

Research Article

Development of Kahoot-Based Cognitive Learning Outcome Evaluation for Elementary School Students in Science Learning

Renita*, Suciati, and Suhartono

Master of Elementary Education, Postgraduate, Universitas Terbuka, Samarinda, Indonesia, 75126

*Corresponding Author: 530068533@ecampus.ut.ac.id | Phone: +628349299826

ABSTRACT

The integration of technology in education represents a strategic effort to enhance the quality and effectiveness of learning processes. One form of technological innovation in assessment is the use of the Kahoot application as a digital evaluation tool. Learning assessment serves as concrete evidence to measure students' cognitive development. This study aimed to: (a) develop a valid Kahoot-based assessment product for evaluating cognitive learning outcomes of elementary school students in IPAS (science and social studies) learning; (b) examine the practicality of the Kahoot application as an assessment tool; and (c) analyze its effectiveness in improving students' cognitive learning outcomes. This research employed a Research and Development (R&D) approach using the ADDIE development model. The research subjects were fourth-grade students from SD Negeri 012 Jempang and SD Negeri 010 Jempang. Data were collected through interviews, questionnaires, and tests, and analyzed using descriptive qualitative and descriptive quantitative techniques. The results indicated that the Kahoot-based assessment was highly feasible, with validation scores of 100% from material experts, 92% from media experts, and 88% from language experts. Furthermore, the application was categorized as very practical and demonstrated effectiveness in improving cognitive learning outcomes of fourth-grade students at SDN 010 Jempang, East Kalimantan.

Keywords: assessment technology; Kahoot; cognitive learning outcomes; elementary education; ADDIE model

1. INTRODUCTION

Learning is an active effort in organizing and managing the learning environment, with a focus on developing students' potential and talents through interactions between educators, students, and learning resources (Janawi, 2019). According to Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, learning not only focuses on the transfer of knowledge from teachers to students but also involves active interaction between students, teachers, and learning resources. The learning environment built in learning must support students to actively participate, think critically, collaborate, and develop their potential holistically (Kusumawati et al., 2023). In addition to the learning environment, the learning strategies used by teachers must also be tailored to students' needs. Teachers play a crucial role in determining appropriate learning strategies for students to develop their thinking skills (Prasetyo & Rosi, 2021). Teachers can design learning activities that encourage students to think analytically, synthetically, evaluatively, and creatively (Widiya & Radia, 2023). For example, teachers can assign assignments or questions that require complex problem-solving, group discussions that encourage critical thinking, or creative projects.

Teachers can design assessment instruments that measure cognitive abilities, such as project assignments, essay writing, or decision-making based on data analysis (Lismaya, 2019). Assessment activities can help teachers determine the extent to which students have mastered cognitive skills and provide appropriate feedback for further development (Batubara & Siregar, 2022). Assessment in this learning process is expected to develop cognitive abilities that will help students become critical, creative individuals capable of facing changes and challenges in today's global era (Tiwery, 2021). Assessment is a crucial activity in learning. Poerwanti (2015) stated that assessment is a series of activities aimed at improving performance, quality, and productivity in learning. This involves monitoring and evaluating the learning process and obtaining information about student learning outcomes. The assessment process involves collecting objective data and information about student learning progress (Ramatni et al., 2023). Data can be obtained through various techniques, such as tests, project assignments, observations, interviews, and portfolios. Through data analysis, teachers can evaluate student achievement and identify student strengths and weaknesses (Andayani & Madani, 2023). Assessment results are used to plan the next steps in learning according to individual student needs.

The primary purpose of assessment is to provide useful feedback to students, teachers, and other stakeholders to guide their next steps (Efriani et al., 2024). By obtaining accurate information about learning outcomes, teachers can identify student needs and challenges and design effective learning strategies (Mambu et al., 2023). Assessment can also motivate

students to continuously improve their abilities and develop themselves in the learning process. Assessment activities are carried out by developing questions aimed at students (Novitasari et al., 2022). Assessment questions can be created with the aid of advanced technology, which is highly advanced in the world of education. The application of technology in education is an effort to bring about positive change in the educational process. Technological developments in the 21st century provide significant opportunities to improve the quality of education (Friticarani et al., 2023). By utilizing technology, teachers can create more engaging, interactive, and relevant learning experiences for students.

21st-century learning currently utilizes educational technology as an alternative resource to address 21st-century challenges (Banarsari et al., 2023). Teachers must be able to utilize technology in school learning (Dayu et al., 2022). The 21st century has resulted in a paradigm shift in learning, marked by changes in curriculum, media, and technology (Rahayu et al., 2022). Technology-based learning is inseparable from the demands of 21st-century learning. One of the demands of 21st-century learning is the integration of technology as a learning medium to develop learning skills (Mardhiyah et al., 2021). There are three most important competencies in the 21st century: the ability to think, act, and live in the world (Mayudana & Sukendra, 2020). 21st-century learning skills equip students with the 4C skills needed to address today's challenges (Khasanah et al., 2023). The 4Cs are soft skills that have far greater benefits than mastering hard skills (Ariyana, 2018). The 4C skills (Communication, Collaboration, Critical Thinking, and Creativity) are crucial to develop in facing the challenges of the 21st century. Developing these 4C skills can leverage the various advanced technologies that have become widespread today. In line with this, the use of digital media can help improve communication and collaboration skills, while creative software can stimulate student creativity (Pujiani & Wathon, 2021). The application of 4C skills in assessment activities is also crucial. Technology-based assessment can be one innovation that teachers can implement in line with increasingly rapid technological developments. Assessments using technology can utilize the Kahoot application.

