequently, snakes and ladders as an educational media can enhance student learning results across several areas, including animal life cycles, culture, and Javanese script.

Given these parameters, a gap exists, namely current specific digestive system media lack interactivity, but interactive snakes and ladders media for digestive system content have yet to be established. The incorporation of game-based media possesses significant potential to enhance educational results by stimulating diverse intelligences and fostering an engaging learning environment. Consequently, researchers created LANTERA (Interactive Educational Snakes and Ladders) media for the human digestive system, featuring innovations such as: (1) high-resolution banner format printing, (2) inclusion of question cards, challenge cards, and knowledge cards with visual representations of digestive organs, (3) provision of an educational guidebook and student worksheets (LKPD), and (4) promotion of cooperative group learning.

This research has a distinct and novel character in comparison to prior studies. First, from the material aspect, this research is the first to develop snakes and ladders media specifically for human digestive system material for grade V SD. Second, from the media form aspect, previous research used snakes and ladders printed on regular cardboard, whereas LANTERA is printed in high-resolution banner format with more attractive visual appeal. Third, from the visualization and component completeness aspect, previous research only displayed forward-backward play without images or material visualization and without a guidebook, while LANTERA is equipped with question cards, challenge cards, knowledge cards with digestive organ visualizations, an educational guidebook, and LKPD (Videnovik et al., 2025).

The interactivity aspect in previous research was limited to rolling dice and moving pawns, while LANTERA offers higher interactivity through answering questions, completing challenges, filling out worksheets, and group discussions that encourage cooperative learning (Ariya et al., 2025). The development of LANTERA media is based on constructivism theory, where the learning process occurs when students actively participate and interact with relevant learning contexts (Zajda, 2021). Constructivism theory views learning as an active process, where students actively construct their own knowledge and understanding through real experiences and processing the information obtained (Kritt & Budwig, 2022). By applying this

theory, LANTERA is expected to encourage active student participation in learning (Rahman Agus et al., 2023).

LANTERA media was developed by paying attention to visual clarity, high levels of interactivity, and providing direct feedback to facilitate students' understanding of the digestive process from the mouth to the anus (Syafrilianto et al., 2022). This research is essential due to the scarcity of educational media specifically tailored for teaching the human digestive system at the elementary level. Media constraints hinder students' comprehension of the abstract concepts and processes of digestion, which are not directly observable (Permata & Surmilasari, 2023). This research is innovative due to its emphasis on interactive educational games that enhance learning outcomes through the integration of gamification aspects. Additionally, this media is tailored to meet needs of elementary school students (Wardani, 2022).

This research centers on the development of LANTERA media pertaining to the human digestive system, encompassing the following stages: (1) the development process of LANTERA media; (2) the feasibility of LANTERA media for digestive system learning; (3) the improvement of student learning outcomes after using LANTERA media in digestive system learning; and (4) the practicality of LANTERA media in digestive system learning. The objective of this research is to develop, assess feasibility, measure the increase in learning outcomes, and assess the practicality of LANTERA media on human digestive system material. The formulation of this research objective is in line with development that emphasizes relevance to needs and improving student learning outcomes.

METHOD

This research employed a Research and Development (R&D) approach utilising the ADDIE model framework. Branch & Varank (2009) elucidated that the ADDIE model has five interconnected core phases: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation. This model was selected due to its systematic and usable attributes in actual scenarios. The ADDIE model is pertinent for application in the development of instructional media (Izzaturahma et al., 2021). Every stage of the ADDIE framework possesses a procedural description that can be articulated in detail as follows.

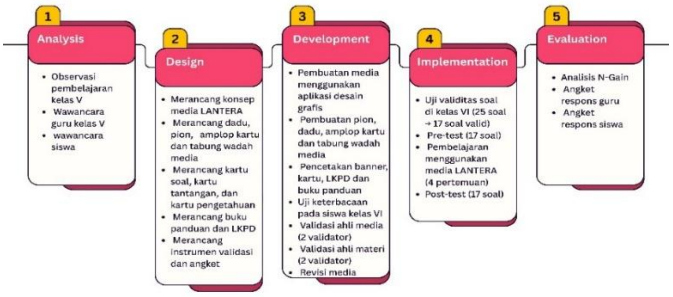

Figure 1. Stages of the ADDIE model

This research was executed through five systematic stages: analysis, design, development, implementation, and evaluation. The initial phase, analysis, was to identify issues that emerge in learning activities and assess the necessity for learning media. Identification was achieved through rigorous monitoring of the dynamics within the teaching and learning process as well as conducting interviews with fifth-grade teachers and assessing student needs. The second stage, design, included the design stage which became a very crucial part of the development process, specifically involving the creation of the Interactive Educational Snakes and Ladders (LANTERA) media, encompassing game design, question cards, challenge cards, knowledge cards, a guidebook, LKPD, and game rules that facilitate active student engagement (Moses Adeleke et al., 2024). The third stage, development, covered the media creation process according to the design, followed by validation by validators to assess feasibility and provide input in refining the media before it is implemented.

The fourth stage is implementation, which was carried out by applying the LANTERA media in IPAS learning accompanied by an evaluation of the level of student understanding carried out before and after the learning process through providing a pre-test and post-test as measurement instruments (Shakeel et al., 2023). The fifth stage, evaluation, served to measure the level of media effectiveness through an analysis of result improvement as well as measuring the level of media practicality through teacher and student response questionnaires toward the application of LANTERA media in learning. By employing the five components of the ADDIE learning model, teachers can develop successful learning strategies to optimise student learning results. The ADDIE model is regarded as an effective framework for motivating teachers to create and develop practical teaching resources and learning media, therefore facilitating the implementation of high-quality and innovative learning processes (Paramuditha et al., 2025). Table 1 delineates the research participants at each stage of the ADDIE model.

