BIO EDUCATIO
(*The Journal of Science and Biology Education*)
http: https://jurnal.unma.ac.id/index.php/BE
p-ISSN : 2541-2280
e-ISSN : 2541-4097
DOI: http://doi.org/10.31949/be.v10i2.17966

Development of KuPin Interactive Media Using the ADDIE Model to Enhance Elementary Students' Learning Motivation in Integrated Science

Tia Latifatu Sadiah[1],[2]*, Maman Fathurrohman[3], Suroso Mukti Leksono[4], Yulistina Nur DS[5], Yudi Firmansyah[6]
[1] Universitas Buana Perjuangan Karawang, Indonesia
[2] Doctoral Program in Education, Graduate School, Universitas Sultan Ageng Tirtayasa, Indonesia
[3] Doctoral Program in Education, Graduate School, Universitas Sultan Ageng Tirtayasa, Indonesia
[4] Doctoral Program in Education, Graduate School, Universitas Sultan Ageng Tirtayasa, Indonesia
[5] Universitas Buana Perjuangan Karawang, Indonesia
[6] Universitas Buana Perjuangan Karawang, Indonesia
Corresponding Author: 7782220004@untirta.ac.id

Article Info
Article History
Received: 25-08-2025
Revised: 18-09-2025
Accepted: 20-09-2025

Keywords:
Interactive Learning Media;
Learning Motivation;
ADDIE Model;
Elementary Education;
Integrated Science (IPAS);
Student Engagement

ABSTRACT
This study aims to develop and evaluate an interactive learning media, KuPin (Kucing Pintar), to enhance elementary students' learning motivation in integrated science (IPAS). The study employed a Research and Development (R&D) approach using the ADDIE model, which includes analysis, design, development, implementation, and evaluation stages. The product was tested in two different elementary school contexts involving students, teachers, and expert validators. Data were collected using validation sheets, student response questionnaires, motivation questionnaires, and observation sheets, and analyzed using descriptive and inferential statistics. The results indicate that KuPin achieved a high level of validity, with expert validation scores ranging from 84% to 86% (very valid). The practicality results show that the media is easy to use, efficient, and well accepted by students, categorized as practical to very practical. In terms of effectiveness, although the statistical test showed no significant difference in motivation between groups ($p > 0.05$), observational findings revealed increased student engagement, attention, and participation during learning activities. These findings suggest that KuPin provides consistent motivational support across different learning contexts. This study concludes that KuPin is a valid, practical, and context-adaptive interactive learning media that contributes to enhancing students' motivation and supports student-centered learning in elementary education.

INTRODUCTION

Education plays a fundamental role in developing human potential and improving the quality of life. In Indonesia, educational transformation continues through the implementation of the *Merdeka Curriculum*, which emphasizes student-centered learning, contextual understanding, and the strengthening of the *Profil Pelajar Pancasila*. This curriculum promotes integrated learning approaches, including the combination of science and social studies into *Ilmu Pengetahuan Alam dan Sosial* (IPAS), aimed at fostering holistic and meaningful understanding among elementary school

students. However, the implementation of integrated science learning still faces conceptual and practical challenges, particularly in aligning instructional practices with curriculum expectations and students' developmental characteristics (Winarno et al., 2020; Marthawati & Setyo, 2024).

At the elementary level, students are in the concrete operational stage, requiring learning experiences that connect abstract concepts with real-world contexts. Nevertheless, classroom practices remain largely teacher-centered, relying on textbooks and conventional instructional methods. Such conditions limit students' active engagement and reduce their motivation to learn. Previous studies indicate that low learning motivation is closely associated with passive learning environments and limited instructional innovation (Lin et al., 2017). In contrast, research has shown that the use of interactive and digital learning environments can significantly enhance students' motivation and learning outcomes by promoting active participation and meaningful engagement (Sahronih et al., 2019; Schindler et al., 2017).

Learning motivation is a key determinant of students' academic success. From the perspective of *Self-Determination Theory*, motivation is driven by the fulfillment of three basic psychological needs: autonomy, competence, and relatedness (Ryan & Deci, 2023; Adams et al., 2017). When learning environments support these needs, students are more likely to develop intrinsic motivation and sustained engagement. Autonomy-supportive learning environments enable students to take control of their learning process, which has been shown to positively influence both academic achievement and psychological well-being (Vasquez et al., 2016; Haerens et al., 2018). Furthermore, student engagement, as a multidimensional construct, plays a crucial role in mediating the relationship between instructional strategies and learning outcomes (Wong & Liem, 2022).

