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Scratch-based Science Interactive Animation Media to Improve Concept Understanding of Junior High School Learners

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ABSTRAK

Kesulitan yang dialami dalam proses pembelajaran adalah sulitnya memahami pembelajaran dikarenakan kurangnya penjelasan materi yang menarik serta ketersediaan bahan ajar di sekolah masih terbatas. Penelitian ini bertujuan untuk menganalisis bagaimana validitas media animasi interaktif berbasis scratch dan bagaimana peningkatan pemahaman konsep peserta didik setelah menggunakan media animasi interaktif berbasis scratch. Metode penelitian yang digunakan adalah Research and Development (R&D) dengan menerapkan model ADDIE. Penelitian ini melibatkan 34 peserta didik yang menjalani uji coba pretest-posttest untuk menguji efektivitas pembelajaran menggunakan media. Evaluasi dalam penelitian ini menggunakan dua jenis alat validasi: lembar validasi materi dan media yang dinilai oleh lima validator ahli, dan lembar keterbacaan yang diisi oleh peserta didik. Hasil validasi dari penelitian ini menunjukkan bahwa materi dan media memiliki tingkat kevalidan sebesar 93,25%, yang menunjukkan bahwa media tersebut sangat valid. Keterbacaan oleh siswa mencapai 84%, menandakan bahwa media tersebut sangat praktis untuk digunakan. Berdasarkan hasil tersebut, media animasi interaktif berbasis Scratch terbukti sangat layak dan efektif untuk meningkatkan pemahaman konsep siswa.

ABSTRACT

The difficulty experienced in the learning process is the difficulty of understanding learning due to the lack of interesting material explanations and the availability of teaching materials in schools is still limited. This study aims to analyze the validity of scratch-based interactive animation media and how to improve students' concept understanding after using scratch-based interactive animation media. The research method used is Research and Development (R&D) by applying the ADDIE model. This study involved 34 students who underwent pretest-posttest trials to test the effectiveness of learning using the media. The evaluation in this study used two types of validation tools: material and media validation sheets assessed by five expert validators, and readability sheets filled out by learners. The validation results of this study show that the materials and media have a validity level of 93.25%, which indicates that the media is very valid. Readability by students reached 84%, indicating that the media was very practical to use. Based on these results, Scratch-based interactive animation media proved to be very feasible and effective to improve students' concept understanding..

1. INTRODUCTION

Education is a system that consists of several main components, namely educators, students, educational goals, educational tools, and the educational environment. These components are interconnected, dependent on each other, and function together to achieve optimal educational goals (Aada, 2020; Odondi, 2024). In this context, the education system in Indonesia must be able to prepare students to face future challenges, including preparing them to become the golden generation of 2045 who excel in various fields to make Indonesia a great country (Hamdani et al., 2022; Mahadi, 2021). To achieve this goal, educators in Indonesia need to focus on developing learners' concept understanding. Various approaches can be used by teachers to facilitate learners in understanding the concepts taught. According to previous study state that the right learning approach can help students develop a strong conceptual framework (Sopandi & Andina Sopandi, 2021). For example, teachers can ask students to

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observe and compare the characteristics of objects, so that they can better interpret and infer certain topics, and avoid errors in understanding concepts. In general, the approach to teaching a concept involves explanation, classification, and inference, which helps students build solid concepts (Höft & Bernholt, 2019; Irwandi & Fajeriadi, 2019). Concept understanding is very important because it allows learners to more easily understand subsequent concepts and develop their overall thinking ability. Thus, the right learning approach and supportive educational components will help the education system achieve its goals in shaping the golden generation of 2045.