According to Bunyamin (2020), the Kahoot application can help optimize student interest in completing assessment questions. Kahoot is a game-based learning application that allows teachers to create quizzes, surveys, or interactive discussions in class (Daryanes & Ririen, 2020). This application utilizes technology to create an engaging, engaging, and competitive learning experience for students (Tika, 2023). Teachers can evaluate student understanding in a fun and interactive way with Kahoot. Furthermore, students can take quizzes in real time using their own devices or existing computer facilities (Ashari et al., 2023). This not only allows teachers to see the extent of student understanding but also increases student motivation and engagement in learning. Cognitive assessment can also be developed using the Kahoot application. The Kahoot application can be used to design questions that encourage students to think critically, analyze information, evaluate correct answers, and generate creative solutions (Rosdiyah & Badriyah, 2024). Thus, the Kahoot application can be an effective tool in developing cognitive abilities in students. The application of assessment in learning also needs to consider student characteristics. According to Dirman and Juarsih (2014), there are several characteristics of upper-grade students aged 9-12 that teachers need to understand:

1. A positive relationship between physical or bodily condition and academic achievement. This characteristic indicates that a student's physical or bodily condition can affect their academic achievement. Therefore, it is important for teachers to pay attention to students' physical health and well-being so they can achieve their optimal learning potential.
2. Compliant attitude to following rules. Students at this age tend to be compliant with rules. Teachers can capitalize on this attitude by establishing clear and consistent rules in the assessment process, so that students have a clear understanding of the expectations and actions expected of them.
3. Students tend to praise themselves. At this age, students tend to praise themselves. Teachers can capitalize on this by providing positive feedback and strengthening students' confidence in the assessment process.
4. Likes to compare themselves to others. Students at this age often compare themselves to others. Teachers need to manage this presentation wisely and direct it so that students focus more on their personal progress.
5. Views unsolvable problems as unimportant. This characteristic indicates that students tend to lose interest when faced with difficult or unsolvable problems. Therefore, it is important for teachers to provide challenges appropriate to students' ability levels, while also providing support and guidance when needed.
6. Desiring good grades without considering actual achievements. Students at this age often focus solely on good grades without considering the process and actual achievements. Teachers need to focus students' attention on the importance of the learning process and developing their abilities, not just the end result.

Teachers must be aware of their students' learning styles in addition to their personal characteristics. Students from higher social classes typically prefer varied learning and incorporate engaging techniques, audio, video, and graphics. To increase student interest and engagement in the assessment process, educators can use a variety of innovative media and teaching strategies. According to research by Asmarani et al. (2024), the implementation of a gamified learning model assisted by Kahoot significantly improved student learning outcomes in science in fifth grade elementary school. This was evident in the increase in average scores from 41.88 in the pre-test to 83.52 in the post-test, as well as the percentage of students achieving mastery of the subject, which was 88.00%. Furthermore, statistical tests show that the use of Kahoot as a gamification medium is effective in improving student understanding and learning outcomes. Other research related to Kahoot demonstrates that the application has a positive and significant impact on student learning outcomes in Arabic language learning at Muhammadiyah Senior High School in Bantul. The use of Kahoot not only statistically improves learning outcomes but also creates a more interactive, enjoyable, and effective learning experience (Ihwaludin & Fauji, 2024). A study by Irawan & Latifah (2023) also demonstrated that the Kahoot application helps teachers evaluate student performance, solve problems, make learning enjoyable, and encourage critical thinking.

Based on initial observations conducted by researchers in fourth-grade students at SD Negeri 010 Jempang, data showed that out of 20 students, 65%, or 13, scored below the Minimum Completion Criteria (KKM) in Natural and Social Sciences (IPAS). The school's minimum competency standard (KKM) is 70, while the average student social studies (IPAS) score is only 62. During informal interviews with several students, researchers found that most students considered the subject boring and difficult to understand because the learning process only focused on reading books without any interesting activities. Based on these conditions, learning innovation is needed to make the subject more interesting and interesting for students. Furthermore, teacher competence is still limited in the ability to develop assessment questions.

Jempang 010 Public Elementary School has adequate facilities, including 15 Chromebooks. Based on the school's facilities, one innovation that can be implemented to increase student interest and learning outcomes in science is the use of Kahoot-based learning media. Kahoot is a digital learning platform that takes the form of a technology-based interactive quiz game. Through Kahoot, students can take quizzes directly using devices such as mobile phones or laptops, making the learning process more enjoyable and less monotonous. Furthermore, Kahoot fosters a healthy competitive element in the classroom, as students can view their scores in real time. The development of the Kahoot application aims to create a more engaging and effective learning environment for students. Adequate facilities, such as Chromebooks, can maximize innovative learning. Kahoot allows teachers to create interactive quizzes that foster healthy competition among students, increasing their enthusiasm for learning. In accordance with the context described above, the researcher has the basis for conducting this research, entitled "Development of Kahoot-Based Cognitive Learning Outcome Evaluation for Elementary School Students in Science Learning."

2. RESEARCH METHOD

This study employed a Research and Development (R&D) approach. According to Sugiyono (2019), Research and Development is a method aimed at developing new products or innovations and validating the effectiveness and feasibility of the developed products. In the educational context, R&D is widely used to design and evaluate learning media, instructional materials, teaching strategies, and assessment tools. Therefore, the R&D approach was considered appropriate for developing a technology-based evaluation medium in the form of a Kahoot application for assessing students' cognitive learning outcomes. The development model applied in this study was the ADDIE model, which consists of five systematic stages: *Analysis, Design, Development, Implementation, and Evaluation*. The ADDIE model provides a structured framework that supports the development of instructional products in a logical and iterative manner. In this research, the ADDIE model was used to guide the development of a Kahoot-based evaluation application for fourth-grade elementary school students in the IPAS (Science and Social Studies) subject. In addition, this study employed a one-group pretest–posttest design to measure the impact of the Kahoot application on students' cognitive learning outcomes. The pretest was administered prior to the implementation of the Kahoot-based evaluation, while the posttest was conducted after students participated in learning activities using the developed application.

Operational definitions were formulated to clarify the meaning of variables used in this study. First, the development of the Kahoot application refers to the process of designing and producing a digital evaluation tool intended to increase students' engagement, motivation, and effectiveness in learning. The development process was based on preliminary observations and a needs analysis involving teachers and students. Second, cognitive learning outcomes refer to students' achievement in the cognitive domain of IPAS learning, which includes understanding, comprehension, and mastery of subject matter. These outcomes were measured using objective tests in the form of multiple-choice questions. The research was conducted at SD Negeri 010 Jempang, East Kalimantan, Indonesia. A preliminary study was carried out in December 2024 to obtain initial data related to IPAS learning activities through direct interviews with teachers and students. The stages of design, development, implementation, and evaluation were conducted from January 2025 onward. The population of this study consisted of all fourth-grade students at SD Negeri 010 Jempang. In accordance with Sugiyono (2019), the population represents a group of individuals possessing specific characteristics relevant to the research objectives. The sampling technique used was saturated sampling, in which all members of the population were included as research participants. Consequently, the sample comprised 20 fourth-grade students, ensuring that the sample fully represented the population.