In addition, the *Cognitive Theory of Multimedia Learning* emphasizes that students learn more effectively when information is presented through a combination of visual and verbal representations. Interactive multimedia environments facilitate deeper cognitive processing by reducing cognitive load and enhancing conceptual understanding (Mayer, 2024). The integration of technology in learning environments has also been shown to increase engagement and motivation, particularly when supported by features such as interactivity, feedback, and learner control (Alenezi, 2023). This aligns with findings that computer-based and digital learning tools significantly contribute to improving student engagement and learning effectiveness (Schindler et al., 2017).

Despite these advantages, the integration of interactive digital media in elementary education remains limited. Many schools still face constraints related to infrastructure, teacher readiness, and the availability of pedagogically appropriate digital learning tools. This gap is particularly evident in nature-based learning environments, where experiential learning is emphasized but often lacks technological support to enhance conceptual understanding (Jordan & Chawla, 2019; Mann et al., 2021). While nature-based learning has been proven to improve cognitive and affective development, its integration with digital interactive media remains underexplored. To address these challenges, this study develops an interactive learning media called KuPin (Kucing Pintar), designed to support IPAS learning in elementary schools. The media integrates interactive features, visual representations, and formative assessments to create an engaging learning environment. The design is grounded in multimedia learning principles and motivation theory, aiming to enhance students' autonomy, competence, and engagement. Previous

studies have demonstrated that interactive learning media can significantly improve students' competencies and learning outcomes, reinforcing the importance of developing technology-based instructional tools (Damarwan & Khairudin, 2017; Sahronih et al., 2019).

This study adopts a Research and Development (R&D) approach using the ADDIE model, which consists of analysis, design, development, implementation, and evaluation stages. The ADDIE model provides a systematic framework for developing effective instructional media and has been widely recognized for its ability to improve teaching and learning processes through structured design and evaluation (Adeoye et al., 2024; Zou et al., 2024). Through this approach, the developed media is evaluated in terms of its validity, practicality, and effectiveness in real classroom settings. Therefore, the objectives of this study are: (1) to develop KuPin interactive learning media using the ADDIE model for IPAS learning in elementary schools; (2) to evaluate its validity and practicality through expert validation and user responses; and (3) to examine its effectiveness in enhancing students' learning motivation. By integrating theoretical foundations, instructional design principles, and empirical evaluation, this study contributes to the development of innovative digital learning media that support meaningful and engaging learning in the context of the *Merdeka Curriculum*.

METHOD

Research Design

This study employed a Research and Development (R&D) approach aimed at producing and evaluating an interactive learning media, namely KuPin (Kucing Pintar), to enhance students' learning motivation in integrated science (IPAS) at the elementary level. The development process followed the ADDIE model, which consists of five systematic stages: analysis, design, development, implementation, and evaluation. This model was selected because it provides a structured and iterative framework that ensures the developed product is theoretically grounded and empirically validated (Adeoye et al., 2024; Zou et al., 2024). Through this approach, the study not only focuses on product development but also evaluates its quality in terms of validity, practicality, and effectiveness.

Research Setting and Participants

The study was conducted in two different elementary school contexts, namely SDN Wadas I Karawang and Sekolah Alam Amani. These settings were purposively selected to represent both conventional and nature-based learning environments, allowing the researcher to examine the adaptability of the developed media. The participants consisted of Grade V students aged 10–11 years, IPAS teachers, and three expert validators comprising a media expert, a subject matter expert, and an information technology expert. The selection of participants was based on purposive sampling, considering their relevance to the research objectives and their involvement in the implementation of IPAS learning.

Development Procedure

The development of KuPin followed the ADDIE model, which includes five interconnected stages. In the analysis stage, data were collected through classroom observations, interviews with teachers and students, and curriculum document analysis to identify learning needs and existing problems. The findings revealed limited use of interactive media, low student motivation, and difficulties in understanding abstract IPAS concepts. In the design stage, the

structure and features of KuPin were systematically planned based on IPAS learning objectives, multimedia learning principles, and motivational aspects derived from Self-Determination Theory. This stage included the development of storyboards, interface layouts, and instructional flow consisting of introduction, content delivery, interactive exercises, and feedback mechanisms.

The development stage involved the creation of KuPin using a digital platform with chatbot-based interaction. The media integrated visual elements, animations, videos, and interactive quizzes with immediate feedback. After development, the product underwent expert validation to ensure its content accuracy, design quality, and technical functionality. The implementation stage was conducted through both small-scale (limited) and large-scale (field) trials. During this phase, students directly interacted with the KuPin media in IPAS learning activities. Finally, the evaluation stage was carried out to assess the overall quality of the product, including its validity, practicality, and effectiveness, through both formative and summative evaluation processes.