One of the subjects taught in junior high school is Natural Sciences (IPA). Science is a collection of structured knowledge that arises from scientific practices such as testing and observation, as well as a scientific mindset characterized by traits such as curiosity, openness, and honesty. However, the use of science in everyday life is still limited to natural phenomena (Pratama et al., 2023; Young et al., 2018). This opinion is reinforced by previous study which states that science is knowledge obtained from the structured collection of information about nature and its conditions, which is carried out based on a good scientific attitude so that the results become scientific products (Ariawati et al., 2022). Therefore, learning science is very important for students because the basic substance is to develop the scientific process into the mindset of students (Harefa et al., 2022; Mailani et al., 2022)

Science subjects have an important role for students, but in the learning process, this subject still faces several obstacles. One of these obstacles is the lack of student understanding of the material Structure and Function of the Body of Living Things, which is science material for grade 8. This material includes subchapters such as the food and digestive system, circulatory system, respiratory system, and excretory system. Understanding the concept of students in this material is very important because it includes a lot of material and discussion. However, this material is often considered difficult by students because the explanation of the material is not interesting (Handayani, 2022; Munzil et al., 2022).

Science teachers also stated that the availability of teaching materials in schools is still limited. Teachers often ask students to read the package books provided by the government and immediately proceed with doing assignments, which makes science learning less interesting and contributes significantly to the low understanding of students' concepts (Abidin et al., 2021). Therefore, the role of digital technology in learning is needed so that learning can run smoothly and effectively (Payu et al., 2022; Widianto, 2021). These obstacles are also experienced by students at SMPN 26 Semarang, which results in low student understanding of the science material Structure and Function of the Body of Living Things. Thus, the importance of interesting and effective science learning cannot be ignored. The use of digital technology in learning can be a solution to improve students' understanding of concepts, especially in materials that are considered difficult such as the Structure and Function of the Body of Living Things.

Based on the problems that researchers found in learning science in 8th-grade students of SMPN 26 Semarang, it is necessary to have an alternative solution to overcome these problems. Researchers will develop technology-based interactive animation learning media in science learning to help students visualize the material Structure and Function of the Body of Living Things. Through interactive animation media based on digital technology, the role of students in learning will increase, and the use of this media will involve students in its operation. The use of technology in learning also helps educators to visualize the material while increasing students' learning motivation (Sutardi et al., 2022; Utomo et al., 2022). The benefits of technology in education certainly help teachers in carrying out learning. Ideally, teachers in the 21st century have competence in integrating professional skills, pedagogical skills, and technological skills in learning to achieve basic competencies (Boholano, 2017; Oktaviana & Yudha, 2022). However, according to the use of technology in education is still not optimal, this is due to teachers' lack of understanding of the use of technology (Mukhtar & Putri, 2021).

The process of combining technology with learning models and strategies and the process of collaborating technology with subject matter are fundamental problems that educators often experience in implementing the use of technology. Technology has an important role in the field of education, one of which is learning media. Technological developments in this field can be utilized by teachers to create an attractive learning media design that can help students find information and students can learn anywhere and anytime (Ningsih et al., 2019; Schmidt et al., 2014). Effective and enjoyable learning activities can be created by innovative learning activities, including innovations in the use of learning media. Learning media is a tool that can help the teaching and learning process so that the meaning of the messages conveyed becomes clearer and the educational or learning objectives can be achieved effectively and efficiently (Ariani & Puspasari, 2021; Praheto et al., 2020). The use of learning media at the learning orientation stage will greatly assist the effectiveness of learning and the delivery of learning messages and content. In addition, the use of learning media can also help students improve understanding, present data interestingly, and make it easier to interpret data (Isnandar et al., 2022; Suwiantini et al., 2021).

The development of information technology causes many applications that can be used to create interactive learning media that can be stored on a computer or uploaded on an internet site. Information technology-based interactive learning media can provide visualization with still and moving images with the addition of navigation as a media control facility when explaining material and evaluation (Dewanti et al., 2021; Rasheed et al., 2020). The use of interactive learning media like this is expected to create a varied, interesting, and not boring learning process. One of the applications that can be utilized in developing interactive learning media is Scratch. This application was developed by the Massachusetts Institute of Technology (MIT), which is a freeware and easy-to-use application for creating games, interactive multimedia, animated stories, and simulations. *Scratch* is a visual programming language that uses drag-and-drop block code (Dewi et al., 2021; Zubaidah, 2019), so it can be used to develop interactive learning media by using appropriate programming algorithms. In addition, the work produced from Scratch can be seen through the official website of Scratch, namely https://scratch.mit.edu/, so that teachers and students can easily use learning media in places that have internet access. Scratch is a digital website that provides interactive animation features that can be used in learning.