Data collection was conducted using both non-test and test techniques. Non-test instruments included interviews, questionnaires, and documentation. Interviews were conducted with fourth-grade teachers and students to identify learning needs, challenges in evaluation practices, and perceptions of technology-based assessment. Questionnaires were used to collect expert validation data from subject-matter experts, language experts, and media experts, as well as responses from teachers and students after the implementation of the Kahoot application. Documentation was employed to record research activities in the form of photographs and supporting documents. The test instrument consisted of 20 multiple-choice questions designed to measure students' cognitive learning outcomes in IPAS. The test was administered twice, as a pretest and posttest, to determine the effectiveness of the developed Kahoot application. The research procedures followed the five stages of the ADDIE model. The analysis stage involved identifying learning problems and students' needs. The design stage focused on formulating learning objectives and designing the Kahoot-based evaluation. During the development stage, the Kahoot application was produced and validated by experts. The implementation stage involved applying the developed application in classroom learning using a discovery learning model. Finally, the evaluation stage was conducted to assess product feasibility and effectiveness based on expert validation, student responses, and test results.

Data analysis involved both qualitative and quantitative approaches. Qualitative data from interviews were analyzed descriptively to describe the development process and learning implementation. Quantitative data from questionnaires and test scores were analyzed using descriptive statistics. Product feasibility was calculated using percentage analysis, while

effectiveness was measured using the normalized gain (N-gain) score, comparing pretest and posttest results. The N-gain scores were classified into high, medium, and low effectiveness categories. The research activities were conducted according to a structured schedule, including proposal preparation, research implementation, data analysis, supervision, and final examination, spanning from November 2024 to May 2025.

3. RESULTS AND DISCUSSION

3.1. Results

The development of learning media in this study adopted the ADDIE model, which emphasizes a systematic and iterative approach to instructional design. At the analysis stage, data were collected through interviews conducted at SDN 012 Jempang, East Kalimantan, complemented by curriculum analysis to ensure alignment with instructional standards. The needs analysis revealed that fourth-grade students commonly encountered difficulties in IPAS evaluation activities, particularly due to lengthy, complex, and text-heavy test items that were still administered manually without technological support. Despite these challenges, students expressed positive attitudes toward digital-based assessments, reporting greater comfort, motivation, and ease of understanding when evaluation tasks were delivered via digital devices incorporating visual and audiovisual elements. Interviews with teachers further indicated constraints related to time, facilities, and limited digital literacy, which hindered the development of varied and technology-integrated assessment tools. Nevertheless, these findings underscore the pedagogical necessity of integrating digital media to enhance assessment relevance and accommodate diverse learning modalities.

Based on these analytical findings, Kahoot was selected as the instructional evaluation medium due to its game-based, interactive nature and its capacity to support formative assessment through immediate feedback and measurable learning outcomes. The curriculum analysis confirmed that SDN 012 Jempang had fully implemented the Merdeka Curriculum, which guided the selection of learning materials and the formulation of instructional objectives. Content development was aligned with learning outcomes and learning progression pathways, particularly focusing on the IPAS Grade IV Semester 2 topic “*Cerita tentang Daerahku*.” This topic was chosen due to students’ relatively low interest in IPAS and its contextual relevance to local diversity, which is essential for fostering awareness, appreciation, and preservation of regional characteristics. Consequently, the analysis stage provided a robust empirical and curricular foundation for developing a Kahoot-based evaluation medium that is pedagogically sound, contextually relevant, and responsive to both learner and teacher needs.

Table 1. Learning Outcomes (CP) and Learning Objective Flow (ATP)

Learning Outcomes (LO)	Learning Objectives Sequence (LOS)
By the end of this phase, students are able to perform roles and responsibilities as members of their families and school communities, and to describe social interactions occurring in their home and school environments. Students identify various types of natural landscapes and their relationships to community professions. They describe the water cycle and are able to locate their city/regency and province on conventional and digital maps. Students explain biodiversity, cultural diversity, local wisdom, and efforts toward their preservation. They recognize the culture and history (including figures and historical periods) of their home province and relate them to contemporary life contexts. In addition, students are able to create or obtain products using available tools and materials in their surroundings, recognize needs and wants, understand the value of currency, and demonstrate how money is used to obtain needed benefits.	<ol style="list-style-type: none"> 1. Describing the historical development of the local region. 2. Identifying and presenting natural resources available in the local area. 3. Analyzing the influence of regional development on the economic life of the local community.

The design stage focused on the systematic planning of both the Kahoot-based cognitive assessment media and the evaluation instruments used in this study. At this stage, two primary activities were conducted: designing the structure and features of the Kahoot application as a digital assessment tool, and developing evaluation items aligned with the curriculum and instructional content. The learning material selected was IPAS Grade IV, Chapter 5 “*Cerita tentang Daerahku*”, which was chosen due to its strong relevance to students’ everyday experiences and its alignment with the learning outcomes prescribed in the Merdeka Curriculum. The assessment content for both the pretest and posttest was derived from this chapter, encompassing three main thematic domains: (1) historical development, natural resources, and economic life of the local area; (2) regional natural resources and their relationship with geographical conditions and sustainable utilization; and (3) social life within the local community, including occupational patterns and the influence of migrant populations.

Learning objectives were formulated based on the IPAS teacher’s guidebook and were mapped across multiple cognitive levels of the revised Bloom’s taxonomy, ranging from remembering (C1) and understanding (C2) to applying (C3), analyzing (C4), and evaluating (C5). These objectives served as the foundation for constructing the evaluation instruments. The test items were designed to measure students’ cognitive achievement comprehensively by reflecting the intended learning outcomes and cognitive demands of the curriculum. A total of 20 multiple-choice questions were developed and embedded within the Kahoot platform for use in both the pretest and posttest. Each item was carefully aligned with specific learning objectives and cognitive levels to ensure content validity, conceptual clarity, and consistency between instructional goals and assessment practices.