Table 1. Research participants at the ADDIE stage

ADDIE Stage	Participants	Description
Analysis	1 grade V teacher, 33 grade V students	Observation, teacher interview and student needs interview
Design	Researcher	Concept design and media components
Development	2 media expert validators, 2 material expert validators	Media development based on design results and feasibility validation of media and material by experts
Implementation	33 grade V students of SDN 1 Purwogondo (1 class) using total sampling technique	Pre-test, LANTERA learning (4 meetings), post-test
Evaluation	1 grade V teacher, 33 grade V students	Practicality response questionnaire

The research was conducted at SDN 1 Purwogondo, Kalinyamat District, Jepara Regency, Central Java, from September 2025 to January 2026. Research participants at each ADDIE stage are presented in Table 1. In the implementation stage, the research was conducted in 1 class, namely grade V, consisting of 16 male students and 17 female students (total 33 students) using the total sampling technique. This technique was selected as the complete grade V population served as the sample due to its limited size, ensuring that the data collected is more representative,

comprehensive, and accurately reflects the real learning environment in the classroom.

Data collection techniques were carried out through three main instruments. First, media expert validation was conducted to assess design aspects, visual display quality, and the technical feasibility of the media. Additionally, material expert validation was carried out to assess the consistency of content with basic competencies, conceptual accuracy, sequence of presentation, and material relevance to the cognitive development stage of grade V elementary school students. Second, learning outcome tests in the form of objective multiple-choice tests consisted of 17 C3-C6 items. This test was given in two stages, namely a pre-test to identify students' initial abilities before the application of learning media, and a post-test to assess the increase in understanding after using the media. Third, questionnaires aimed at teachers and students were used to obtain data regarding the level of practicality, attractiveness, and ease of use of the learning media. A thorough analysis was conducted using these three instruments to assess the feasibility, effectiveness, and practicality of the learning media concerning the human digestive system content.

Table 2. Validity criteria for materials and media

Score	Criteria	Percentage
5	Meets feasibility criteria	$80\% \leq x \leq 100\%$
4	Feasible to use	$60\% \leq x \leq 80\%$
3	Sufficiently feasible	$40\% \leq x \leq 60\%$
2	Less feasible	$20\% \leq x \leq 40\%$
1	Not feasible to use	$0\% \leq x \leq 20\%$

(Asri & Dwiningsih, 2022)

The feasibility criteria for material or teaching materials are presented in the following criteria table.

Table 3. Material feasibility criteria

Score	Criteria	Percentage
5	Meets feasibility criteria	$80\% \leq x \leq 100\%$
4	Feasible to use	$60\% \leq x \leq 80\%$
3	Sufficiently feasible	$40\% \leq x \leq 60\%$
2	Less feasible	$20\% \leq x \leq 40\%$
1	Not feasible to use	$0\% \leq x \leq 20\%$

(Siregar et al., 2023)

The data analysis method employed to evaluate the efficacy of media development utilised a descriptive quantitative methodology. Subsequent to the development of the media, it was sent to teachers for the validation of material feasibility via data analysis, employing a qualitative technique to incorporate validator feedback as a foundation for media enhancement, alongside a quantitative approach utilising the percentage formula $P = (\Sigma x/N) \times 100\%$

Description:

P = Percentage of score attained by students

Σx = Total score acquired by students

N = Maximum score possible

The validity test results were analysed using the specified formula, yielding quantitative values given as percentages (%). To enhance interpretation with the implementation of the paired sample T-test and the N-Gain test. The enhancement in learning outcomes was assessed via the N-Gain formula as outlined below.

$$\text{N Gain score} = \frac{\text{Post test score} - \text{Pre test score}}{\text{Maximum score} - \text{Pre test score}}$$

Interpretation of the N-Gain test results was then categorized according to the criteria listed in the N-Gain value classification table.

Table 4. Interpretation of N-Gain Index

N-Gain Score	Percentage	Interpretation
$g > 0,7$	> 70%	High
$0,3 \leq g \leq 0,7$	30% - 70%	Medium
$g < 0,3$	< 30%	Low

(Hake, 1999)

RESULTS AND DISCUSSION

Needs analysis was conducted through in-depth observation and interviews with one grade V teacher of SDN 1 Purwogondo, as well as needs interviews with grade V students. Teacher interviews covered four dimensions: (1) learning needs, (2) media availability, (3) student involvement, and (4) media effectiveness. Student interviews covered six dimensions: (1) media needs, (2) media availability, (3) student involvement, (4) media effectiveness, (5) media preferences, and (6) student learning patterns. Student interviews were carried out with a structured interview guide (10 questions) to explore perceptions, difficulties, and student needs regarding IPAS learning on digestive system material.

Synthesis of findings from interview activities with the grade V teacher is presented in Table 5.

Table 5. Teacher interview results

Dimension	Indicator	Core Finding
Learning needs	Difficulty of teachers in delivering material without the help of interactive media	Digestive system material is abstract; there is no concrete media for visualizing digestive organs.
Media availability	Availability of media in school	Media is very limited; only textbooks as the main reference; interactive media is almost unavailable.
Student involvement	Student participation when the teacher uses media	Students are enthusiastic, without media students quickly get bored and passive.
Media effectiveness	Ease of delivering material with the help of media	Interactive media helps convey abstract concepts; educational games are considered an appropriate solution.

