JKTP: Jurnal Kajian Teknologi Pendidikan
Vol. 9, No. 2, May 2026: 134-146
e-ISSN: 2615-8787
DOI: 10.17977/um038v9i22026p134-146
https://journal-fip.um.ac.id/index.php/jktp

INTERACTIVE MULTIMEDIA ON THE WATER CYCLE FOR FIFTH-GRADE ELEMENTARY SCHOOL STUDENTS

Sumiyati, Herman Dwi Surjono
Universitas Negeri Yogyakarta
sumiyati2024@uny.ac.id

Article History
Received: 20 February 2026, Accepted: 05 March 2026, ***Published: 10 May 2026***

Abstrak
Penelitian ini bertujuan mengembangkan multimedia interaktif pada materi siklus air yang layak dan praktis untuk digunakan dalam pembelajaran Ilmu Pengetahuan Alam (IPA) kelas V sekolah dasar. Pengembangan multimedia dilakukan dengan mengacu pada model Alessi dan Trollip yang mencakup tiga tahapan utama, yaitu perencanaan, perancangan, dan pengembangan. Pengumpulan data dilakukan melalui wawancara, lembar evaluasi produk, lembar observasi, angket respon siswa, serta angket respon guru. Data yang diperoleh dianalisis menggunakan pendekatan kuantitatif dan kualitatif. Hasil penelitian menunjukkan bahwa multimedia interaktif yang dikembangkan memperoleh kategori valid berdasarkan penilaian ahli materi dan kategori sangat valid berdasarkan penilaian ahli media. Selain itu, hasil uji kepraktisan menunjukkan respon positif dari siswa dan guru yang mengindikasikan bahwa multimedia dapat digunakan secara efektif dalam pembelajaran. Dengan demikian, multimedia interaktif ini memenuhi kriteria kelayakan dan kepraktisan sebagai media pembelajaran IPA di sekolah dasar. Pemanfaatan multimedia ini diharapkan mampu menciptakan pembelajaran yang lebih menarik dan efektif serta meningkatkan partisipasi dan pemahaman peserta didik terhadap konsep siklus air.

Kata Kunci: Multimedia; Siklus Air; Kelas V

Abstract
This study aims to develop interactive multimedia on the water cycle that is feasible and practical for science learning in fifth-grade elementary schools. The multimedia development process was based on the instructional design model proposed by Alessi and Trollip, which consists of three main stages: planning, design, and development. Data were collected through interviews, product evaluation instruments, observation sheets, student response questionnaires, and teacher response questionnaires. The collected data were analyzed using both quantitative and qualitative approaches. The results indicate that the developed interactive multimedia was categorized as valid based on evaluations conducted by subject matter experts and highly valid according to media expert assessments. In terms of practicality, the multimedia received positive responses from both students and teachers, suggesting that it can be effectively implemented in classroom learning. Therefore, the interactive multimedia meets the feasibility and practicality criteria as an instructional medium for elementary school science learning. The use of this multimedia is expected to create a more engaging and effective learning environment and to enhance students' participation and understanding of the water cycle concept.

Keyword*: Multimedia; Water Cycle; Grade V*

To cite this article:
Sumiyati, & Surjono, H. D. (2026). Interactive multimedia on the water cycle for fifth-grade elementary school students. *JKTP: Jurnal Kajian Teknologi Pendidikan, 9*(2), 134–146. doi: 10.17977/um038v9i22026p134-146

INTRODUCTION

Science is one of the compulsory subjects whose competencies must be mastered at the elementary school level. Science learning in elementary schools encompasses knowledge, attitudes, and skills required for students to understand and adapt to their surrounding environment. At the elementary level, students are expected to at least acquire basic process skills (Farida, 2016); however, in practice, not all students are able to achieve the expected learning outcomes.

Based on interviews conducted with fifth-grade students and the classroom teacher at SD Negeri Rejowinangun 1, it was found that science is considered one of the most challenging subjects, particularly the topic of the water cycle. Students still experience difficulties in understanding water cycle concepts. In addition, the presence of various scientific terms, both in Indonesian and Latin, makes the material difficult for students to memorize. Achievement data also indicate that the average score in science is the lowest compared to other subjects. The Minimum Mastery Criterion (KKM) for science is 75, yet the students' average score remains below this threshold, at 54.4. One of the factors contributing to the low learning outcomes is students' limited understanding of science content at SD Negeri Rejowinangun 1. Students possess diverse characteristics, which influence differences in mastery of learning materials and learning interests. Furthermore, the teaching methods and instructional media employed have not been sufficiently varied.