Table 2. Topics, Learning Objective Flow, and Cognitive Level of Learning Objectives

Topic	Learning Objectives	Bloom's Cognitive Level	Explanation
Topic A: What Was My Local Area Like in the Past?	Students are able to describe the historical development of their local area.	C2 (Understanding)	The action verb “describe” requires students to interpret information obtained from interviews or literature and organize it into a coherent and comprehensible narrative.
	Students are able to identify and demonstrate the natural resources found in their local area.	C3 (Applying)	Although the focus on natural resources is elaborated further in Topic B, in Topic A this objective requires students to apply their understanding of local heritage by identifying real-world examples of natural resources in their environment.
	Students are able to examine the influence of regional development on the economic life of the local community.	C4 (Analyzing)	The verb “examine” requires students to analyze and establish relationships between two variables, namely regional development and community economic conditions.
Topic B: My Region and Its Natural Resources	Students are able to identify and demonstrate the natural resources found in their local area.	C3 (Applying)	This objective requires students to apply conceptual knowledge of natural resource classifications (biotic and abiotic; renewable and non-renewable) to classify real examples from their region.
	Students are able to analyze the impact of regional development on the economic life of the local community.	C4 (Analyzing)	Analyzing requires students to break down cause-effect relationships, such as how regional development (e.g., mining or tourism) influences economic outcomes, including income levels and occupational changes.
	Students are able to determine sustainable ways of utilizing natural resources.	C4 (Analyzing) / C5 (Evaluating)	The verb “determine” in a sustainability context involves analysis of various utilization methods (C4). When students are required to judge and select the most appropriate long-term strategy, this objective shifts to C5 (Evaluating).
Topic C: Communities in My Region	Students are able to demonstrate differences between past and present community life in their local area.	C2 (Understanding)	The phrase “demonstrate differences” requires students to compare and interpret conditions across two time periods.
	Students are able to correlate geographical factors with dominant livelihoods in their local area.	C3 (Applying)	The verb “correlate” reflects the application of geographical concepts to explain observable economic activities and livelihoods.
	Students are able to identify the impacts of migrant communities on the local area.	C4 (Analyzing)	Identifying both positive and negative impacts requires students to analyze a social phenomenon and categorize its consequences.
	Students are able to determine the most appropriate attitudes in responding to the impacts of migrant communities.	C5 (Evaluating)	The keyword “most appropriate” indicates evaluation, as students must compare alternatives and justify the best course of action to promote social harmony and sustainability.

After establishing the learning objectives and constructing assessment items, the next step involved selecting an appropriate instructional media model guided by the needs analysis, specifically targeting the evaluation of cognitive learning outcomes; consequently, the Kahoot application was chosen as the digital assessment platform (accessible at https://kahoot.it/challenge/01430306?challenge-id=afaca445-53a1-42e4-a983-dbd6aed11925_1763930970835) due to its interactive capabilities and suitability for formative evaluation, after which a set of 20 multiple-choice questions with carefully constructed distractors was developed for the instructional unit “Cerita tentang Daerahku,” and this instrument was administered following the completion of the instructional sequence to assess cognitive achievement and to quantify differences in performance before and after the integration of the Kahoot-based media.



Figure 1. First look at the kahoot app for students

Figure 1 shows the first screen of the Kahoot application for students. The teacher will provide a game link to open the questions. After students click the shared game link, they will be asked to enter their name.



Figure 2. Second look at the kahoot app for students

Figure 2 shows the second screen of the Kahoot application for students. This is the page for entering student IDs. All students must enter their names to facilitate assessment. After students enter their IDs and click “OK, start,” they are directed to the next screen, which contains the test questions.