The interview results indicate that teachers have significant difficulties in teaching digestive system material which is abstract in nature. This finding is in line with research by Permata & Surmilasari (2023) which asserts that the limitation of concrete media is the main obstacle to student understanding of digestive organ concepts. From a theoretical perspective, Vygotsky states that effective learning requires the mediation of tools and signs. The absence of adequate media directly inhibits the students' Zone of Proximal Development (Kritt & Budwig, 2022).

Table 6. Student interview results

Dimension	Core Finding	Need
Media needs	Many organ names must be memorized; easy to forget because the material is abstract	Media to help memory and conceptual understanding
Media availability	Only books and small images; no teaching aids	More varied and visual media
Student involvement	Bored because of only taking notes and listening	Media that increases interest and involvement
Media effectiveness	Easier to understand if using learning media	Media facilitates understanding of the digestive system
Preference media	Likes learning while playing; interested in educational games	Educational game media
Learning pattern	Prefers learning in groups	Media supporting group learning

An analysis of student interview findings indicated that the primary challenge resides in the abstract characteristics of the digestive system content and the absence of illustrative learning resources. Students acknowledged challenges in memorising and comprehending the names of various digestive organs due to the absence of tangible resources to assist them. This aligns with the findings of Mutaalimah et al. (2024), who observed that science learning outcomes regarding digestive content are often subpar due to uninspired instruction without tangible media. In contrast, students exhibited considerable enthusiasm while engaging in group learning through educational games. Auliyawati & Nugroho (2023) substantiate this choice, indicating that the utilisation of snakes and ladders media significantly enhanced SD students' learning motivation from a good to a very good category, achieving an N-Gain score of 0.66 in Science courses.

Research conducted by Sari et al. (2021) demonstrated that educational games in thematic learning substantially enhance student motivation and academic performance. Consequently, there is a significant congruence between student needs and preferences and the potential of educational snakes and ladders-based game media as a targeted learning solution. This media enables teachers to cultivate a more engaging and enjoyable learning environment, while concurrently offering students direct experiential learning opportunities to concretely investigate digestive system content through organised educational activities.

Designing LANTERA

During the design stage, researchers developed the LANTERA media concept and its components, which encompass: a snakes and ladders game board in high-resolution banner format with illustrations of digestive organs, multiple-choice and short answer question cards based on Bloom's Taxonomy (C3-C6), challenge cards, knowledge cards with images of digestive organs, an educational guidebook, LKPD, animated student pawns, dice, and a tube-shaped storage container labeled LANTERA. The design employs vibrant colours and an organised layout specifically adapted to the cognitive development traits of fifth-grade elementary students. The material design was connected with the Science and Social Studies (IPAS) Learning Outcomes (CP) Phase C of the Merdeka Curriculum, particularly with the scientific understanding of organs and the mechanisms of the human digestive system (Rahayu

et al., 2022). Design features incorporated vibrant colours and images of digestive organs to enhance student engagement (Marcela et al., 2022).

Developing LANTERA

The development stage produced a concrete LANTERA media product based on the design that had been previously prepared. At this stage, the design was visualized into a concrete product. Prior to implementation, the prototype underwent two evaluation phases: (1) validation by two media specialists and two content experts, and (2) a readability assessment for sixth-grade students, to confirm that the language, game instructions, and card questions were comprehensible for fifth-grade students. Table 7 presents an overview of recommendations and revision follow-ups.

Table 7. Validator suggestions and revision follow-ups

Validator	Comment/Suggestion	Revision Follow-up
Media Expert 1	There are typos in the guidebook, text size needs adjustment, design evidence in the form of barcodes added	typos corrected, text size adjusted, barcodes for question, challenge, knowledge card, and board designs added to the guidebook
Media Expert 2	LKPD size needs enlargement, LKPD doesn't have grade and score columns	LKPD size enlarged, grade and score columns added
Material Expert 1	Material is already good, fix typos, and it needs to be implemented well during practice	typos corrected, material feasible to use
Material Expert 2	Material is already good and ready to use	No revision, suggestions made as implementation notes

Revisions were implemented solely on two components: the handbook and LKPD. The remaining components (LANTERA banner, cards, pawns, dice) were not evaluated as they already satisfied the feasibility criterion. LKPD revisions included: (1) enlarging the display size, (2) adding a grade column, and (3) adding a score column. Guidebook revisions included: (1) correcting typos, (2) adjusting text size, (3) adding QR barcodes for card designs, guidebook, LKPD, and snakes and ladders board. Comparison of display before and after revision is presented in Figure 2.

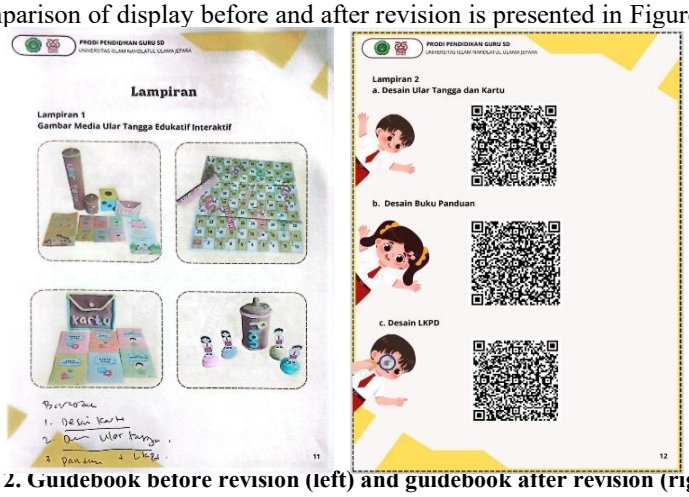

Figure 2. Guidebook before revision (left) and guidebook after revision (right)