Development research on Scratch-based interactive learning media has been widely carried out along with technological advances. As research conducted produced Scratch-based physics learning media products on optical devices with valid categories, the learning media developed is feasible to use as a learning resource in the learning process at school (Chiang & Qin, 2018). Other research revealed that Scratch-based learning media can be used as an alternative learning resource for students (Aniati et al., 2021). Research entitled "Application of *Scratch* media on the material of moment diagram, normal diagram, latitude force in class XI SMK Negeri 3 Jombang" revealed that the use of Scratch can improve the response of students in the learning process and the use of *Scratch* in the learning process can increase the percentage of students' score completeness (Bernard & Setiawan, 2020).

Based on this description, not much research has been done on the development of scratch media to improve understanding of science concepts in the material Structure and Function of the Body of Living Things so researchers are interested in developing scratch-based science interactive animation media to improve students' understanding of concepts in the material. This study aims to analyze the validity of scratch-based interactive animation media and how to improve students' concept understanding after using scratch-based interactive animation media.

2. METHOD

In this study, the method applied is the research and development (R&D) method. R&D is a research method that aims to create new products and assess their effectiveness so that these products provide benefits to the intended users (Yang et al., 2020). The analysis stage includes various types of analysis such as needs, learner characteristics, curriculum, media, competencies and indicators, and materials. For the material analysis, the material of the Structure and Function of the Body of Living Things was selected to be processed into an interactive multimedia animation using the Scratch application. In the design phase, this process includes the selection of hardware and software, organizing the material to be displayed in interactive animations, as well as developing flowcharts, storyboard sketches, media designs, layouts, and display backgrounds including other elements in the media. This stage also involves making evaluation tools through a collection of questions and game design. Currently, the product design is still a conceptual framework that forms the basis for product development. The development process continues by expanding the existing design using Canva and Scratch. After that, the developed product is tested by material and media experts who have been made with a grid that can be seen in Table 1 and Table 2 so that suggestions for improvement are obtained.

Table 1. Material Expert Assessment Instrument Grid

No.	Aspects	Indicator
1	Display Aspect	Attractive design
		Clear and attractive illustrations
		Clarity of audio and animation
		Easy-to-read fonts
2	Usage Aspect	Easy to access and simple to operate
		Media can be maintained/processed easily and can be used repeatedly
		Media can be installed and run on a variety of existing hardware and software.
		Media is interactive

Table 2. Media Expert Assessment Instrument Grid

No.	Aspects	Indicator
1	Content/material feasibility aspect	Suitability of material with learning objectives
		Accuracy of images and terms
		Accuracy of facts, concepts, and procedures
		Adaptability to the development of science and technology
2	Presentation and Language Aspects	Train concept understanding
		The sentences used are straightforward and communicative
		Appropriateness of language to learner development

The subjects in this study consisted of 34 students of class VIIIH at SMP Negeri 26 Semarang, who would be the main objects of observation, measurement, or intervention implemented by the researcher. The research involved not only students, but also teachers, a team of expert validators, and the researchers themselves. In this context, science teachers from SMP Negeri 26 Semarang have a role in collecting data through questionnaires related to the needs and assessment of interactive animated media. The validator team, consisting of media and material experts, served as assessors in the assessment of Scratch-based interactive animation media. The researcher is responsible for collecting data, developing products, and analyzing the results obtained.

The data collected through questionnaires in this study includes qualitative data derived from the data collected through questionnaires in this study includes two types of data: qualitative data derived from the experts' input, as well as quantitative data which includes assessment scores given by experts as validators and students as respondents. Qualitative data is obtained from the opinions, suggestions, and criticisms of the experts regarding the content and quality of the developed interactive animated media, while quantitative data consists of values given based on structured assessments. Data from the validation test results will be analyzed using a Likert scale, a measurement method used to assess attitudes, opinions, and perceptions of social phenomena with a weighted scale from 1 (not very good) to 4 (very good). This method allows researchers to quantify qualitative opinions and simplify the statistical analysis process. Scores from the validity test were then calculated using Aiken's V formula, a formula specifically designed to measure the level of validity of an instrument through the coefficient of content validity. The results of this calculation, which will be expressed as a percentage, will be further analyzed to evaluate the effectiveness of the developed product. The percentage obtained from this analysis gives an idea of how valid and effective the interactive animated media is in achieving the learning objectives that have been set.