Table 1. ADDIE Development Stages

Stage	Description
Analysis	Identification of learning problems, student needs, and curriculum requirements
Design	Development of storyboard, interface design, and learning structure
Development	Creation of KuPin media and expert validation
Implementation	Trial in classroom settings (small and large scale)
Evaluation	Assessment of validity, practicality, and effectiveness

Instruments

Several research instruments were used to collect data in this study. Validation sheets were used by experts to assess the feasibility of the developed media based on content, design, and technical aspects using a Likert scale. A student response questionnaire was administered to evaluate the practicality of the media and students' perceptions after using KuPin. In addition, a learning motivation questionnaire was used to measure students' motivation based on indicators such as attention, relevance, confidence, and satisfaction. An observation sheet was also used to document student engagement during the implementation process.

Table 2. Research Instruments

Instrument	Purpose	Respondents
Validation Sheet	Assess validity of media	Experts (media, material, IT)
Student Response Questionnaire	Measure practicality	Students
Motivation Questionnaire	Measure learning motivation	Students
Observation Sheet	Observe engagement	Researcher

Data Analysis Techniques

The collected data were analyzed using both descriptive and inferential techniques. Validity data from expert judgment were converted into percentage scores and categorized into levels of

feasibility. Practicality data from student responses were analyzed descriptively to determine the ease of use and acceptance of the media. Effectiveness was evaluated by comparing students' motivation scores and supported by statistical tests. Instrument reliability was tested using Cronbach's Alpha, with a coefficient greater than 0.60 indicating acceptable reliability. Furthermore, the assumption tests included the Shapiro–Wilk test for normality and Levene's test for homogeneity. These analyses were conducted using JASP software to ensure the accuracy and reliability of the statistical results.

Table 3. Data Analysis Criteria

Aspect	Technique	Criteria
Validity	Percentage	≥81% = Very Valid
Practicality	Descriptive (%)	High = Practical
Reliability	Cronbach's Alpha	>0.60 = Reliable
Normality	Shapiro–Wilk	$p > 0.05$ = Normal
Homogeneity	Levene's Test	$p > 0.05$ = Homogeneous

Ethical Considerations

This study adhered to ethical research standards by ensuring that all participants were informed about the research objectives and procedures. Participation was voluntary, and confidentiality was maintained by anonymizing all collected data. The study also ensured that the use of digital media did not disrupt the normal learning process but rather supported instructional activities.

RESULTS

This section presents the results of the development and evaluation of the KuPin interactive learning media using the ADDIE model, which includes analysis, design, development, implementation, and evaluation stages. The findings are organized according to the product quality criteria, namely validity, practicality, and effectiveness.

Needs Analysis

The analysis stage revealed that IPAS learning in both SDN Wadas I Karawang and Sekolah Alam Amani was still dominated by conventional teaching methods, with limited use of interactive learning media. Instructional resources were primarily limited to textbooks and static visual aids, which were insufficient to support students' understanding of abstract concepts such as light, sound, ecosystems, and electricity. As a result, students experienced difficulties in conceptualizing dynamic scientific processes, leading to surface-level learning characterized by memorization rather than deep understanding. Further analysis through observations, interviews, and questionnaire data indicated a significant gap between the expectations of the Merdeka Curriculum and actual classroom practices, particularly in terms of interactive and student-centered learning. This finding confirms the need for developing an interactive learning medium that is capable of enhancing students' motivation and engagement.

Design and Development of KuPin Media

Based on the identified needs, KuPin was designed as an interactive learning medium that integrates structured learning pathways, including introduction, conceptual understanding, interactive exercises, and feedback. Unlike conventional digital materials, KuPin was developed as an interactive system that facilitates two-way communication between users and the media. The design incorporates multimedia learning principles, such as the integration of text, visuals, and audio, as well as progressive information delivery to reduce cognitive overload. In addition, motivational elements such as autonomy (user control), competence (feedback and scoring), and engagement (interactive features) were embedded in the system.

Table 4. Storyboard of KuPin Interactive Media

Figure	Description
Access Page	
	The initial page used to access the KuPin link via a web browser (Google Chrome/Mozilla Firefox). The underlying principle is to build initial arousal motivation and create a positive first impression.
Introduction Page	
	After accessing the link, users click "START" to proceed to the introduction page. This stage emphasizes learner autonomy by giving students control, aligned with Self-Determination Theory (Deci & Ryan), which focuses on intrinsic motivation.
Name Input	After clicking "START," KuPin asks users to input their name. This personalization enhances emotional engagement and makes students feel valued as individuals.

Greeting Page

After entering their name, KuPin greets the user personally and directs them to the main menu. This stage is grounded in the humanistic approach, emphasizing emotional connection in learning.