Science learning at SD Negeri Rejowinangun 1 is mainly conducted using printed textbooks and student worksheets (LKS). The instructional materials presented in these resources are largely characterized by extensive textual descriptions with minimal use of visual elements, particularly uncolored images. For instance, the explanation of the water cycle process is presented in a single diagram illustrating several stages evaporation, condensation, precipitation, and infiltration along with extensive written descriptions. This approach has not been adequate in providing concrete learning experiences, resulting in students' difficulties in comprehending and reasoning about phenomena related to the water cycle. Moreover, the amount of information contained in the worksheets is considered to exceed students' cognitive capacity, which may lead to cognitive overload (De Jong, 2010).

Furthermore, students' learning interest remains relatively low. According to interviews with the teacher, students tend to pay limited attention to instructional explanations. Many students engage in unrelated activities, such as chatting with peers, drawing in their notebooks, or even sleeping during class. Students are also reluctant to express their opinions or respond to questions posed by the teacher and often remain silent when prompted to answer. Consequently, the learning process tends to be teacher-centered.

Optimal learning outcomes are closely related to the learning environment (Kember & Leung, 2006). Teachers may employ various strategies to design innovative learning experiences that enhance students' interest and achievement, one of which is the use of instructional media. Instructional media can function as a means of stimulating students' motivation and attention through direct interaction between learners and learning resources (Heriyanto, Haryani, & Sedyawati, 2014). In addition, the use of media in the learning process can foster new interests and desires, increase motivation, stimulate learning activities, and even generate positive psychological effects on students (Djamarah & Zain, 2006). As stated by Kustandi and Sutjipto (2011), instructional media can clarify meaning, thereby supporting the effective and optimal achievement of learning objectives. The appropriate and varied use of instructional media can also help overcome students' passive attitudes in learning (Sadiman, 2014), as it can generate enthusiasm for learning and facilitate direct interaction, enabling students to learn according to their abilities and interests.

Learning supported by multimedia has been shown to be more effective than conventional instructional approaches (Barzegar et al., 2012). Multimedia enhances students' creativity, participation, and interest in the learning process and has the potential to create high-quality learning environments (Nusir et al., 2011). Through the integration of multiple media formats, multimedia is capable of establishing more realistic learning contexts. Furthermore, multimedia presents learning materials in a holistic manner, providing meaningful learning experiences and simulations of real-life situations within students' surroundings (Aryani et al., 2021; Siddik et al., 2019). The integration of text, audio, images, and video enables teachers to move beyond lecture-based instruction (Putri & Sibuea, 2014).

Based on interviews with teachers and students, it was found that fifth-grade students at SD Negeri Rejowinangun 1 show a stronger preference for learning activities that involve digital technology. During conventional classroom instruction, students tend to demonstrate low enthusiasm and limited engagement. Many students are distracted by playing, joking, or engaging in unrelated activities. In contrast, when learning materials are delivered through audiovisual media, students appear more focused, calm, and attentive. They demonstrate greater enthusiasm toward the learning content presented. Multimedia has been implemented across various subjects at SD Negeri Rejowinangun 1, including science, indicating that both teachers and students are familiar with its use. Teachers and students are also capable of utilizing multimedia in the computer laboratory. However, the availability of multimedia specifically designed for science topics remains limited. In particular, multimedia materials for the water cycle topic are not yet available at the school. Existing water cycle multimedia products on the market are not fully aligned with the school curriculum or the characteristics of fifth-grade elementary students. Therefore, this study focuses on the development of science multimedia for the water cycle topic.

The selection of the water cycle topic was based on the results of the problem analysis. The water cycle involves abstract concepts that require instructional media capable of visualizing content to facilitate students' understanding. In practice, not all natural objects and phenomena can be directly presented in classroom learning (Wahyuni & Djukri, 2015). Moreover, many aspects of the water cycle cannot be observed firsthand by students. When explained solely through conventional instruction, students often experience difficulties in comprehending and interpreting the material. In this context, multimedia plays a crucial role in supporting both students and teachers during the learning process. Multimedia can enhance the effectiveness of instruction and help prevent misconceptions during learning activities (Astuti et al., 2018).