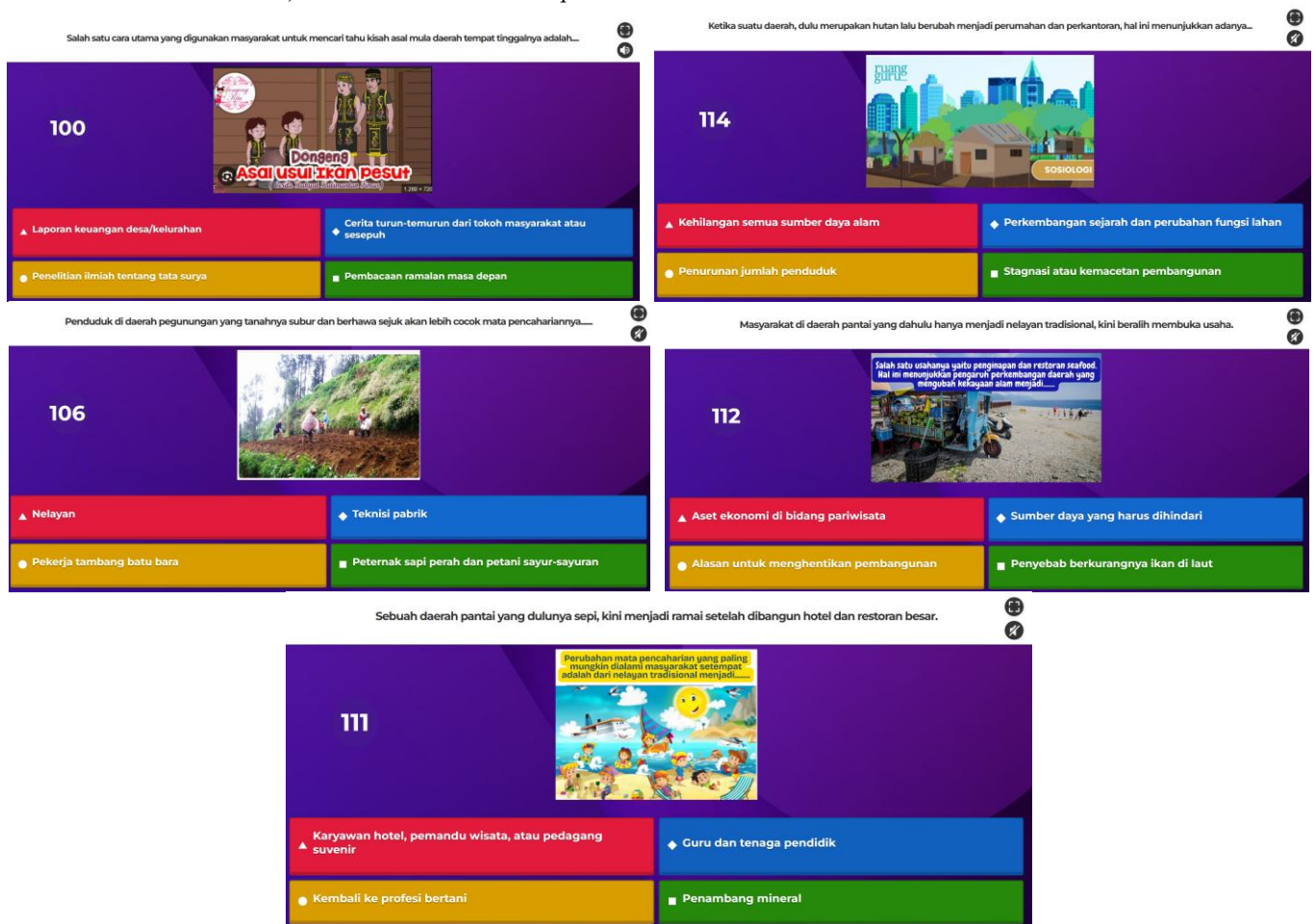


Figure 3. Example of question display in the Kahoot application with Levels C1, C2, C3, C4, and C5

Figure 3 presents the interface of the pretest and posttest instruments, which consist of 20 multiple-choice questions administered sequentially. Each item is allocated a response time of 120 seconds, ensuring sufficient opportunity for students to process the questions. The test items are structured across five cognitive levels, enabling comprehensive measurement of students’ cognitive learning outcomes. Upon selecting an answer, students immediately receive automated feedback indicating whether their response is correct or incorrect, and a cumulative score is displayed at the end of the test.

This real-time feedback mechanism is intended to enhance students’ awareness of their performance and support formative evaluation.

The development stage focused on designing and producing the Kahoot-based evaluation media and research instruments. During this stage, the researcher constructed multiple-choice questions in accordance with Kahoot’s technical specifications, which limit each question to 120 characters and each answer option to 75 characters, with four alternatives provided. Answer keys were predetermined to enable automatic scoring and instant feedback within the application. Kahoot’s interactive features, such as color-coded answer options and background sound effects were intentionally utilized to foster student engagement, create a game-like learning atmosphere, and reduce test-related anxiety. However, the character limitation posed challenges for lengthy or narrative-based items, which were addressed by embedding question text into images created using Canva. The development process required one day to complete. Following development, the evaluation media underwent expert judgment to assess its feasibility and validity. Validation involved subject-matter, media, and language experts using structured validation instruments. The subject-matter expert examined alignment with curriculum standards and learning objectives, the media expert evaluated interface design, usability, and functional effectiveness, and the language expert reviewed linguistic accuracy and clarity for elementary-level comprehension. The validation results indicated that the developed Kahoot-based evaluation media met feasibility criteria and was appropriate for implementation in the school context.

Table 3. Material Expert Validation Results

Component	Aspects Assessed	Assessment				
		1	2	3	4	5
Material	The questions in the test items align with the targeted Learning Outcomes.					✓
	The test items align with the established learning objectives.					✓
	The questions in the test items reflect the established indicators.					✓
	Each test item includes questions tailored to the students' needs.			✓		
	The test items are presented sequentially, facilitating understanding.					✓
	Each test item is presented clearly and specifically for students.				✓	
Construction	Each test item is not related to the answer to the previous question.					✓
	The use of features in the Kahoot application, such as images, video, and audio, must be clear and operate properly. The test items and their answers must use appropriate and correct sentences.					✓
	Each test item is not related to the answer to the previous question.					✓
Ethics	The questions do not contain elements of violence, demean ethnicity, religion, race, politics, or pornographic content.					✓
Total Amount					4750	
Percentage					94%	

The results of the content validation conducted by the subject-matter expert demonstrate a very high level of feasibility of the developed evaluation instrument. The total validation score reached 4,750, corresponding to a percentage of 94%, which falls within the *very feasible* category. Core aspects assessed included the alignment of test items with learning outcomes, learning objectives, and predefined indicators. Each of these aspects received the maximum score, indicating that the questions accurately measured the intended competencies and were fully consistent with curricular targets. This confirms that the items were contextually relevant and theoretically grounded, enabling them to function as valid measures of students’ cognitive achievement without requiring revision in these domains. Further validation focused on the appropriateness of test items in relation to students’ needs and cognitive development, as well as the logical sequencing and clarity of the questions. While most aspects achieved very high validity scores, the relevance of several items to students’ immediate needs received a moderate rating. The expert noted that some questions addressed regional development and population mobility phenomena that, although aligned with the instructional material “Cerita Tentang Daerahku,” might exceed the experiential background of students in underdeveloped areas. Nonetheless, these items remained pedagogically justifiable, as such phenomena are observable within the research context, thereby maintaining their instructional relevance.

From a construction and linguistic perspective, the validation confirmed that each test item was independent, clearly formulated, and free from ambiguity. The sequencing of items followed a logical progression that supported students’ comprehension, and the language used in both questions and answer options was grammatically accurate and conceptually precise. However, the expert highlighted that certain items employed language and concepts that could be challenging for some learners, suggesting the need for contextual scaffolding rather than structural revision. Overall, the instrument demonstrated strong internal coherence and readability appropriate for elementary-level assessment. In terms of ethical standards and media integration, all items were verified to be free from violence, discrimination, political bias, and inappropriate content, ensuring a safe and inclusive assessment environment. Additionally, the supporting media features within the Kahoot application, such as images, videos, and audio were validated as functioning properly and providing clear visual and auditory quality. Collectively, these findings indicate that the developed test items and the Kahoot-based evaluation media meet rigorous content, construction, ethical, and technical standards. Consequently, the instrument is deemed highly valid and suitable for implementation in learning evaluation without requiring substantive revision from a content perspective.