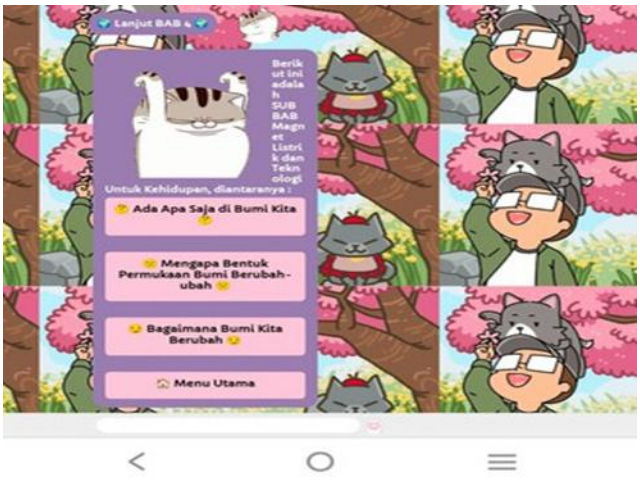
Main Menu

Students select the material they want to learn. This reflects student-centered learning, where learners choose according to their interests, thereby increasing motivation.

"Getting to Know Our Earth"

One of the learning topics in KuPin, where students can select subtopics related to Earth. This stage is based on contextual learning, connecting science concepts to real-life experiences.

Subtopic Page



Students navigate to specific subtopics by selecting "Continue Chapter." This stage applies scaffolding, supporting structured and gradual knowledge acquisition.

Learning Content

Students explore specific content and can watch videos. This stage applies multimodal learning (visual and audio) to facilitate understanding of abstract scientific concepts.

Main Menu Button

After completing the material, students return to the main menu to access exercises. This supports self-regulated learning, encouraging independent and reflective learning.

Exercise Menu

Students select the "Exercise" option to begin answering questions. This stage emphasizes formative evaluation to reinforce conceptual understanding.

Quiz Activity

Students answer multiple-choice questions and receive immediate feedback. This stage is based on positive reinforcement (Operant Conditioning), enhancing students' confidence.

Correct Answer

When students answer correctly, they proceed to the next question. This stage supports a growth mindset by reducing fear of failure.

Next Question

Students continue to the next question, promoting reflection on their learning progress.

Incorrect Answer

If students answer incorrectly, they can still proceed to the next question. This stage encourages self-evaluation and continuous improvement.

Final Question

Students complete the last question and proceed to view their results. This stage reinforces reflective learning.

Result Page

Displays students' scores after completing the quiz. This stage supports self-evaluation and encourages continuous learning improvement.

The storyboard illustrates the sequential learning experience provided by KuPin, starting from initial interaction, personalization, navigation, content exploration, and formative assessment. Each stage is designed to support students' active engagement and motivation through interactive and meaningful learning experiences.

Validity of KuPin Media

The validity of the KuPin interactive learning media was evaluated to determine its feasibility prior to implementation in classroom settings. This process involved three expert validators consisting of a media expert, a material expert, and an information technology (IT) expert. Each expert assessed the product based on specific criteria, including design quality, content accuracy, and technical functionality. The validation results were then converted into percentage scores and categorized according to predefined feasibility criteria.

Table 5. Expert Validation Results of KuPin Media

Aspect Evaluated	Expert Type	Score (%)	Category	Key Suggestions
Media Design	Media Expert	84%	Very Valid	Improve interactivity and reduce dependency on internet access
Content Accuracy	Material Expert	86%	Very Valid	Add more contextual examples and refine scientific terminology
Technical Functionality	IT Expert	86%	Very Valid	Enhance interface design and improve accessibility features

The validation results indicate that the KuPin media achieved consistently high scores across all aspects, ranging from 84% to 86%, which fall into the *very valid* category. This consistency suggests that the developed media has met the essential requirements of instructional quality, covering pedagogical, technical, and design dimensions. The media design aspect, with a score of 84%, reflects that KuPin has successfully incorporated interactive elements that support student engagement. However, the expert feedback highlights the need for further enhancement of interactivity and reduced dependence on internet connectivity. This suggests that while the media is already functional, improving offline accessibility could increase its usability in varied educational contexts. The material aspect obtained the highest score (86%), indicating strong alignment with curriculum standards and learning objectives. The recommendations provided emphasize the importance of enriching contextual examples and refining scientific terminology, which are crucial for supporting students' conceptual understanding, particularly at the elementary level.

Similarly, the technical aspect also achieved a score of 86%, confirming that the system is operationally reliable and suitable for classroom use. The suggested improvements in interface design and accessibility indicate that enhancing user experience remains an important consideration, especially to ensure inclusivity for all learners. Overall, these findings confirm that KuPin has successfully passed the validation stage and can be categorized as a highly feasible instructional medium. The relatively minor revisions suggested by experts reflect the iterative nature of the ADDIE model, where continuous refinement is essential to optimize the quality and effectiveness of the developed product.