3. RESULT AND DISCUSSION

Result

This research produces a product that is useful in overcoming science learning problems, especially student understanding of the material Structure and Function of the Body of Living Things, the product is in the form of scratch-based interactive animation media. This study was conducted to know the validity of scratch-based interactive animation media and how to increase students' concept understanding after using scratch-based interactive animation media.

Analysis Stage

In the analysis stage of media development, the main focus is to understand the characteristics of students who will use the media and analyze the media to set effective quality standards. The needs analysis was carried out by evaluating various digital media that have been developed by teachers for science education, as well as during the learning process that takes place at school. This analysis also involved interviews with teachers at SMP N 26 Semarang to gain a deeper understanding. The results of the observations and interviews showed that the use of learning media that are more innovative, motivating, fun, interesting, and that adapt to the latest technology, has not been optimized by teachers. The material that will be integrated into this learning media is Chapter 2 Structure and Function of the Body of Living Things, covering four subchapters namely: Food and Digestive System, Circulatory System, Respiratory System, and Excretory/Waste System. Based on the analysis conducted, an urgent need was identified to develop interactive animated media that supports the teaching of the structure and function of the body of living things, especially for junior high school students in grade VIII. This indicates a great potential to improve learning effectiveness through the application of technology that suits the needs and characteristics of students.

Design Stage

The design stage is the second step in the creation of learning media, where the media is specifically designed. At this stage, design elements are developed to ensure that the media is effective in the educational process. The results of this stage include the creation of a flow chart showing the organization and structure of the learning media, as shown in Figure 1.

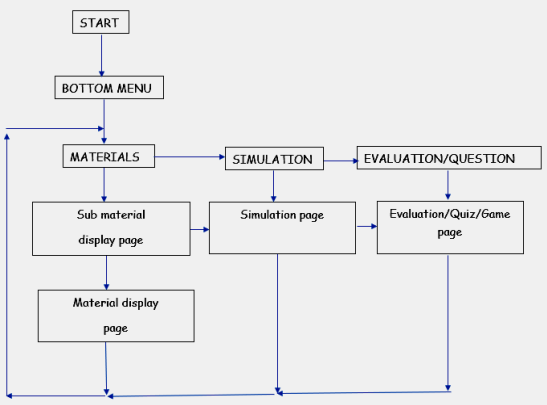

Figure 1. Media Flow Chart

Base on Figure 1, the flowchart that has been created is used as a guide in making the learning media. The background design is made using the Canva application, which supports the creation of attractive and professional visuals. This learning media was developed using the Scratch programming application, which facilitates the creation of interactive media with an attractive visual appearance. This media design is equipped with brightly colored images to attract attention and increase student motivation. Illustrations used in this media are also made using the Canva application, and all components that have been prepared are carefully integrated according to the storyboard that has been designed. To evaluate students' conceptual understanding of the material presented, this learning media is equipped with quizzes and games related to the material. These quizzes and games are not only to test knowledge, but also to make the learning process more fun and interesting for students, which in turn increases the effectiveness of learning in general.

Development Stage

The "Development" stage is the phase where the results of the previous analysis and design are realized into ready-to-use media products. In this stage, visual elements such as background images are created using Canva. Then, the previously prepared supporting components of the app are integrated according to the storyboard layout designed using Canva and Scratch, ensuring perfect integration of all elements. The development process involved programming using the Scratch app, which uses a block-based programming approach. The implemented code was tested to ensure that the functions within the media operated according to the defined storyboard. Examples of the results of this development stage are shown in Figure 2, and Figure 3.