Figure 3. LKPD before revision (left) and LKPD after revision (right)

The final LANTERA media product was generated following the completion of all revision processes and was deemed feasible for implementation. LANTERA media is an educational game based on snakes and ladders, packaged comprehensively in a single storage tube set labelled LANTERA. The final product consists of nine main components that are mutually integrated: (1) main tube as a container for all components, (2) banner tube to store the game board, (3) pawn tube, (4) four elementary student character pawns, (5) large dice, (6) educational guidebook containing a summary of human digestive system material and LANTERA game rules, (7) group LKPD equipped with grade and score columns, (8) card holder, and (9) three types of cards: question cards, challenge cards, and knowledge cards.

Figure 4. Components of LANTERA Media

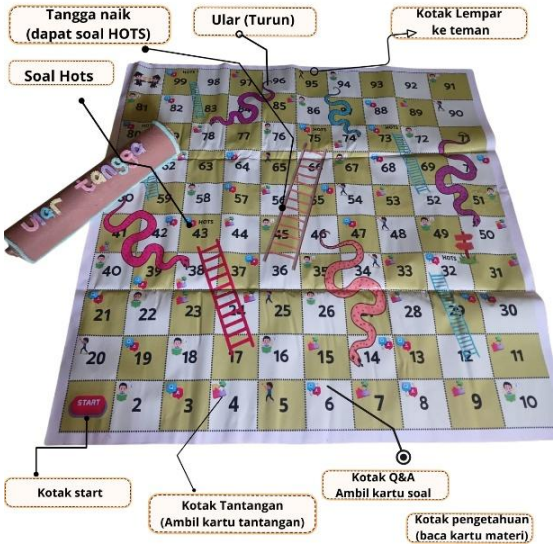

Figure 5. LANTERA Media

Feasibility of LANTERA

A feasibility assessment was performed by two media expert validators and two material expert validators. The Table 8 presents a summary of the assessment results from the media and material expert validators.

Table 8. Results of media expert and material expert validation

Validator	Total Score (Σ)	Number of Indicators	Maximum Score (N)	Final Score (%)
Media Expert 1	65	14	70	92,86%
Media Expert 2	70	14	70	100%
Average				**96,43%**
Material Expert 1	56	13	65	86%
Material Expert 2	54	13	65	83%
Average				**84,5%**

The data in Table 8 indicate that the validation by media experts yielded an average percentage of 96.43%. According to the media feasibility criteria outlined in Table 2, this value falls within the range of 80% ≤ x ≤ 100%, classified as "Meets Feasibility Criteria". This accomplishment substantiates Seechaliao's (2024) assertion that effective learning media must satisfy two primary dimensions: visual technological feasibility and content pedagogical appropriateness. The utilisation of appealing colour schemes, clear and detailed visual representations of the digestive system organs, and a systematically structured layout effectively enhanced student focus in comprehending the educational content. The findings align with Kwangmuang's (2021) research, which determined that systematically constructed visual design contributes to the efficiency of information processing in elementary-level students.

The superiority of this media is also supported by several studies. Research by Ekawati (2024) states that snakes and ladders learning media gets a very valid category and meets feasibility criteria for implementation in learning. Other research by Auliyawati & Nugroho (2023) shows that snakes and ladders learning media

reaches the very feasible criterion, can increase student learning motivation, and facilitates the creation of a more enjoyable learning experience. Thus, LANTERA media not only meets validity standards but also contributes to facilitating engaging learning experiences for elementary school students.

The material validation process was conducted by two expert validators who evaluated content suitability with learning outcomes, accuracy of the human digestive system material, and relevance to the characteristics of fifth-grade elementary students. The evaluation by material expert validators yielded an average score of 84.5%. According to the material feasibility requirements outlined in Table 3, this score is classified within the range of $80\% \leq x \leq 100\%$, designated as "Meets Feasibility Criteria". LANTERA media has established a cognitive bridge by transforming imperceptible biological digestion processes into tangible visualisations that students may influence and investigate using educational game mechanisms (Wardani et al., 2024).

Implementation of LANTERA in Learning Process

The next stage is Implementation. After obtaining feasibility approval from the media and material expert validators and being declared feasible for implementation in the human digestive system learning process, researchers began implementing it in learning activities. Before the media was used, an initial test (pre-test) was conducted to identify the level of student understanding of the human digestive system material before learning began using an objective assessment instrument in multiple-choice format covering 17 valid question items. Subsequently, the human digestive system material was delivered with the help of LANTERA media for four meetings. The learning process began with dividing students into four groups, where each group received equipment such as pawns, dice, guidebook, and LKPD.

During the game, students learned through educational snakes and ladders where each box contained questions, challenges, and knowledge about the human digestive system. Students were actively involved in answering questions, completing challenges, and filling in the provided worksheets. The learning activity was closed with a group discussion discussing the questions and challenges answered in the worksheet so that students could deepen their knowledge while reflecting on their learning experience. At the fourth meeting, researchers conducted a post-test to measure student understanding after the implementation of LANTERA media.

Enhancement of Learning Outcomes Through LANTERA

The next stage was conducting an N-Gain test to measure the magnitude of the increase in student learning outcomes based on the implemented pre-test and post-test scores. The results of the N-Gain test are presented in the Table 9.