The development of multimedia in this study is grounded in the assumption that multimedia offers numerous advantages that facilitate and support instructional implementation. Multimedia makes learning more engaging, interactive, relaxed, and enjoyable, thereby motivating students to participate actively in learning activities. It also provides various features that accommodate students' diverse learning needs and preferences. In addition, multimedia is mobile in nature, allowing learning to take place anytime and anywhere. Students can utilize multimedia for independent learning at home when instructional time at school is limited. The multimedia developed is designed to operate on multiple devices, such as computers and laptops, enabling its use both in classroom settings and at home, depending on available resources. Based on the considerations above, the proposed solution is the development of multimedia-based learning materials for the water cycle topic in science for fifth-grade elementary students.

METHOD

This study employed a research and development (R&D) approach aimed at developing a new instructional product and evaluating its validity and practicality. The development model adopted in

this study was derived from the model proposed by Alessi & Trollip, which consists of three main stages: planning, design, and development. This model was selected because, although relatively simple, each stage contains explicit subcomponents that enable multimedia products to be developed effectively and efficiently while maintaining appropriate management and quality standards.

Table 1. Blueprint of the Subject-Matter Expert Validation Instrument

No	Aspect	Component	Item Numbers	Number of Items
1	Learning	Competency	1,2,3	3
		Introduction	4,5,6,	3
		Learning Process	7,8,9	3
		Evaluation and Educational Games	10,11,12,13,14	5
2	Content / Material	Learning Material	15,16,17,18,19,20,21,22	8
		Language Use	23,24	2
		Practice Questions and Games	25,26,27,28	4
Total Items				**28**

Table 2. Blueprint of the Media Expert Validation Instrument

No	Aspect	Component	Item Numbers	Number of Items
1	Physical Design	Cover Design	1,2,3,4	4
2	Interface Display	Graphics	5,6,7,8	4
		Text	9,10,11	3
		Audio	12,13	2
		Illustration	14	1
		Video	15,16,17	3
		Navigation	18,19,20	3
3	Programming	Program Usability	21,22,23,24,25,26	6
Total Items				**26**

The subjects involved in this study included two media experts and two subject-matter experts who participated in the media validity evaluation. In addition, thirty-two fifth-grade students and one teacher from SDN Rejowinangun 1 were involved in assessing the practicality of the developed multimedia. Data were collected through interviews, expert validation questionnaires for media and content, and response questionnaires completed by teachers and students regarding the multimedia. Data analysis techniques employed in this study comprised both quantitative and qualitative approaches. Quantitative data were obtained from questionnaire scores, which were subsequently converted into qualitative categories using five-point and three-point rating scales. The five-point scale was applied to analyze validation data from subject-matter experts, media experts, and teachers, whereas the three-point scale was used to analyze students' response data.

Table 3. Blueprint of the Student Response Instrument

No	Aspect	Component	Item Numbers	Number of Items
1	Interface Display	Graphics	1,2,3,4	4
		Text	5,6	2
		Audio	7	1
		Illustration	8,9	2
		Video	10	1
		Navigation	11	1
2	Programming	Program Usability	12,13,14	3
3	Learning	Introduction	15,16	2
		Learning Process	17	1
		Evaluation and Educational Games	18,19	2
4	Content / Material	Learning Material	20,21	2
		Language Use	22	1
		Practice Questions and Games	23,24	2
Total Items				**24**

Table 4. Blueprint of the Teacher Response Instrument

No	Aspect	Component	Item Numbers	Number of Items
1	Interface Display	Graphics	1,2,3,4	4
		Text	5,6	2
		Audio	7	1
		Illustration	8,9	2
		Video	10	1
		Navigation	11	1
2	Programming	Program Usability	12,13,14	3
3	Learning	Introduction	15,16	2
		Learning Process	17	1
		Evaluation and Educational Games	18,19	2
4	Content / Material	Learning Material	20,21	2
		Language Use	22	1
		Practice Questions and Games	23,24	2
Total Items				**24**

RESULT

The product developed in this study was an interactive multimedia learning resource for science instruction focusing on the water cycle topic. The stages of multimedia development were adapted from the model proposed by Alessi & Trollip (2001), which consists of three main phases: planning, design, and development. The first phase, planning, involved identifying the scope of the content. The determination of content scope was based on the results of a needs analysis conducted through classroom observations, questionnaire data, and interviews with students and classroom teachers. In addition, an analysis of student characteristics was carried out to ensure that the developed multimedia product was appropriate and aligned with users' needs. At this stage, a planning document was also prepared, including material scripts, test items, and multimedia assessment instruments.