Practicality of KuPin Media

The practicality of KuPin was evaluated through both small-scale and large-scale implementation trials involving elementary school students. This assessment aimed to determine the ease of use, efficiency, and user acceptance of the developed media in real classroom settings. Data were collected through student response questionnaires and observations during the implementation process.

Table 6. Practicality Results of KuPin Media

Aspect	Indicator	Result	Category
Ease of Use	Navigation and operation	High	Practical
Efficiency	Time effectiveness in learning	High	Practical
User Acceptance	Student engagement and response	Very High	Very Practical

Analytical Interpretation

The practicality results indicate that KuPin falls within the *practical to very practical* category across all evaluated aspects. Students were able to navigate the system independently, suggesting that the interface design is intuitive and user-friendly. The high efficiency score reflects that the media supports learning activities without causing additional cognitive or technical burden. Moreover, the strong user acceptance highlights that students were actively engaged and showed positive responses toward the learning experience. This suggests that KuPin not only meets usability standards but also aligns with students' learning preferences. Overall, these findings confirm that the developed media is operationally feasible and can be effectively implemented in elementary classroom contexts.

Effectiveness of KuPin Media

The effectiveness of KuPin was evaluated based on students' learning motivation, supported by statistical analysis and observational data. This stage aimed to determine whether the developed media contributes to improved learning engagement and motivation among students.

Instrument Reliability

Prior to hypothesis testing, the reliability of the research instruments was examined to ensure the consistency of the data collected.

Table 7. Reliability Test Results

Instrument	Value Estimate	α Coefficient
Motivation Instrument	0.9333	0.05
KuPin Response Instrument	0.927	0.05

The reliability analysis shows that both instruments achieved Cronbach's Alpha values above 0.90, which are categorized as *very high reliability*. This indicates that the instruments have strong internal consistency and are highly reliable for measuring students' motivation and responses. Consequently, the data generated from these instruments can be considered accurate and dependable for further analysis.

Normality Test

The normality test was conducted using the Shapiro–Wilk method to determine whether the data distribution met the assumptions required for parametric statistical analysis.

Table 8. Normality Test Results

Variable	p-value (Shapiro–Wilk)
KuPin Response	0.459
Motivation	0.506

The results indicate that all p-values are greater than 0.05, confirming that the data are normally distributed. This fulfills the assumption of normality and allows the use of parametric statistical tests in further analysis.

Homogeneity Test

The homogeneity test was conducted using Levene's Test to determine whether the variance between groups was equal.

Table 9. Homogeneity Test Results

Variable	F	p-value
Motivation	0.311	0.579

The homogeneity test results show a p-value greater than 0.05, indicating that the data are homogeneous. This confirms that the variance between groups is equal, satisfying another important assumption for parametric testing.

Hypothesis Testing

The effectiveness of KuPin was further analyzed using an Independent Samples T-test to compare students' motivation across different school contexts.

Table 4.13 Hypothesis Test Results

Test	Variable	p-value
Independent T-test	Motivation	0.580

The hypothesis testing results indicate that the p-value (0.580) is greater than the significance level of 0.05, suggesting that there is no statistically significant difference in students' motivation between the two schools. However, this finding does not imply that the media is ineffective. Instead, it demonstrates that KuPin provides a consistent level of motivational support across different learning environments. This consistency indicates that the media is adaptable and stable, functioning effectively regardless of variations in school context. Furthermore, observational data revealed increased student enthusiasm, attention, and participation during the learning process, reinforcing the conclusion that KuPin contributes positively to students' learning motivation in practical settings.

DISCUSSION

The findings of this study demonstrate that the development of KuPin as an interactive learning media has successfully met the key criteria of instructional product quality, namely validity,

practicality, and effectiveness. These results confirm that a systematically designed digital learning medium can support meaningful learning experiences in elementary integrated science (IPAS). From the perspective of validity, the high scores obtained across media, material, and IT aspects indicate that KuPin fulfills essential standards of instructional feasibility. This finding is consistent with previous studies emphasizing that the validity of educational media reflects the alignment between pedagogical design, content accuracy, and technological functionality (Siahaan et al., 2023). The minor revisions suggested by experts further highlight that the development process follows an iterative refinement cycle, which is a core characteristic of the ADDIE model in producing high-quality instructional products (Spatioti et al., 2022). Thus, validity in this study is not merely an evaluation outcome but also a quality assurance mechanism ensuring that the developed media is ready for practical application.