Table 9. N-Gain Test Result

N	Minimum	Maximum	Mean	Std. Deviation
33	,00	1,00	,6187	,26360
33				

N-Gain analysis was derived using a formula that compares the actual gain (the difference between post-test and pre-test scores) with the highest potential gain (the difference between the maximum score and pre-test score). The analysis of N-Gain indicated that among 33 students, 48.5% (16 students) achieved a high category ($g > 0.7$), 39.4% (13 students) attained a medium category ($0.3 \leq g \leq 0.7$), and 12.1%

(4 students) fell into the low category (g < 0.3). The class average N-Gain was 0.6187, categorizing it as medium according to Hake (1999). Despite being classified as medium, this achievement demonstrates that LANTERA media positively influenced the optimization of student comprehension regarding the human digesting mechanism.

The most significant gain was observed in the C3 indicator, encompassing comprehension of digestive organ functions, identification of digestive problems, assessment of nutritious food, and understanding of digestion processes in the stomach and small intestine. This accomplishment is explicable as the information and question cards on LANTERA media visually represent digestive organs and their functions, so enhancing conceptual comprehension at the application level. Nuralisa et al. (2021) shown a significant enhancement in cognitive learning outcomes through the use of card media in elementary schools.

The lowest increase occurred in the C5 and C6 indicators, namely evaluating the impact of unhealthy food and formulating conclusions about the impact of bad habits on the digestive system. This condition is in accordance with Piaget's cognitive development characteristics, where grade V SD students are still in transition from the concrete operational to formal stage, so evaluative thinking and synthesis abilities still require more intensive scaffolding (Wardani, 2022). This indicates that the number of HOTS questions on the cards needs to be increased and reflective questions need strengthening in future media development so that students are better trained in higher-order thinking through existing game mechanisms (Sun et al., 2024).

Practicality of LANTERA in Learning Process

The final stage was evaluation, which was carried out to measure the practicality of LANTERA media based on the users' perspective, namely teachers and students. This evaluation aims to identify the level of acceptance, ease of use, and media benefits in supporting the human digestive system learning process. Evaluation data were obtained through teacher and student response questionnaires after implementing LANTERA media in learning. The teacher response questionnaire was designed to measure three main aspects: material suitability, media display, and media benefits. The results of the teacher response questionnaire are presented in the Table 10.

Table 10. Teacher response questionnaire results toward the media

Aspect	Score	Percentage
Material suitability	10	100%
Media display	14	93%
Media benefits	20	100%
Total	44	
Maximum total	45	
Acquisition score		98%

Table 10 shows that the sum of each indicator shows a score of 44 out of a maximum score of 45. Meanwhile, the average teacher response assessment of LANTERA media resulted in a percentage of 98%. This shows that the teacher's assessment of LANTERA media falls into the very good category. Teachers considered that LANTERA media was able to increase student learning motivation and facilitate more optimal understanding of human digestive system concepts (Hariyono et al., 2023). Additionally, teachers stated that this media is practical to use

and has good durability so that it can be used repeatedly in learning. Meanwhile, student responses can be observed in Table 11.

Table 11. Student response questionnaire results toward the media

Aspect	Score	Percentage
Media display	336	98%
Language	294	89%
Media benefits	899	90,8%
Total	1.529	
Maximum total	1.650	
Acquisition score		92,6%

Based on the summary of the student response questionnaires toward the learning media filled out by 33 students, an acquisition score of 92.6% was obtained, in the very good category. In detail, the media display aspect obtained a percentage of 98%, the language aspect 89%, and the media benefits aspect 90.8%. This finding indicates that the constructed learning media has an attractive visual design, applies a language structure accessible to students, and provides excellent benefits in helping students understand the learning material. The evaluation findings from both teachers and students indicate that LANTERA media satisfies the criteria for practicality and effectiveness in the learning of the human digestive system. This media not only aids in attaining cognitive learning goals but also offers an engaging and meaningful educational experience for students.

LANTERA media supports learning tailored to individual student needs because the group game format allows students with various ability levels to participate actively and meaningfully. Teachers assessed that LANTERA media has good durability and can be used repeatedly, making it a beneficial learning investment. In addition to favourable feedback from the teachers, LANTERA media was as positively received by the students. A favourable response is crucial, as student motivation and engagement are primary determinants of academic achievement. The research results indicate that LANTERA can provide an enjoyable and significant learning experience for students.

The visualisation aspect in LANTERA media significantly enhances student comprehension of the intricate and abstract concepts related to the human digestive system. This media addresses learning topics such as the identification of digestive organs and their functions, the mechanisms of the digestion process from mouth to anus, the recognition of digestive disorders, the selection of healthy foods, and the assessment of the effects of poor eating habits on the digestive system. Learning objectives aligned with Bloom's Taxonomy levels C3–C6 were successfully attained, as demonstrated by an average N-Gain of 0.6187 in the medium category. This product includes an educational guidebook that provides a comprehensive visual depiction of the digestive process from mouth to anus, demonstrating that clear and contextually relevant visual representations enhance student comprehension of concepts that are challenging to observe directly (Debrenti, 2024; Nurcahyanto et al., 2024).

This research presents a paradigm for developing learning media that may be utilised by teachers and media developers across diverse areas, extending beyond IPAS to encompass numerous disciplines with abstract or difficult content. A game-based learning approach, integrated with visual components and collaborative efforts, may serve as a more effective alternative to conventional lecture-dominated methods, fostering an enjoyable educational experience while enhancing cognitive learning outcomes for elementary students (Ruiz et al., 2024). The investigation by Zeng et al.