The second phase, design, focused on idea development and initial content planning for the multimedia product. The initial content design encompassed decisions regarding color schemes, text types, images, videos, and other elements to be presented in the multimedia. Concept analysis was also conducted to identify key concepts to be taught and to organize them hierarchically. The outputs of this phase included flowcharts and storyboards, which served as guidelines for program flow and preliminary visual representations of the product.

Table 5. Results of Multimedia Validation by Material Experts

No	Aspect	Expert		Mean Score	Category
		I	II		
1	Learning	4,33	3,73	4,03	Valid
2	Content	4,25	3,87	4,06	Valid
Overall Mean Score		**4,29**	**3,8**	**4,04**	**Valid**

The third phase, development, involved preparing instructional materials related to the water cycle, which were compiled from various reference sources and redesigned to be more concise and communicative to avoid rigid presentation. Graphic production was also conducted, including the creation of button icons, animated characters, backgrounds, and other supporting visuals. Graphic design was developed using Corel Draw X7 and Adobe Animate. Subsequently, audio and video components were produced. The audio production included narration for the opening and closing sections of the multimedia program, while background music and sound effects were obtained from online sources and edited using Wondershare Filmora 9. All prepared components were then integrated and programmed using Adobe Flash CS6, with careful consideration of multimedia learning principles proposed by Richard E. Mayer (2009).

Table 6. Results of Multimedia Validation by Media Experts

No	Aspect	Expert		Mean Score	Category
		I	II		
1	Physical Aspect	4,60	5,00	4,80	Highly Valid
2	Interface Display	4,68	4,89	4,55	Highly Valid
3	Programming	4,71	5,00	4,85	Highly Valid
Overall Mean Score		**4,66**	**4,96**	**4,73**	**Highly Valid**

After the product was completed, an alpha test was conducted in which the multimedia was validated by four experts, consisting of two media experts and two subject-matter experts. Media experts evaluated the physical aspects, visual appearance, and programming quality, while subject-matter experts assessed instructional and content-related aspects. The results of the alpha test are presented in detail in the product trial results section. Revisions were subsequently made based on feedback from both media and content experts.

Table 7. Results of Multimedia Practicality Test Based on Students' Responses

No	Aspect	Mean Score	Category
1	Small-Group Trial	2,77	Valid
2	Small-Group Trial	2,84	Valid
Overall Mean Score		**2,80**	Valid

A beta test was then conducted by implementing the product with the target users, namely fifth-grade elementary school students. The beta testing was carried out in two stages, beginning with a small-group trial involving six students and one teacher. The selected students represented varying ability levels, including two high-achieving students, two students with moderate abilities, and two low-achieving students. This small-group trial aimed to obtain information regarding the quality of the developed multimedia based on user responses. Revisions were made according to students' feedback before the product was tested in a larger group consisting of 26 students and one teacher. Further revisions were conducted based on feedback from students and the teacher. A summary of the results of the validity and practicality tests is presented in Tables 5, 6, 7, and 8.

Table 8. Results of Multimedia Practicality Test Based on Teacher's Assessment

No	Aspect	Mean Score	Category
1	Interface Display	4,63	Highly Valid
2	Programming	4,25	Highly Valid
3	Learning	4,83	Highly Valid
4	Content	4,80	Highly Valid
Overall Mean Score		**4,62**	**Sangat Layak**

Based on the data presented in the tables above, it can be concluded that the developed water cycle multimedia product is considered feasible according to evaluations by both subject-matter experts and media experts. The expert assessments indicate that the science multimedia for the water cycle topic meets the established quality criteria for instructional multimedia. The content and conceptual structure of the multimedia are aligned with the predetermined learning objectives and basic competencies. Furthermore, the multimedia was also deemed practical based on students' responses and teachers' evaluations. These findings indicate that the science multimedia for the water cycle topic can be effectively utilized in accordance with the characteristics and needs of both students and teachers, as reflected in the feedback and suggestions provided. Subsequent revisions were carried out based on input from students and teachers to further improve the product. The final outcomes of the interactive multimedia development in this study are illustrated in Figures 1, 2, 3, 4, and 5.

Figure 1. Main Page

Figure 1 illustrates the initial interface of the interactive multimedia learning program on the water cycle. On the main page, students are welcomed by two animated characters designed to create a more engaging and enjoyable learning experience. The background features a natural landscape illustration depicting the surrounding water environment, which provides a relevant visual context aligned with the learning content. This introductory display aims to attract students' attention and prepare them for the learning activities presented in the multimedia.