The practicality results indicate that KuPin is easy to use, efficient, and well-accepted by students, which reflects its usability in real classroom settings. Students' ability to independently navigate the system and complete learning tasks suggests that the media design successfully supports intuitive interaction and minimizes cognitive load. This aligns with findings that interactive digital learning environments enhance usability and engagement when designed with user-centered principles (Muir et al., 2022). Furthermore, high student engagement observed during implementation supports the argument that interactive pedagogical approaches can significantly increase students' participation and involvement in learning processes (Li & Xue, 2023). Therefore, the practicality of KuPin demonstrates that the media is not only theoretically appropriate but also operationally effective in facilitating classroom learning.

In terms of effectiveness, the findings reveal that although there was no statistically significant difference in motivation between the two school contexts ($p > 0.05$), students demonstrated increased enthusiasm, attention, and participation during learning activities. This suggests that the effectiveness of KuPin lies in its ability to sustain a consistently positive learning experience rather than producing differential outcomes. This interpretation is supported by research indicating that learning motivation is a dynamic construct influenced by the interaction between learners and their learning environment (Edu et al., 2021; Ojo et al., 2024).

From a theoretical perspective, the effectiveness of KuPin can be explained through the lens of Self-Determination Theory (SDT). The integration of interactive features, learner control, and immediate feedback supports students' autonomy, competence, and engagement, which are key drivers of intrinsic motivation (Chiu, 2022, 2023). This is consistent with studies showing that digital learning environments that fulfill psychological needs significantly enhance student engagement and motivation (Ojo et al., 2024). Additionally, the presence of reinforcement mechanisms such as instant feedback aligns with behavioral learning principles that contribute to increased motivation and persistence in learning tasks (Attakhidijah, 2022).

Moreover, the use of multimedia elements in KuPin, such as visuals, animations, and interactive quizzes, supports students' conceptual understanding and engagement. Previous studies have demonstrated that interactive multimedia learning significantly improves learning effectiveness and students' ability to understand abstract concepts in science (Islamyati & Manuaba, 2021; Sekarwangi et al., 2021). Similarly, game-based and interactive media have been found to enhance learning effectiveness by creating enjoyable and engaging learning environments

(Azizah et al., 2022). The integration of such features in KuPin indicates that the media successfully combines cognitive and affective learning dimensions.

The findings also suggest that KuPin has a stable and adaptable impact across different learning contexts, including both conventional and nature-based schools. This indicates that the media possesses contextual flexibility, which is an important characteristic of effective instructional tools. Similar findings have been reported in studies on interactive learning media development, where adaptability across different learning environments contributes to the overall effectiveness of the media (Daryanes et al., 2023).

However, this study also identifies several limitations. The reliance on internet-based access may limit usability in low-resource settings, and the current evaluation focuses primarily on motivation rather than broader learning outcomes such as critical thinking or problem-solving skills. Future research should explore these aspects to provide a more comprehensive understanding of the impact of interactive learning media. This study contributes to the field of educational technology by demonstrating that interactive digital media developed through a systematic model such as ADDIE can achieve high validity, practicality, and consistent effectiveness. More importantly, the findings emphasize that the success of instructional media lies not only in technological sophistication but also in its ability to integrate pedagogical theory, learner needs, and contextual relevance into a cohesive learning experience.

CONCLUSION

This study aimed to develop and evaluate the KuPin interactive learning media using the ADDIE model to enhance elementary students' learning motivation in integrated science (IPAS). The findings demonstrate that KuPin has successfully met the essential criteria of instructional product quality, namely validity, practicality, and effectiveness. From the validation results, KuPin was categorized as *very valid*, indicating that the media is pedagogically appropriate, technically feasible, and aligned with curriculum standards. The practicality findings further confirm that the media is easy to use, efficient, and well-accepted by students, reflecting its applicability in real classroom contexts. In terms of effectiveness, although no statistically significant difference was found between groups, the media demonstrated a consistent ability to support students' motivation, engagement, and participation during learning activities. These findings suggest that the effectiveness of KuPin lies not in producing differential outcomes across contexts but in its ability to maintain a stable and positive learning experience. Therefore, this study contributes to the understanding that interactive digital learning media can function as a *context-adaptive instructional tool*, capable of supporting student motivation across diverse educational environments.

ADDITIONAL INFORMATION

Section	Description
Funding	This research received no external funding.
Conflict of Interest	The authors declare no conflict of interest.
Author Contributions	All authors contributed to this study. The first author led conceptualization, methodology, analysis, and drafting. The second author supported validation,

	analysis, and review. The third author supervised and revised the manuscript. All authors approved the final version.
Data Availability	Data are available from the corresponding author upon reasonable request.
Ethical Approval	The study followed ethical standards. Participation was voluntary, and data were collected anonymously.
AI Usage Statement	AI tools were used only for language editing. All scientific work and conclusions were conducted by the authors.