(2024) corroborates this conclusion, suggesting that gamification significantly enhances student learning outcomes, evidenced by an impact size of 0.782, relevant across all educational levels, including primary school (Arlinwibowo et al., 2023). The integration of cooperative learning within LANTERA media fosters active engagement and enhances the attainment of student learning outcomes (Öztürk, 2023).

This research has several limitations that need to be noted. Implementation was conducted only in one class at SDN 1 Purwogondo with 33 students using the total sampling technique, so generalization of the results to other school contexts needs careful consideration. The research design used one-group pretest-posttest without a control class, so it cannot be ascertained whether the increase in learning outcomes was entirely due to LANTERA media or also influenced by other factors. The practicality questionnaire was only filled out by one teacher, so teacher response data do not yet represent a broader perspective. This research also only measured learning outcomes in the cognitive domain (C3–C6) and has not included affective or psychomotor domains. These limitations can serve as a basis for improvement in similar development research in the future.

CONCLUSION

Interactive Educational Snakes and Ladders (LANTERA) media developed through the ADDIE model has met the criteria for feasibility, practicality, and successfully increased student learning outcomes in the human digestive system material in grade V of SDN 1 Purwogondo. Evaluations by media and material specialists affirm that LANTERA is feasible for application in education. The adoption of media enhanced students' cognitive learning results, yielding an average N-Gain in the medium category, with nearly half of the students attaining high improvement classifications. Favourable feedback from teachers and students highlights that this media is practical, attractive, and meaningful as a game-based learning tool for abstract material at the elementary school level.

This media effectively converted the abstract notion of the digestive system into a tangible representation by incorporating visualisation, gamification, and collaborative learning, hence promoting active student engagement in knowledge acquisition. From a practical perspective, this research presents a media development model that can be applied by teachers for other learning materials with abstract or complex characteristics. Recommendations for learning practice include integrating interactive educational game-based media in IPAS learning and teacher training in designing gamification-based learning. Thus, LANTERA media is feasible, practical, and able to improve learning outcomes of the human digestive system.

REFERENCES

Andrianti, T., & Widiyono, A. (2025). Pengembangan bahan ajar berbasis e-books terhadap hasil belajar IPA materi perubahan wujud benda siswa di sekolah dasar. *SCIENCE: Jurnal Inovasi Pendidikan Matematika Dan IPA*, *5*(2), 617–626. https://doi.org/10.51878/science.v5i2.5003

Ariya, P., Wongwan, N., Intawong, K., & Puritat, K. (2025). Digital literacy through gaming: A comparative study of knowledge acquisition, social presence, and emotional reactions in digital and non-digital board games. *Social Sciences & Humanities Open*, *11*, 101387. https://doi.org/10.1016/j.ssaho.2025.101387

Arlinwibowo, J., Ishartono, N., Linguistika, Y., Purwoko, D., & Suprapto. (2023). Gamification in the Stem Domain Subject: the Prospective Method To Strengthen Teaching and Learning. *Jurnal Pendidikan IPA Indonesia*, *12*(4),

562–572. https://doi.org/10.15294/jpii.v12i4.48388
Asri, A. S. T., & Dwiningsih, K. (2022). Validitas E-Modul Interaktif sebagai Media Pembelajaran untuk Melatih Kecerdasan Visual Spasial pada Materi Ikatan Kovalen. *PENDIPA Journal of Science Education*, *6*(2), 465–473. https://doi.org/10.33369/pendipa.6.2.465-473
Auliyawati, J., & Nugroho, O. F. (2023). Pengembangan Media Pembelajaran Ular Tangga Untuk Meningkatkan Motivasi Belajar Siswa Sekolah Dasar Pada Materi IPA. *Pedagogia: Jurnal Ilmiah Pendidikan*, *15*(2), 61–64. https://doi.org/10.55215/pedagogia.v15i2.9117
Branch, R. M., & Varank, İ. (2009). *Instructional design: The ADDIE approach* (Vol. 722). Springer.
Debrenti, E. (2024). Game-Based Learning experiences in primary mathematics education. *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1331312
Ekawati, S. (2024). Pengembangan Media Pembelajaran IPAS Berbasis Permainan Ular Tangga Pada Materi Energi di Kelas IV SD Annur Yapis Kota Sorong. *MISOOL: Jurnal Pendidikan Dasar*, *6*(2), 94–102.
Fitriani, C. D., & Insani, N. H. (2024). The Effectiveness of Game Based Learning Utilizing Snakes and Ladders Media on Javanese Script Learning Outcomes. *International Journal of Elementary Education*, *8*(3). https://doi.org/10.23887/ijee.v8i3.78934
Fitriyaningsih, N., Agustini, F., & Priyanto, W. (2022). Pengembangan media pembelajaran "pencernaan manusia" berbasis android pada pembelajaran ipa materi organ pencernaan manusia kelas V Sekolah Dasar. *Tahun*, *1*(2), 1. https://doi.org/10.26877/cm.v1i2.13878
Hadyansah, D., Dimyati, D., Hermawan, H. A., Fadillah, H. M., & Mulyana, F. R. (2024). Educational Game "Pusaran Ular Tangga" To Improve Fundamental Motor Skill (FMS) of Grade 3 Elementary School Students. *Retos*, *57*, 502–508. https://doi.org/10.47197/retos.v57.101855
Hake, R. R. (1999). American educational research association's division d, measurement and research methodology: analyzing change/gain scores. *USA: Woodland Hills*.
Hariyono, E., Rizki, I. A., Lestari, D. A., Citra, N. F., Islamiyah, A. N., & Agusty, A. I. (2023). Engklek game ethnoscience-based learning material (egeblm) to improve students' conceptual understanding and learning motivation. *Jurnal Pendidikan IPA Indonesia*, *12*(4), 635–647. https://doi.org/10.15294/jpii.v12i4.43941
Izzaturahma, E., Putu, L., Mahadewi, P., & Simamora, A. H. (2021). Pengembangan Media Pembelajaran Video Animasi Berbasis ADDIE pada Pembelajaran Tema 5 Cuaca untuk Siswa Kelas III Sekolah Dasar. *Jurnal Edutech Undiksha*, *9*(2), 216–224. https://doi.org/10.23887/jeu.v9i2.38646
Kholis, A., & Azmi, U. (2023). A need analysis on developing English interactive multimodal e-book oriented to 21st century skills. *Elsya: Journal of English Language Studies*, *5*(1), 85–106. https://doi.org/10.31849/elsya.v5i1/11804
Kritt, D., & Budwig, N. (2022). The future of constructivist education. *Human Development*, *66*(4–5), 295–309. https://doi.org/10.1159/000526275
Kwangmuang, P., Jarutkamolpong, S., Sangboonraung, W., & Daungtod, S. (2021). The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools. *Heliyon*, *7*(6). https://doi.org/10.1016/j.heliyon.2021.e07309
Maghfiroh, A. N., Daksana, M., & Salma, S. N. (2024). Efektivitas penggunaan