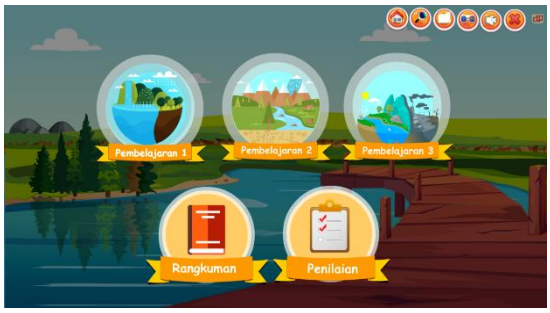

Figure 2. Main Menu Page

Figure 2 presents the main menu page, which allows students to select various learning options. The menu is designed using intuitive icons that divide the learning content into several sections, such as Learning Session 1, Learning Session 2, Learning Session 3, as well as access to summaries and assessments. This structure enables students to explore the learning materials independently according to their individual needs and learning pace. The use of bright colors and a clear layout is intended to enhance readability and visual appeal, thereby increasing students' motivation to engage in the learning process.

Figure 3. Content Page

Figure 3 displays the content page, where students can access more detailed information about the water cycle. This page consists of several main components, including a list of selectable topics on the left side of the screen and visual displays that support conceptual understanding. One of the key features of this page is the presentation of learning materials through animations and interactive diagrams. For example, in the explanation of the water cycle, visual illustrations depict the main

processes, such as evaporation, condensation, precipitation, and infiltration. Students can interact with on-screen elements to obtain further explanations of each stage of the water cycle. In addition, the presence of animated characters serving as learning guides represents a notable advantage of this interface. These characters provide instructions and explanations using simple language, making the content more accessible to elementary school students. Through the integration of text, images, and animations, this page is designed to facilitate more effective learning for students with diverse learning styles.

Figure 4. Assessment Start Page

Figure 4 presents the initial assessment page of the interactive multimedia. On this page, students are required to enter their name, student number, and class before starting the test. This procedure is intended to systematically document students' evaluation results. By requiring student identification prior to the assessment, the multimedia supports organized data recording and facilitates teachers in monitoring and evaluating students' learning outcomes.

Figure 5. Assessment Page

Figure 5 illustrates the assessment page, where students are presented with a series of multiple-choice questions related to the water cycle topic. After completing all questions, the system automatically provides feedback in the form of a final score and indicates correct and incorrect answers. This feature enables students to immediately recognize their level of understanding and identify areas that require improvement. The assessment page is designed so that evaluation functions not only as a measurement tool but also as an integral part of an interactive and engaging learning process.

DISCUSSION

The interactive multimedia developed in this study supports teachers in presenting water cycle concepts to fifth-grade elementary school students. This interpretation is grounded in the outcomes of the validity and practicality evaluations, which demonstrate that the multimedia satisfies the required feasibility standards. The product was intentionally designed to address the learning characteristics of fifth-grade students by fostering learning interest and strengthening their conceptual understanding of the water cycle. The learning content is organized systematically according to the stages of the scientific approach, which encompass observing, questioning,

experimenting, reasoning, and communicating. Such an instructional structure enables students to actively construct knowledge and promotes more meaningful learning experiences (Mayer, 2014). Furthermore, the multimedia incorporates contextual examples drawn from students' everyday experiences, allowing abstract concepts to be presented in a more concrete and comprehensible manner (Nuraini et al., 2021). This finding aligns with the perspective of Malik and Agarwal (2012), who emphasize that multimedia elements should be designed in a balanced and coherent manner with visually appealing and aesthetic qualities to effectively capture students' attention and enhance learning engagement.

The developed multimedia incorporates all stages of the scientific approach. Observing activities are facilitated through animations illustrating the water cycle process and videos depicting water sources in the surrounding environment. Questioning activities are presented in the form of guiding questions designed to stimulate students' curiosity about the learning material. Reasoning activities are supported through the outcomes of experimenting, while communicating activities are facilitated by tasks that require students to restate what they have learned by completing response fields provided in the multimedia.