Figure 2. Main Page Display Figure

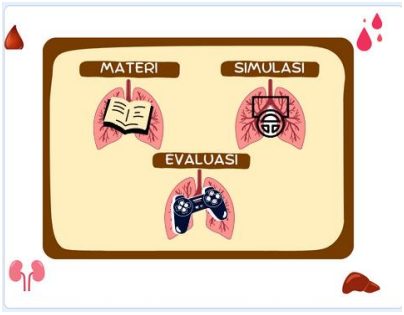

Figure 3. Home Page Display

After the stage of designing and making media using various software, the next stage is media product validation. This validation involves experts to test and evaluate whether the media product meets the expected quality and effectiveness standards. After that, the product is also tested on students to

assess their reaction to the media and collect feedback that will be used for further product improvement. This validation and pilot test is an important step to ensure that the developed learning media functions properly and effectively in an educational environment. The results of the assessment from material experts and media experts on this learning media are presented in Table 3, and Table 4.

Table 3. Media Expert Assessment Results

Indicator	Average	Criteria
Display Aspect	0.92	Very Valid
Usage Aspect	0.98	Very Valid

Table 4. Material Expert Assessment Results

Indicator	Average	Criteria
Content/material Appropriateness	0.90	Very Valid
Presentation and Language Aspects	0.93	Very Valid

Based on Table 3 and Table 4, the feedback and evaluation from the media and material experts, the interactive learning media created using the Scratch application was declared in the "Very Valid" category. Based on the recommendations from the experts, some improvements were made to the design of the interactive learning media to address some aspects that needed improvement. After the improvement process, the media was tested on a group of 34 students, and they filled out a readability questionnaire after using the media. The results of this readability questionnaire showed that the learning media was categorized as "Highly Valid", indicating its effectiveness in the learning context.

Implementation Stage

This learning media, created using the Scratch platform, has been implemented and disseminated to students via a link sent via WhatsApp, allowing students to access and open the application from their laptops. Furthermore, the students were directed to pilot this interactive media to evaluate its effectiveness in the learning context. The learning process regarding the structure and function of the body of living things through this interactive animated media includes three main stages: beginning, core, and end, which are designed according to the needs of the Merdeka curriculum. In the context of evaluating understanding, tests are held to measure students' understanding of the material, carried out at two important moments, namely before and after learning takes place. This test is important to assess the effectiveness of interactive animation media developed with Scratch in improving students' understanding of concepts. The test was held in class, where students answered questions individually but under the supervision of the researcher to ensure data integrity. This supervision is important to ensure that the data collected truly reflects students' understanding of the material taught. The results of this test are presented in a table that records the post-test results for each item related to understanding natural science concepts as show in Table 5.

Table 5. Results of Student Concept Understanding Assessment on Material

Indicator of Concept Understanding	Percentage %	Criteria
Restate a concept	98	Very High
Classifying an object	97	Very High
Presenting examples and non-examples of a concept	87	Very High
Presenting concepts in the form of mathematical representations	72	High
Select and perform procedures	93	Very High
Develop and review concepts	70	Medium
Implement or relate to real-life	93	Very High

Table 5 illustrates the level of concept understanding by students, providing a clear indication of the effectiveness of using Scratch-based interactive animation media in the learning process. The recapitulation of the item tests on the understanding of concepts on the material of the structure and function of the body of living things.

Evaluation Stage

During the evaluation stage, the developed interactive learning media undergoes a series of improvements and revisions. This step is taken based on feedback received from experts, teachers, and students who participated in the media trial. The purpose of these revisions is to ensure that the app

meets the standards of effectiveness and feasibility for use in science learning. The app was developed to support both classroom and individual learning and is customized for use on computers or laptops with a minimum Windows 10 operating system. This evaluation process also included media testing to calculate the N-Gain value, with the results shown in Table 6.

Table 6. N-Gain Hail

Form of Assessment	Average	N-Gain Value	Gain Interval	Criteria
Pre-test	57	0.57	0.30 ≤ N-Gain ≤ 0.70	Medium
Post-test	80.52			

Based on the data presented in Table 6, it is known that the average value of the pre-test before using learning media is 57, while the average value of the post-test after using interactive animation media is 80.52. There was an increase in the average score from the pre-test to the post-test of 0.57, which is included in the criteria for moderate improvement. The general evaluation shows that respondents generally agree that the interactive learning media developed is effective in supporting the learning process, both in the context of traditional classes and in independent learning.