media pembelajaran interaktif dalam pembelajaran matematika di sekolah dasar. *Griya Journal of Mathematics Education and Application*, *4*(1), 55–64. https://doi.org/10.29303/griya.v4i1.429

Manrique, H. M., Friston, K. J., & Walker, M. J. (2024). 'Snakes and ladders' in paleoanthropology: From cognitive surprise to skillfulness a million years ago. In *Physics of Life Reviews* (Vol. 49, pp. 40–70). Elsevier B.V. https://doi.org/10.1016/j.plrev.2024.01.004

Marcela, R., Idris, M., & Aryaningrum, K. (2022). Pengembangan media permainan ular tangga dalam pembelajaran IPS siswa kelas IV SD Negeri 138 Palembang. *Jote: Journal On Teacher Education*, *4*(1), 54–61.

Moses Adeleke Adeoye, Kadek Adrian Surya Indra Wirawan, Made Shania Satya Pradnyani, & Nyoman Intan Septiarini. (2024). Revolutionizing Education: Unleashing the Power of the ADDIE Model for Effective Teaching and Learning. *JPI (Jurnal Pendidikan Indonesia)*, *13*(1), 202–209. https://doi.org/10.23887/jpiundiksha.v13i1.68624

Mutaalimah, D., Mariati, P., Ibrahim, M., & Nafiah, N. (2024). Peningkatan Hasil Belajar Siswa pada Mata Pelajaran IPA Kelas IV Melalui Media Ular Tangga IPA (UTIPA) di SDN 3 Jekek Nganjuk. *Indonesian Research Journal on Education*, *4*(3), 108–112. https://doi.org/10.31004/irje.v4i3.736

Nastiti, S. H., Eka Putri, K., & Amirul Mukmin, B. (2022). Pengembangan Media Pembelajaran Ular Tangga pada Materi Siklus Hidup Hewan Kelas IV Sekolah Dasar. *PTK: Jurnal Tindakan Kelas*, *3*(1), 48–57. https://doi.org/10.53624/ptk.v3i1.122

Noor, N. A. M., Saim, N. M., Alias, R., & Rosli, S. H. (2020). Students' performance on cognitive, psychomotor and affective domain in the course outcome for embedded course. *Universal Journal of Educational Research*, *8*(8), 3469–3474. https://doi.org/10.13189/ujer.2020.080821

Nuralisa, S. F., Vitasari, M., & Nestiadi, A. (2021). Pengembangan Media Pembelajaran Kokami (Kotak Kartu Misterius) Tema Pelestarian Lingkungan Untuk Meningkatkan Hasil Belajar Kognitif. *Quantum: Jurnal Inovasi Pendidikan Sains*, *12*(1), 33. https://doi.org/10.20527/quantum.v12i1.10251

Nurcahyanto, G., Yuliana, I., Risalam, N. M., Anggraini, E., & Laela, F. F. (2024). Development of Multimedia Interactive Science Learning Based on Cross Platform on Human Reproductive System Materials in The Ninth Grade of Junior High School. *Quantum: Jurnal Inovasi Pendidikan Sains*, *15*(1), 53–67. https://doi.org/10.20527/quantum.v15i1.15749

Öztürk, B. (2023). The Effect of Cooperative Learning Models on Learning Outcomes: A Second-Order Meta-Analysis. *Educational Policy Analysis and Strategic Research*, *18*(3), 273–296. https://doi.org/10.29329/epasr.2023.600.13

Paramuditha, E. K., Hakim, L., & Nindiati, D. S. (2025). Pengembangan Media Pembelajaran Aplikasi Ular Tangga Berbasis Digital pada Pembelajaran IPAS Kelas V Sekolah Dasar. *Edukasiana: Jurnal Inovasi Pendidikan*, *4*(4), 1539–1550.