Experimenting activities are presented in the form of educational games, including puzzle games and crossword puzzles. In the puzzle game, students are required to arrange image fragments to form a complete illustration of the stages of the water cycle. In the crossword puzzle game, students are challenged to recall and input correct answers related to key terms learned in the water cycle material. Engaging in crossword puzzles can help sharpen students' memory, as they are encouraged to recall and reinforce previously learned concepts. This is in line with the findings of Tresna Aditya and Ajat Sudrajat (2021), who reported that educational games can support the learning process and contribute to improved student learning outcomes.

Through these interactive features, students are expected to gain a deeper understanding of the material, making learning more meaningful. Student interactivity in learning with water cycle multimedia is further strengthened through the inclusion of educational games such as puzzles and crossword activities. These games are not merely designed for entertainment but also function as tools for reinforcing students' conceptual understanding of the learning material. This aligns with the findings of Torrente et al. (2010), who suggest that games can enhance the learning process in various ways, particularly by increasing student engagement and motivation (Dichev & Dicheva, 2017). Game elements such as features, design, and structure have been shown to motivate learners and make the learning process more engaging and enjoyable (Attali & Arieli, 2015; Gonzalez et al., 2016; Seaborn & Fels, 2015).

The learning materials presented in the multimedia comply with technical standards for multimedia presentation, including the integration of textual explanations supported by images and animations, as well as the inclusion of audio and video components to clarify the learning content. Ong and Mannan (2002) state that animations and simulations enhance the visualization of key concepts and principles within learning materials. Furthermore, Leow and Neo (2014) emphasize that the use of multimedia in learning can improve memory retention, which in turn contributes to improved student learning outcomes. Therefore, interactive multimedia offers significant advantages in motivating students to actively engage in learning activities.

In addition, the presence of navigation buttons in the multimedia supports students' active engagement during the learning process. Students are given autonomy to continue or repeat learning materials according to their individual needs. Learning media that allow learner control have been shown to increase students' enthusiasm for learning (Arkun & Akkoyunlu, 2008). Through

interactive navigation features, students can freely move between pages, play, pause, and replay animation and video content presented in the multimedia (Nugent et al., 2016).

The findings of this study also indicate that the use of interactive multimedia in learning the water cycle enhances students' conceptual understanding. This result is consistent with constructivist learning theory proposed by Jean Piaget (1952), which emphasizes that learning occurs when students actively construct knowledge based on their experiences. In this context, interactive multimedia provides more concrete learning experiences through visualization and simulation, enabling students to connect new concepts with their prior knowledge. Furthermore, the cognitive theory of multimedia learning developed by Richard E. Mayer (2009) asserts that the integration of visual and auditory elements in multimedia optimizes students' cognitive processing during learning. The modality and dual-channel principles explain that humans process information through two primary channels verbal and visual thereby allowing multimedia to reduce cognitive load and enhance understanding of complex concepts such as the water cycle. Thus, the findings of this study reinforce the notion that multimedia-based learning not only increases student engagement but also supports deeper cognitive processing.

The interactive multimedia developed for the water cycle topic has met the criteria of validity and practicality for use in science learning for fifth-grade elementary students. The multimedia functions effectively as a learning medium, in line with the view expressed by Hujair AH. Sanaky (2015), who states that instructional media serve as intermediary tools in the learning process to improve effectiveness and efficiency in achieving learning objectives. The findings of this study are consistent with research conducted by I Kadek Wisnu Nata (2021), which reported that interactive multimedia in fifth-grade science learning creates a highly interactive and varied learning environment, increases students' interest, and reduces learning boredom. These results are further supported by the study conducted by Luthfi Riyadh Rahman (2017), which concluded that science learning using multimedia is more effective in improving learning outcomes compared to instruction without multimedia. Similarly, Kuswidayani et al. (2021) found that interactive multimedia enhances students' attention during learning, as students are able to independently navigate and revisit learning materials according to their needs.

In line with previous studies, the results of this research demonstrate that learning supported by interactive multimedia creates a more enjoyable and interactive learning atmosphere. Moreover, the use of multimedia contributes to increased student interest and improved learning outcomes in classroom settings (Wardani, 2019). These findings are consistent with the research conducted by Rodhiyah et al. (2021), which indicates that the integration of multimedia in learning fosters students' motivation and enthusiasm in understanding instructional content. Therefore, the development and implementation of interactive multimedia, such as that applied to the water cycle topic for fifth-grade elementary students, represents an effective strategy for enhancing student engagement and promoting deeper conceptual understanding.