REFERENCES

Adams, N., Little, T. D., & Ryan, R. M. (2017). Self-determination theory. In M. Wehmeyer, K. Shogren, T. Little, & S. Lopez (Eds.), *Development of self-determination through the life-course* (pp. 47–54). Springer. https://doi.org/10.1007/978-94-024-1042-6_4

Adeoye, M. A., Wirawan, K. A. S. I., Pradnyani, M. S. S., & Septiarini, N. I. (2024). Revolutionizing education: Unleashing the power of the ADDIE model for effective teaching and learning. *Jurnal Pendidikan Indonesia, 13*(1), 202–209. https://doi.org/10.23887/jpiundiksha.v13i1.68624

Alenezi, M. (2023). Digital learning and digital institution in higher education. *Education Sciences, 13*(1), 88. https://doi.org/10.3390/educsci13010088

Attakhidijah, S. (2022). The effect of discipline and learning motivation on student learning outcomes in elementary schools. *Jurnal Ilmiah Sekolah Dasar, 6*(3), 494–500. https://doi.org/10.23887/jisd.v6i3.49806

Azizah, S., Widjanarko, M., Darmanto, E., & Pratama, H. (2022). Interactive learning media 2D educational game to improve learning effectiveness in kindergarten students. *ICCCM Journal of Social Sciences and Humanities, 1*(1), 23–28. https://doi.org/10.53797/icccmjssh.v1i1.4.2022

Chiu, T. K. F. (2022). Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *Journal of Research on Technology in Education, 54*(Suppl. 1), S14–S30. https://doi.org/10.1080/15391523.2021.1891998

Chiu, T. K. F. (2023). Student engagement in K–12 online learning amid COVID-19: A qualitative approach from a self-determination theory perspective. *Interactive Learning Environments, 31*(6), 3326–3339. https://doi.org/10.1080/10494820.2021.1926289

Damarwan, E. S., & Khairudin, M. (2017). Development of an interactive learning media to improve competencies. In *Proceedings of the International Conference on Technology and Vocational Teachers (ICTVT 2017)* (pp. 24–27). Atlantis Press. https://doi.org/10.2991/ictvt-17.2017.5

Daryanes, F., Darmadi, D., Fikri, K., Sayuti, I., Rusandi, M. A., & Situmorang, D. D. B. (2023). The development of articulate storyline interactive learning media based on case methods to train students' problem-solving ability. *Heliyon, 9*(4), e15082. https://doi.org/10.1016/j.heliyon.2023.e15082

Edu, A. L., Jaya, P. R. P., & Ni, L. (2021). The phenomenon of learning motivation of elementary school students. *International Journal of Elementary Education, 5*(2), 337–342. https://doi.org/10.23887/ijee.v5i2.33934

Fitriadi, F., Sinaga, R. M., & Muhammad, R. R. (2024). A literature review on the cultural perspective study in elementary school education in Indonesia. *Journal of Innovation in Educational and Cultural Research, 5*(1), 51–61. https://doi.org/10.46843/jiecr.v5i1.848

Haerens, L., Vansteenkiste, M., De Meester, A., Delrue, J., Tallir, I., Vande Broek, G., Aelterman, N. (2018). Different combinations of perceived autonomy support and control: Identifying the most optimal motivating style. *Physical Education and Sport Pedagogy, 23*(1), 16–36. https://doi.org/10.1080/17408989.2017.1346070

Islamyati, M. P., & Manuaba, I. B. S. (2021). Multimedia interactive learning in science subjects for grade fourth elementary school students. *Indonesian Journal of Educational Research and Review, 4*(2), 201–212. https://doi.org/10.23887/ijerr.v4i2.39664

Jordan, C., & Chawla, L. (2019). A coordinated research agenda for nature-based learning. *Frontiers in Psychology, 10*, 766. https://doi.org/10.3389/fpsyg.2019.00766

Li, J., & Xue, E. (2023). Dynamic interaction between student learning behaviour and learning environment: Meta-analysis of student engagement and its influencing factors. *Behavioral Sciences, 13*(1), 59. https://doi.org/10.3390/bs13010059

Lin, M. H., Chen, H. C., & Liu, K. S. (2017). A study of the effects of digital learning on learning motivation and learning outcome. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(7), 3553–3564. https://doi.org/10.12973/eurasia.2017.00744a

Ma, X., Shen, J., Krenn, H. Y., Yuan, J., & Hu, S. (2016). A meta-analysis of the relationship between learning outcomes and parental involvement during early childhood and elementary education. *Educational Psychology Review, 28*, 771–801. https://doi.org/10.1007/s10648-015-9351-1