Table 4. Media Expert Validation Results

Component	Aspects Assessed	Assessment				
		1	2	3	4	5
App Appearance	The Kahoot app's appearance is attractive					✓
	The questions and answer choices are presented in an attractive manner					✓
	The image quality is good					✓
App Quality	The score display is clear				✓	
	Can be used in both face-to-face and online learning				✓	
	The features and question types are varied				✓	
	The app is easily accessible to students				✓	
	The effectiveness of using the Kahoot app					✓
	The practicality of using the Kahoot app					✓
	The features (buttons) of the Kahoot app are easy to understand					✓
Total Amount					46	
Percentage					92%	

Table 4 presents the results of media expert validation concerning the feasibility of the developed Kahoot application. The evaluation focused on visual appearance aspects, including overall interface design, color composition, layout, and graphic elements. The expert assessment indicated that the application interface was highly attractive and aesthetically well designed, receiving the highest possible score. An appealing visual design plays a critical role in enhancing students' attention, motivation, and engagement during learning activities, while also supporting intuitive navigation and reducing cognitive load. These findings demonstrate that the visual presentation of the Kahoot application effectively supports an interactive and enjoyable learning environment. In addition, the presentation of questions and answer options, as well as the quality of images used within the application, were evaluated. The media expert confirmed that the visual arrangement of questions and alternatives was engaging, clear, and easy to comprehend, thereby maintaining students' focus throughout the evaluation process. High quality images were also rated very positively, indicating that the visual materials were clear, sharp, and pedagogically supportive. Such visual clarity is essential in facilitating students' understanding of learning content and ensuring that multimedia elements enhance rather than distract from the learning process.

The validation further examined functional aspects of the application, including clarity of score display, usability in both face to face and online learning contexts, variation of question types, and ease of access for students. These indicators generally received very high scores, reflecting that the application effectively communicates assessment results, supports flexible learning modalities, and provides sufficient diversity in evaluation formats. Although minor improvements were suggested, particularly regarding accessibility and feature variation, the overall functionality of the application was considered highly appropriate for classroom implementation. Overall, the media expert validation yielded a total score of 46, with a feasibility percentage of 92 percent, categorizing the Kahoot application as highly feasible. This result confirms that the application demonstrates strong visual quality, functional effectiveness, practicality, and user friendliness. Collectively, these findings affirm that the developed Kahoot application is suitable for use as an interactive and efficient learning media to support cognitive evaluation in IPAS learning at the elementary school level.

Table 5. Linguist Validation

Component	Aspects Assessed	Score				
		1	2	3	4	5
Correct sentence structure	Sentences used comply with Indonesian language rules.				✓	
Sentence effectiveness	Language used is easily understood by students.					✓
Standard terminology	Language used is in accordance with the Big Indonesian Dictionary (KBBI).					✓
Level of understanding of information	Information in questions uses commonly used language for easy understanding by students.				✓	
Clear punctuation function	Appropriate punctuation is used.					✓
Ability to explain concepts	Language used effectively explains the intended concept.					✓
Suitability to student development	Language used is appropriate to the development of students.				✓	
Language usage rules	Questions should not use language that could offend ethnicity, religion, race, etc.				✓	
Good language skills	Questions should not contain offensive language that could cause discomfort to students.				✓	
Grammatical accuracy	Spelling should use Enhanced Spelling (EYD).				✓	
Total Amount					44	
Percentage					88%	

The language expert validation results indicate that the developed assessment instrument demonstrates a very high level of linguistic feasibility. Based on the validation presented in Table 5, the instrument obtained a total score of 44, corresponding to a feasibility percentage of 88 percent, which falls within the very feasible category. This overall score reflects strong compliance with linguistic standards and confirms that the language quality of the items is appropriate for

use in elementary school learning evaluation, particularly in supporting clarity, comprehension, and instructional effectiveness. From a structural and semantic perspective, the validation covered multiple linguistic aspects, including grammatical accuracy, readability, vocabulary standardization, and conceptual clarity. The expert evaluation showed that sentence structures generally conform to Indonesian grammatical rules and effectively convey intended meanings, although minor refinements could further enhance precision. The use of language was assessed as highly communicative and aligned with students' linguistic competence, ensuring that instructions and questions can be understood without causing cognitive overload. Furthermore, vocabulary usage was found to be consistent with the Indonesian Dictionary standards, and punctuation was applied correctly, which contributes to textual accuracy and readability.

Additional validation aspects focused on contextual appropriateness, ethical language use, and developmental suitability. The language employed was largely familiar and relevant to students' daily experiences, facilitating comprehension of question contexts. The instrument also demonstrated adequate sensitivity to ethical considerations, including neutrality toward ethnicity, religion, race, and social groups, as well as the use of polite and non-offensive expressions. Although several aspects received scores indicating room for minor improvement, the language expert confirmed that the items were generally aligned with students' cognitive and linguistic development levels and did not pose interpretative risks. Based on the language validation outcomes, the developed assessment instrument is considered suitable for implementation, with only minor revisions recommended, such as simplifying sentence structures, avoiding unfamiliar terminology, and enhancing clarity through supportive visuals. Following validation and revision, the implementation phase was conducted through limited and large-scale trials. A limited trial involved 10 fourth-grade students at SDN 012 Jempang, while a broader trial included 20 fourth-grade students at SD Negeri 010 Jempang, East Kalimantan. The implementation followed a pretest and posttest procedure integrated into the learning process on the topic *Cerita tentang Daerahku*, enabling the measurement of cognitive learning improvement after the application of the developed learning media.



Figure 4. Implementation of the pretest

Figure 4 shows the implementation of the pretest, which consisted of 20 multiple-choice questions on the theme "Stories about My Region." The questions were given on paper before students were introduced to the Kahoot application. After completing the pretest, the teacher provided learning materials using the fourth-grade science guidebook and media. After the teacher finished delivering the material in Chapter IV on "Stories about My Region," a posttest was conducted to determine learning outcomes after using the Kahoot application.



Figure 5. Implementation of the posttest

Figure 5 illustrates the implementation of the posttest using the Kahoot application, in which students completed a set of 20 multiple choice questions delivered digitally through the platform. The same set of questions, identical in content and format, was administered for both the pretest and posttest. The pretest was conducted prior to the treatment, while the posttest was administered after the learning intervention using Kahoot. This design introduces a potential memory effect, as students may recall previously encountered items when completing the posttest. However, any observed improvement in posttest scores can be interpreted as an interaction between prior exposure to the questions and the instructional treatment, indicating that students were able to better understand and process the material after engaging with the Kahoot based learning activities.

The evaluation of learning outcomes was conducted after the completion of both the trial class and the experimental class using the same procedural stages. Data collection began with the administration of the pretest, followed by the implementation of the Kahoot application as a learning and evaluation medium, and concluded with the posttest and a student response questionnaire. Changes between pretest and posttest scores served as indicators of improvement in students' cognitive learning outcomes, reflecting the effectiveness of the Kahoot based instructional media. In the limited trial phase, the product was tested with ten fourth grade students at SDN 012 Jempang, East Kalimantan. The effectiveness of the media in this phase was primarily assessed through students' response data after using the Kahoot application, providing initial empirical evidence of its feasibility and pedagogical impact.