CONCLUSION

The development of interactive multimedia for the water cycle topic demonstrates that multimedia-based learning can be strategically designed to address the characteristics and learning needs of elementary school students, particularly in understanding abstract science concepts. The integration of structured content, interactivity, and learner control supports a more student-centered learning environment and aligns with contemporary pedagogical approaches in science education. This study highlights the importance of designing instructional multimedia that is not only technologically engaging but also pedagogically grounded. By organizing learning activities through a scientific approach and embedding interactive elements such as animations and educational games,

multimedia can function as a meaningful learning medium rather than merely a presentation tool. Consequently, interactive multimedia has the potential to support teachers in facilitating learning experiences that encourage active participation, conceptual understanding, and learner autonomy. Overall, this research reinforces the role of interactive multimedia as a viable instructional strategy in elementary science education and provides a reference for future development of similar learning media tailored to curriculum demands and student characteristics.

REFERENCES

Aditya, T., Sudrajat, A., & Sumantri, M. S. (2021). The development of interactive multimedia based on the quiz education game on the content of ips learning in basic schools. International *Journal of Multicultural and Multireligious Understanding. 8*(4), 654-661. http://dx.doi.org/10.18415/ijmmu.v8i4.2627

Alessi, S. M. & Stanley R. Trollip.(2001). *Multimedia for: methods and development*. Massachusetts: A Pearson Education Company.

Arkun, S. & Akkoyunlu, B. (2008). A study on the development process of a multimedia learning environment according to the addie model and students' opinions of the multimedia learning environment. *Interactive Educational Multimedia, 17*, 1-19.

Aryani, N. W., & Ambara, D. P. (2021). Video pembelajaran berbasis multimedia interaktif pada aspek kognitif anak usia dini. *Jurnal Pendidikan Anak Usia Dini Undiksha, 9*(2), 252. https://doi.org/10.23887/paud.v9i2.36043.

Astuti, F. K., Cahyono, E., Supartono., Van, N. C., & Duong, T. D. (2018). Effectiveness of elements periodic table interactive multimedia in nguyen tat thanh high school. *International Journal of Indonesian Education and Teaching, 2* (1), 1-10. https://doi.org/10.24071/ijiet.2018.020101.

Attali, Y., & Arieli-Attali, M. (2015). Gamification in assessment: do points affect test performance. *Computers & Education, 83*. https://doi.org/10.1016/j.compedu.2014.12.012.

Barzegar, N., Farjad, S., & Hosseini, N. (2012). The effect of teaching model based on multimedia and network on student learninng (case study:guidance schools in Iran). *Procedia-Sosial and Behavioral Sciences, 47*, 1263-1267. https://doi.org/10.1016/j.sbspro.2012.06.809.

De Jong, T. (2010). Cognitive load theory, educational research, and instructional design: some food for thought. *Instructional Science, 38*(2), 105–134. https://doi.org/10.1007/s11251009-9110-0

Dichev, C., & Dicheva, D. (2017). Gamifying education: what is known, what is believed and what remains uncertain: a critical review. *International Journal of Educational Technology in Higher Education, 14*(1). https://doi.org/10.1186/s41239-017-0042-5.

Djamarah, S. B. (2008). *Psikologi belajar*. Jakarta: Rineka Cipta.

Egok, A. S., & Hajani, T. J. (2018). Pengembangan multimedia interaktif pada pembelajaran ipa bagi siswa sekolah dasar Kota Lubuk Linggau. *Journal of Elemantary School (JOES), 1*(2), 141-157). https://doi.org/10.31539/joes.v1i2.446.

González, C. S., Gómez, N., Navarro, V., Cairós, M., Quirce, C., Toledo, P., & Marrero-Gordillo, N. (2016). Learning healthy lifestyles through active video games, motor games and the gamification of educational activities. *Computers in Human Behavior, 55*. https://doi.org/10.1016/j.chb.2015.08.052.

Heriyanto, A., Haryani, S., & Sedyawati, S. M. R. (2014). Pengembangan multimedia pembelajaran interaktif berbasis education game sebagai media pembelajaran kimia. *Chemistry in Education, 3*(1), 1-7. http://journal.unnes.ac.id/sju/index.php/chemined

Kember, D., & Leung, D. Y. P. (2006). Characterising a teaching and learning environment conducive to making demands on students while not making their workload excessive. *Studies in Higher Education, 31*(2), 185–198. https://doi.org/10.1080/03075070600572074.