Permata, R., & Surmilasari, N. (2023). Pengembangan Media Pembelajaran E-Flashcard pada Materi Sistem Pencernaan Manusia Kelas V SD. *Jurnal Edukasi Matematika Dan Sains*, *11*(2), 419–430. https://doi.org/10.25273/jems.v11i2.15568

Pratiwi, A. S., & Hardini, A. T. A. (2022). Pengembangan Media Pembelajaran Berbasis Permainan Ular Tangga untuk Meningkatkan Motivasi Belajar Siswa dalam Mata Pelajaran IPA Kelas IV SD. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*,

5(12), 5682–5689. https://doi.org/10.54371/jiip.v5i12.1271

Rahayu, A. R. D., Febriandi, R., & Egok, A. S. (2022). Pengembangan media ular tangga pada pembelajaran tematik kelas IV SD Negeri Sungai Jauh. *Linggau Journal of Elementary School Education*, *2*(2), 1–14. https://doi.org/10.55526/ljese.v2i2.269

Rahman Agus, K., Syarif, D., Sahid, S., & Dalimunthe, S. (2023). Implementation Of Gamification In Learning Media To Improve Student Activity And Learning Outcomes. *Journal Research and Development (ITJRD)*, *8*(1). https://doi.org/10.25299/itjrd.2022.10068

Ruiz, J. J. R., Sanchez, A. D. V., & Figueredo, O. R. B. (2024). Impact of gamification on school engagement: a systematic review. *Frontiers in Education*, *9*, 1466926. https://doi.org/10.3389/feduc.2024.1466926

Sari, R. K., Mudjiran, M., Fitria, Y., & Irsyad, I. (2021). Meningkatkan motivasi dan hasil belajar siswa dalam pembelajaran tematik berbantuan permainan edukatif di sekolah dasar. *Jurnal Basicedu*, *5*(6), 5593–5600. https://doi.org/10.31004/basicedu.v5i6.1735

Seechaliao, T. (2024). Instructional Strategies to Produce Educational Media Systematically. *Journal of Education and Learning*, *13*(4), 121–133.

Shakeel, S. I., Al Mamun, M. A., & Haolader, M. F. A. (2023). Instructional design with ADDIE and rapid prototyping for blended learning: validation and its acceptance in the context of TVET Bangladesh. *Education and Information Technologies*, *28*(6), 7601–7630. https://doi.org/10.1007/s10639-022-11471-0

Siregar, M. A. P., Ammamiarihta, A., & Rohimah, N. (2023). Pengembangan Media Pembelajaran Papan Pintar Pada Pembelajaran Matematika Berbasis Drill And Practice. *AXIOM: Jurnal Pendidikan Dan Matematika*, *12*(1), 106–119. https://doi.org/10.30821/axiom.v12i1.15117

Sun, L., Kangas, M., & Ruokamo, H. (2024). Game-based features in intelligent game-based learning environments: A systematic literature review. *Interactive Learning Environments*, *32*(7), 3431–3447. https://doi.org/10.1080/10494820.2023.2179638

Syafrilianto, S., Nasution, M., & Juniati, M. (2022). Peningkatan Hasil Belajar Siswa Melalui Model Quantum Teaching Di Sd Negeri 033 Hutabaringin Mandailing Natal. *Forum Paedagogik*, *13*(1), 130–142. https://doi.org/10.24952/paedagogik.v13i1.5339

Syalfirah, V., Nur Aeni, A., & Hanifah, N. (2024). Penerapan Game Ular Tangga Berbasis Peta Kebudayaan Untuk meningkatkan Hasil Belajar IPAS Kelas IV Sekolah Dasar. *ELSE (Elementary School Education Journal): Jurnal Pendidikan Dan Pembelajaran Sekolah Dasar*, *8*(1), 106–115. https://doi.org/10.30651/else.v8i1.21331

Tavares, M. C., Azevedo, G., & Marques, R. P. (2022). The challenges and opportunities of era 5.0 for a more humanistic and sustainable society—a literature review. *Societies*, *12*(6), 149. https://doi.org/10.3390/soc12060149

Videnovik, M., Vold, T., Kiønig, L., & Trajkovik, V. (2025). Game Strategies to Engage and Empower Students: *International Journal of Game-Based Learning*, *15*(1). https://doi.org/10.4018/IJGBL.391304

Vuk, S. (2023). Development of creativity in elementary school. *Journal of Creativity*, *33*(2), 100055. https://doi.org/10.1016/j.yjoc.2023.100055

Wardani, H. K. (2022). Pemikiran Teori Kognitif Piaget Di Sekolah Dasar. *Khazanah Pendidikan*, *16*(1), 7–19. https://doi.org/10.30595/jkp.v16i1.12251

Wardani, N. W., Kusumaningsih, W., & Kusniati, S. (2024). Analisis penggunaan media pembelajaran terhadap hasil belajar siswa sekolah dasar. *Jurnal Inovasi,*

Evaluasi Dan Pengembangan Pembelajaran (JIEPP), *4*(1), 134–140.

Yudiyanto, M., Arifillah, M. J., Ramdani, P., & Masripah, I. (2022). Penerapan Permainan Ular Tangga Sebagai Pembelajaran Pada Mata Pelajaran IPA. *MURABBI*, *1*(1), 1–13. https://doi.org/10.69630/jm.v1i1.1

Zajda, J. (2021). Constructivist learning theory and creating effective learning environments. In *Globalisation and education reforms: Creating effective learning environments* (pp. 35–50). Springer.

Zeng, J., Sun, D., Looi, C., & Fan, A. C. W. (2024). Exploring the impact of gamification on students' academic performance: A comprehensive meta-analysis of studies from the year 2008 to 2023. *British Journal of Educational Technology*, *55*(6), 2478–2502. https://doi.org/10.1111/bjet.13496

Zhao, E., He, J., Jin, Z., & Wang, Y. (2022). Student-centered learning environment based on multimedia big data analysis. *Mobile Information Systems*, *2022*(1), 9572413. https://doi.org/10.1155/2022/9572413