Mann, J., Gray, T., Truong, S., Sahlberg, P., Bentsen, P., Passy, R., Cowper, R. (2021). A systematic review protocol to identify the key benefits and efficacy of nature-based learning in outdoor educational settings. *International Journal of Environmental Research and Public Health, 18*(3), 1199. https://doi.org/10.3390/ijerph18031199

Marthawati, C. R., & Setyo, B. S. (2024). Learning implementation of the Merdeka curriculum. *Jurnal Penelitian Pendidikan IPA, 10*(7), 4342–4348. https://doi.org/10.29303/jppipa.v10i7.7247

Mayer, R. E. (2024). The past, present, and future of the cognitive theory of multimedia learning. *Educational Psychology Review, 36*, 8. https://doi.org/10.1007/s10648-023-09842-1

Moller, A. C., & Deci, E. L. (2023). Intrinsic motivation. In F. Maggino (Ed.), *Encyclopedia of quality of life and well-being research*. Springer. https://doi.org/10.1007/978-3-031-17299-1_1532

Muir, T., Wang, I., Trimble, A., Mainsbridge, C., & Douglas, T. (2022). Using interactive online pedagogical approaches to promote student engagement. *Education Sciences, 12*(6), 415. https://doi.org/10.3390/educsci12060415

Ojo, A. O., Ravichander, S., Tan, C. N. L., Anthonysamy, L., & Arasanmi, C. N. (2024). Investigating students' motivation and online learning engagement through the lens of self-determination theory. *Journal of Applied Research in Higher Education, 16*(5), 2185–2198. https://doi.org/10.1108/JARHE-09-2023-0445

Rachman, A., Putro, H. Y. S., Rusandi, M. A., & Situmorang, D. D. B. (2024). The development and validation of the "Kuesioner Tema Proyek Penguatan Profil Pelajar Pancasila (KT-P5)". *Heliyon, 10*(16), e35912. https://doi.org/10.1016/j.heliyon.2024.e35912

Ryan, R. M., & Deci, E. L. (2023). Self-determination theory. In F. Maggino (Ed.), *Encyclopedia of quality of life and well-being research*. Springer. https://doi.org/10.1007/978-3-031-17299-1_2630

Sahronih, S., Purwanto, A., & Sumantri, M. S. (2019). The effect of interactive learning media on students' science learning outcomes. In *Proceedings of the 7th International Conference on Information and Education Technology* (pp. 20–24). https://doi.org/10.1145/3323771.3323797

Schindler, L. A., Burkholder, G. J., Morad, O. A., & Marsh, C. (2017). Computer-based technology and student engagement: A critical review of the literature. *International Journal of Educational Technology in Higher Education, 14*, 25. https://doi.org/10.1186/s41239-017-0063-0

Sekarwangi, T., Sartono, K. E., Mustadi, A., & Abdulah, A. (2021). The effectiveness of problem-based learning-based interactive multimedia for elementary school students. *International Journal of Elementary Education, 5*(2), 308–314. https://doi.org/10.23887/ijee.v5i2.31603

Siahaan, S. M., Patriot, E. A., Scristia, S., Helen, H., Kalsum, U., & Putri, R. E. (2023). The validity and practicality of augmented reality-based media development on science matter. *Jurnal Pendidikan MIPA, 24*(4), 717–729. https://doi.org/10.23960/jpmipa/v24i4.pp717-729

Spatioti, A. G., Kazanidis, I., & Pange, J. (2022). A comparative study of the ADDIE instructional design model in distance education. *Information, 13*(9), 402. https://doi.org/10.3390/info13090402

Vasquez, A. C., Patall, E. A., Fong, C. J., Corrigan, A. S., & Pine, L. (2016). Parent autonomy support, academic achievement, and psychosocial functioning: A meta-analysis. *Educational Psychology Review, 28*, 605–644. https://doi.org/10.1007/s10648-015-9329-z

Winarno, N., Rusdiana, D., Susilowati, E., & Afifah, R. M. A. (2020). Implementation of integrated science curriculum: A critical review of the literature. *Journal for the Education of Gifted Young Scientists, 8*(2), 795–817. https://doi.org/10.17478/jegys.675722

Wong, Z. Y., & Liem, G. A. D. (2022). Student engagement: Current state of the construct, conceptual refinement, and future research directions. *Educational Psychology Review, 34*, 107–138. https://doi.org/10.1007/s10648-021-09628-3

Zou, D., Jong, M. S. Y., Huang, X., Cheng, G., Hwang, G. J., & Jiang, M. Y. C. (2024). A systematic review of SVVR in language education in terms of the ADDIE model. *Interactive Learning Environments, 32*(10), 6672–6697. https://doi.org/10.1080/10494820.2023.2277747