Kustandi, C. & Sutjipto, B. (2011). *Media pembelajaran: manual dan digital*. Bogor: Ghalia Indonesia.

Kuswidayani, N., Degeng, I. N. S., & Wedi, A. (2021). Multimedia berjenis interaktif materi indahnya keanekaragaman budaya di negeriku untuk kelas IV. *JKTP: Jurnal Kajian Teknologi Pendidikan, 4*(3), 233–328. https://doi.org/10.17977/um038v4i32021p299

Leow, Fui Theng., Neo, Mai. (2014). Interactive multimedia learning: innovating classroom education in a Malaysian University. *The Turkish Online Journal of Educational Technology. 13*(2):99-110. https://eric.ed.gov/?id=EJ1022913

Malik, S & Agarwal, A. (2012). Use of multimedia as a new educational technology tool–a study. International *Journal of Information and Education Technology, 2*(5). https://doi.org/10.7763/IJIET.2012.V2.181.

Mayer, R. E. (2014). *Cognitive theory of multimedia learning*. Inr. E. Mayer (ed.), The Cambridge Handbook of multimedia learning. Cambridge University Press.

Mayer, R. E. (2009). *Multimedia learning (2nd ed.)*. Cambridge University Press.

Nata, I K. W., Putra, DB. Kt. Ngr. S. (2021). Media pembelajaran multimedia interaktif pada muatan ipa kelas v sekolah dasar. *Jurnal Ilmiah Pendidikan dan Pembelajaran. 5*(2), 227-237. http://dx.doi.org/10.23887/jipp.v5i2.

Nugent, G., A., Deana N.C., Guretzky, J., Murphy, P., & Lee, D. (2016). Learning from online modules in diverse instructional contexts. *Interdisciplinary Journal of e-Skills and Life Long Learning 12*, 113-121. https://doi.org/10.28945/3511

Nuraini, M. F., Susilaningsih, & Wedi, A. (2021). Pengembangan multimedia interaktif materi perubahan wujud benda bagi siswa sekolah dasar. *JKTP: Jurnal Kajian Teknologi Pendidikan. 4*(1), 1-118. https://doi.org/10.17977/um038v4i12021p033

Nusir, S., Alsmadi, I., Al-Kabi, M., & Shardqah, F. (2011). Designing an interactive multimedia learning system for the children of primary schools in Jordan. *Global Engineering Education Conference (EDUCON)*, 45-51. http://dx.doi.org/10.1109/EDUCON.2011.5773111

Piaget, J. (1952). *The origins of intelligence in children*. Norton.

Putri, I. P., & Sibuea, A. M. (2014). Pengembangan media pembelajaran interaktif pada mata pelajaran fisika. *Jurnal Teknologi Informasi & Komunikasi dalam Pendidikan. 1*(2), 145-155.

Rahman, L. R. (2018). *Pengembangan multimedia pembelajaran berbasis adobe flash untuk meningkatkan hasil belajar dan keaktifan siswa smp pada materi keanekaragaman makhluk hidup*. Tesis Magister, Universitas Negeri Yogyakarta. Diperoleh dari https://eprints.uny.ac.id/5577.

Rodhiyah, L., Degeng, I. N. S., & Adi, E. P. (2021). Peningkatan antusiasme siswa kelas V belajar materi panas dan perpindahannya melalui multimedia linier. *JKTP: Jurnal Kajian Teknologi Pendidikan, 4*(1), 1–118. https://doi.org/10.17977/um038v4i12021p080

Sanaky, H. A. H. (2015). *Media pembelajaran: filsafat, teori, dan aplikasinya*. Yogyakarta: Kaukaba.

Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. *International Journal of Human Computer Studies*, 74. https://doi.org/10.1016/j.ijhcs.2014.09.006.

Sadiman, Arif S., dkk. (2014). *Media pendidikan : pengertian, pengembangan dan pemanfaatannya*. Depok: PT. Raja Grafindo Persada.

Siddik, B., & Kholisho, Y. N. (2019). Pengembangan modul pembelajaran perakitan komputer berbasis multimedia interaktif. *EDUMATIC: Jurnal Pendidikan Informatika, 3*(1), 13. https://doi.org/10.29408/edumatic.v3i1.1389

Torente, Javier., Blanco, A., Marchiori, E.J., Ger, P. M., & Manjon, F. (2010). Introducing educational games in the learning process. *IEE Educon Education Engineering*, 1121-1126. 10.1109/EDUCON.2010.5493056.