The results of the student response questionnaire administered during the trial phase indicate that the use of Kahoot as an evaluation medium was perceived as highly effective. The percentage scores obtained from students' responses consistently fell within the very effective category, reflecting strong positive perceptions toward both the instructional media and the learning content. Students reported that the visual appearance, interactive features, and readability of the Kahoot-based quizzes enhanced their engagement and facilitated their understanding of IPAS material. These findings demonstrate that the developed Kahoot application successfully supported cognitive learning processes by creating an enjoyable, motivating, and accessible evaluation environment. Similarly, the effectiveness of Kahoot was further confirmed in the experimental class, where students completed both a cognitive learning outcomes test using Kahoot and a post-implementation response questionnaire. The overall results revealed very high effectiveness levels across media and content dimensions, including alignment with students' interests, clarity of language, relevance of test items to learning objectives, and increased motivation to complete evaluation tasks. Students also indicated improvements in conceptual understanding and perceived learning achievement after using Kahoot. Collectively, these results provide strong empirical evidence that the Kahoot application developed in this study is highly effective in enhancing students' cognitive learning outcomes in IPAS learning.

Table 6. Description of Student Pre-test and Post-test Score Data for the Experimental Class

Descriptive Statistics				
	Minimum	Maximum	Mean	St. Deviation
Pre test	45	90	68	12.711
Post test	80	100	88	7.847

Table 6 shows the descriptive results of the pre-test and post-test data for the experimental class. The minimum pre-test score was 45 and the maximum was 90, with a mean of 68 and a standard deviation of 12,711. Meanwhile, the minimum post-test score was 80 and the maximum was 100, with a mean of 88 and a standard deviation of 7,847. The students' test scores are presented in the table below.

Table 7. Pretest and Posttest Results of the Experimental Class

No.	Name	SCORE		Gain Score
		Pretest	Posttest	
1	RF	90	100	1.00
2	TR	80	100	1.00
3	JN	85	100	1.00
4	SM	80	90	0.50
5	AZ	80	90	0.50
6	MM	80	90	0.50
7	AO	75	95	0.80
8	AK	75	95	0.80
9	DA	65	95	0.86
10	SR	70	95	0.83
11	FN	65	85	0.57
12	KR	70	85	0.50
13	NJ	65	80	0.43
14	AI	55	80	0.56
15	EJ	65	80	0.43
16	FA	55	80	0.56
17	CY	50	80	0.60
18	MO	60	80	0.50
19	MH	50	80	0.60
20	VO	45	80	0.64
Total Score		1360	1760	13,18
Average Score		68	88	0.66

Table 7 presents the results of the large-scale trial 7 conducted with 20 fourth-grade students of SDN 010 Jempang, East Kalimantan, which demonstrates a substantial improvement in students' cognitive learning outcomes following the implementation of the Kahoot-based evaluation media. The pretest scores ranged from 45 to 90 with a total score of 1360 and a mean score of 68, whereas the posttest scores increased markedly, ranging from 80 to 100 with a total score of 1760 and a mean score of 88, indicating a significant enhancement in students' academic performance after the treatment. To assess the effectiveness of the developed product, data analysis was conducted using both percentage calculations and the normalized gain score, which yielded a value of 0.66 and was classified within the medium effectiveness category, signifying that the Kahoot application was sufficiently effective and appropriate for instructional use. Furthermore, the evaluation of the developed media was strengthened by qualitative data obtained from teacher responses, which revealed

that the Kahoot application was perceived as highly attractive, visually engaging, and interactive, thereby increasing students' enthusiasm and focus during learning activities. The clarity of usage instructions, the application of bright and contrasting colors, and the overall user-friendly interface were considered to facilitate students' comprehension of questions and answer options, leading to improved cognitive learning outcomes. Consequently, the Kahoot application was regarded as highly recommended for use as an effective tool for evaluating students' cognitive achievement in classroom learning contexts.

3.2. DISCUSSIONS

3.2.1. Validity of Kahoot Application Product

Based on expert validation involving media, content, and language specialists, the developed Kahoot application was classified as highly feasible for use as an educational evaluation medium. The subject matter expert confirmed that the test items were conceptually aligned with learning objectives, clearly constructed, and capable of supporting students cognitive understanding. The media expert emphasized that the application met the results of the prior needs analysis, particularly the demand for technology integrated and digitally based evaluation tools in elementary education. Furthermore, the language expert verified that the language used in the IPAS questions was clear, simple, age appropriate for elementary school students, and characterized by well structured sentences and easily understood vocabulary.

These findings indicate that the Kahoot application can be recommended for implementation, particularly in fourth grade classrooms at SDN 010 and SDN 012 Jempang, East Kalimantan. The empirical comparison between learning conditions before and after the use of Kahoot demonstrated a measurable improvement in students cognitive learning outcomes. This improvement suggests that the application functions not only as an assessment tool but also as an instructional medium that supports meaningful learning and reinforces cognitive development during the learning process. Prior to the implementation of Kahoot, students exhibited low learning enthusiasm and several learners achieved scores below the Minimum Mastery Criteria. This condition was largely attributed to the dominance of conventional teaching methods, such as lecture based instruction, which limited student interaction and resulted in passive learning behaviors. Such approaches were insufficient to stimulate deeper cognitive engagement. After the introduction of the Kahoot application, students showed increased enjoyment and focus, supported by visually appealing design elements, clear usage instructions, and the use of time limits that encouraged concentration and active participation during evaluation activities.

The results of this study are consistent with previous research. Ulfaria (2021) reported that the use of the Kahoot application as an evaluation medium in junior high school social studies achieved expert validity scores of 91.4 percent for material validation and 96 percent for media validation, both categorized as very valid. Similarly, Irawan and Latifah (2023) found that Kahoot represents an educational innovation that facilitates teachers assessment of elementary school students cognitive problem solving abilities while fostering an enjoyable learning environment that promotes critical thinking. These findings collectively reinforce the effectiveness and pedagogical relevance of Kahoot as a technology based evaluation medium in basic education.