Discussion

The media that has been developed by researchers in the form of interactive animation media focusing on the material of the structure and function of the body of living things has gone through a thorough validation process by five experts before further testing (Saputri et al., 2018; Yulando et al., 2019). This validation process involved an in-depth examination and evaluation of various important aspects of the media. After a thorough evaluation by the validators, the media scored high on various important aspects such as visual quality, usability, content relevance, and presentation and language use (Legina & Sari, 2022; Sagala & Widyastuti, 2022). Specifically, it scored an average of 0.92 for visual aspects, 0.98 for usability, 0.90 for content relevance, and 0.93 for presentation and language. All these scores confirmed the classification of the media as highly valid and of high quality.

Furthermore, the visual aspect of the media includes several important elements such as an attractive design that attracts students' attention, illustrations that are effective in explaining concepts visually, clear audio to ensure that information can be heard properly, high-quality animations that make the material more vivid and interesting, and easy-to-read typography so that the text can be easily understood by learners. The usability aspect was assessed based on several key criteria, including ease of access which allows students and teachers to easily access the media, simplicity of operation which ensures that the media can be used without technical difficulties, easy maintenance so that the media can be continuously updated and maintained, reusability that allows students to repeat the material if needed, and compatibility with various hardware and software, including interactive properties that support effective and engaging use for students (Haataja et al., 2019; Ivanović et al., 2013).

In terms of content relevance, the media was assessed based on its suitability to the learning objectives that have been set, the strength of the visuals that help in attracting students' attention, the accuracy of the information that ensures that all data and facts presented are correct and up-to-date, and the relevance to the latest technology and science that ensures that this media remains actual and useful in the modern educational context (Pandansari & Gafur, 2016; Shabri et al., 2017). For the presentation and linguistic aspects, the media was assessed for its ability to facilitate understanding of concepts in a way that is easy for students to understand, effective use of language that is appropriate to the level of understanding of learners, and presentation structure that helps in clarifying the material being taught (Langum & Sullivan, 2020; Liu & Chung, 2022). This assessment shows that, although many similar media are available online, the developed media offers content and structure specifically designed to increase learner engagement, motivation, and understanding in utilizing interactive animated media as a tool in learning.

Furthermore, in the context of concept understanding, the test questions consisted of 25 items specifically designed to measure certain desired indicators of concept understanding. The results of the test showed that all students managed to answer the questions correctly. From these results, it can be concluded that although students previously showed a low understanding of the material being taught, they have now managed to understand the concepts being presented through the use of well-designed test items (Aulia & Khalid Riefani, 2021; Mohammadi et al., 2022). This demonstrates the effectiveness of the test questions in identifying and improving students' understanding of the material being studied, as well as showing significant improvements in their ability to understand new concepts. All of these data reinforce the argument that the media and questions developed are well suited to support the learning process, improve concept understanding, and facilitate effective evaluation of student learning

achievement (Lampropoulos et al., 2019; Taştan et al., 2018). Thus, the designed interactive animated media and test questions have proven effective in creating a supportive learning environment and improving the quality of learning and students' concept understanding.

Therefore, based on the analysis conducted in this study, the interactive animation media developed using the Scratch platform specifically for the material of the structure and function of the body of living things for class VIII students has been proven to have excellent quality. This media is not only valid but also effective in the context of education at the junior high school level. The feasibility and effectiveness of this media in supporting the learning process are supported by the results of previous studies which show that the use of interactive media in education can significantly improve the quality of student learning (Majid, 2017; Sudarman et al., 2020). The results of this study reinforce the idea that the integration of interactive animated media, particularly those created with Scratch, into the curriculum, is an effective strategy to improve students' understanding of complex subject matter and support the achievement of better learning outcomes (Oktavianingtyas et al., 2018).

In addition, evidence from other studies also supports that interactive media is suitable for use in primary education settings and can be considered an effective alternative learning resource in the classroom. It is proven that the use of interactive media can increase student activity and engagement in the learning process, as well as provide opportunities for teachers to present subject matter more interestingly and interactively (Cole & Feng, 2015; Lapitan et al., 2021). These findings add to the evidence that interactive media, including the interactive animated media developed using Scratch in this study, have great potential to improve concept understanding among secondary school students and are also very suitable for implementation in elementary schools. This expands the possible benefits of using interactive media at different levels of education. The application of interactive multimedia has been proven to improve students' concept understanding (Suwiantini et al., 2021).