3.2.2. Practicality of Kahoot Application Products

Based on media expert validation results, the developed Kahoot application was categorized as highly feasible and practical for instructional use. The media validator confirmed that the application aligned well with the prior needs analysis, which emphasized the necessity for technology integrated and digital learning media in elementary education. The practicality aspect assessed by the media expert indicated that the Kahoot application demonstrated excellent usability, particularly in terms of accessibility, operational simplicity, and functional clarity. These findings suggest that the application fulfills essential criteria for effective digital learning media in classroom contexts.

The Kahoot application was considered practical because it could be easily accessed by students, functioned effectively during learning activities, and provided intuitive features that were readily understood by users. As a result, the application significantly supported the learning process, especially for fourth grade students at SDN 010 and SDN 012 Jempang, East Kalimantan. Improvements in cognitive learning outcomes before and after the use of Kahoot further reinforced its instructional value. In addition, students displayed high levels of enthusiasm and active engagement when interacting with the application, indicating that its design and interactivity positively influenced student participation. These findings are partially consistent with previous research conducted by Iskandar et al. (2024), who reported that the practicality test of the Kahoot application fell within the fairly practical category with a score of 3.80. Their Mann Whitney test results showed an Asymp. Sig. (2 tailed) value of 0.068, indicating no significant difference between assessments conducted using Kahoot and Google Form. However, the study emphasized that Kahoot is effective when supported by strong internet connectivity. In contrast, Bahri and Asnidar et al. (2024) found significantly higher practicality outcomes, reporting an average score of 100 from teachers and very high practicality ratings from 90 students, categorizing the application as very practical for learning media use.

Further supporting evidence is provided by Hartono (2022), whose study revealed that the practicality level of Kahoot as an evaluation medium reached 81.1 percent, while student assessments yielded a practicality score of 81.5 percent, both categorized as very practical. Similarly, Fahrurrozi and Rahmawati (2021) concluded that the development of evaluation instruments using Kahoot was practical across multiple indicators, including attractiveness at 79 percent categorized as

good, content quality at 83 percent categorized as very good, language at 84 percent categorized as very good, and ease of use at 83 percent categorized as very good. Large scale student response analysis yielded an average score of 82 percent with very good criteria. Collectively, these studies substantiate the conclusion that the Kahoot application demonstrates strong practicality and pedagogical relevance as a digital evaluation medium in elementary education.

3.2.3. Effectiveness of Kahoot Application Products

Based on the calculation of student response questionnaires and learning outcome data from both limited and large scale trials, a clear improvement was observed before and after the implementation of the Kahoot application, as evidenced by the comparison of pretest and posttest scores. The percentage results of student response questionnaires indicated that the use of Kahoot in both trials was classified as very effective. Beyond mean score comparisons, the effectiveness of the Kahoot media was further confirmed through the normalized gain score analysis, which yielded a value of 0.66 and fell within the moderate category according to Safitri et al. (2020). This result indicates that the developed media can be considered sufficiently effective and appropriate for use in instructional activities.

Prior to the use of the Kahoot application, test administration was conducted manually and tended to be monotonous, resulting in student boredom, reduced focus, low enthusiasm, and suboptimal cognitive learning outcomes. Several students achieved scores below the Minimum Mastery Criteria for IPAS at SD Negeri 010 Jempang. After the implementation of Kahoot, students demonstrated improved cognitive achievement. This finding was supported by interviews with the fourth grade teacher at SD Negeri 010 Jempang, who stated that Kahoot enhances students cognitive learning outcomes by integrating game elements into the learning process, thereby increasing focus, enthusiasm, and motivation to learn. The Kahoot application was found to be particularly suitable for evaluating students cognitive learning outcomes, especially in measuring basic understanding and recall. Its interactive format enables students to respond to questions quickly and provides a more engaging assessment experience. However, for evaluating higher level conceptual understanding and complex reasoning skills, other assessment methods that emphasize open ended or descriptive responses may be more appropriate to complement the use of Kahoot. The findings of this study are consistent with previous research. Ulfaria (2021) reported that the effectiveness level of Kahoot as an evaluation medium in junior high school social studies reached 84 percent based on teacher assessments and 90.9 percent based on student responses, both categorized as very effective. Furthermore, Irwan et al. (2019) demonstrated that Kahoot, as a modified game based learning medium, effectively improves instructional effectiveness and positively impacts students learning outcomes. These studies reinforce the conclusion that Kahoot is an effective digital evaluation medium capable of enhancing cognitive learning achievement.

4. CONCLUSION

This study concludes that the developed Kahoot application is highly feasible, practical, and effective as a digital evaluation medium for fourth grade IPAS learning. Expert validation results indicate that the application meets high standards in terms of content accuracy, media design, and language suitability, confirming its appropriateness for elementary school students. From a usability perspective, the application is easy to access, simple to operate, and supported by clear features that facilitate its implementation in classroom learning. Furthermore, the effectiveness analysis demonstrates that the use of the Kahoot application leads to an improvement in students cognitive learning outcomes. This is evidenced by the increase in average pretest and posttest scores and a gain score categorized as moderate, indicating meaningful learning improvement. Overall, the findings show that the Kahoot application is capable of supporting cognitive evaluation and enhancing student engagement in IPAS learning for fourth grade students at SDN 010 Jempang, East Kalimantan.

RECOMMENDATIONS

Schools are encouraged to strengthen digital learning infrastructure and provide continuous support, including training programs, to enhance teachers competencies in utilizing technology based learning media. Teachers are advised to integrate the Kahoot application more intensively into IPAS instruction as an alternative evaluation tool that promotes interactive and enjoyable learning experiences. Students are expected to actively participate in learning activities and make optimal use of digital media to support their understanding and cognitive development. Future researchers are recommended to expand the development of similar digital evaluation media for different subject areas, include additional learning variables, and apply the innovation across broader educational levels and research settings.

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AUTHOR'S CONTRIBUTIONS

Renita was responsible for the overall conception and design of the study, development of the Kahoot application, data collection, data analysis, and interpretation of the results. Renita also drafted and revised the manuscript and served as the corresponding author. Suciati contributed to the supervision of the research process, provided academic guidance, and reviewed the methodological and analytical aspects of the study. Suhartono contributed to the conceptual refinement of the study, provided critical feedback on the research design and findings, and assisted in reviewing and improving the final manuscript. All authors discussed the results and contributed to the preparation and approval of the final manuscript.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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