The development of this interactive media carefully considers the challenges faced in the school environment as well as the needs that exist there. The purpose of this Scratch-based learning media is to be an effective tool for teachers and prospective teachers in delivering materials and facilitating students' understanding of the content taught. The use of well-designed and high-quality learning media will not only facilitate the teaching process for teachers but will also have a positive impact on student learning outcomes by making it easier for them to receive and process the information presented (Marshman et al., 2020; Satria & Sopandi, 2022). One of the main advantages of interactive multimedia is its ability to combine different types of media, thus making it very flexible for various forms of learning, including self-study, online, and traditional classrooms. This makes it easy for students with different abilities and learning styles to access and utilize this media easily.

Ease of use of the interactive media is also ensured as it can be accessed through any other computer or mobile device via a link, which simplifies its distribution and use. Based on the evaluation that states that this media is "very valid," the interactive multimedia that has been developed is very feasible to be used as a science learning media for junior high school students. Furthermore, the use of this interactive animated media has been shown to improve concept understanding in students. The implication of this research is the existence of Scratch-based interactive animation media specifically made for the material of the structure and function of the body of living things in class VIII. This media is not only valid but also very effective in supporting the learning process at school.

4. CONCLUSION

After a detailed review, it is evident that the interactive animated media created using the Scratch platform is highly effective and meets the criteria as a valid learning tool. Not only does it meet the necessary standards but it also provides teaching conveniences that make learning more interesting and enjoyable. It is expected that this will increase students' motivation which can significantly improve their learning outcomes. In addition, it integrates game elements that are not only entertaining but also support active learning visually and auditory. It is also designed to be easily adapted by educators, including prospective teachers, making it a valuable resource for professional development and teaching preparation. Based on this comprehensive evaluation, it is clear that the Scratch-based interactive animated media is highly feasible and effective to use for science learning at the junior high school level, suggesting that it can be an important tool in improving concept understanding and the quality of learning in general.

5. REFERENCES

Aada, K. (2020). Insight on Planning and Assessing the Teaching-Learning Process. *International Journal*

on Social and Education Sciences, *2*(2), 88–96. https://scholarworks.utrgv.edu/wls_fac/14/.

Aniati, S., Degeng, I. N. S., Sugito, S., & Deta, U. A. (2021). Pengembangan media emodul berbasis multiple intellegences untuk meningkatkan pemahaman konsep struktur bumi. *Jurnal Pendidikan Edutama*, *7*(2). https://doi.org/10.30734/jpe.v7i2.919.

Ariani, D. P., & Puspasari, D. (2021). Pengembangan media pembelajaran interaktif berbasis power live quiz pada materi mail handling di SMKN 10 Surabaya. *Jurnal Pendidikan Tambusai*, *6*(2), 14800–14815. https://doi.org/10.31004/jptam.v6i2.4759.

Ariawati, K. N., Suarjana, I. M., & Sudarmawan, G. A. (2022). Implementasi Model Discovery Learning Berbantuan Powerpoint Terhadap Hasil Belajar IPA. *Jurnal Ilmiah Pendidikan Dan Pembelajaran*, *5*(2), 332–342. https://doi.org/10.23887/jipp.v5i2.36781.

Aulia, D., & Khalid Riefani, M. (2021). Google Site as a Learning Media in the 21st Century on the Protista Concept. *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan*, *3*(3), 173–178. http://download.garuda.kemdikbud.go.id/article.php?article=2305629&val=16943.

Bernard, M., & Setiawan, W. (2020). Developing math games media using scratch language. *In Journal of Physics: Conference Series*, 1657. https://doi.org/10.1088/1742-6596/1657/1/012064.

Boholano, H. (2017). Smart social networking: 21st Century teaching and learning skills. *Research in Pedagogy*, *7*(2), 21–29. https://doi.org/10.17810/2015.45.

Chiang, F. K., & Qin, L. (2018). A Pilot study to assess the impacts of game-based construction learning, using scratch, on students' multi-step equation-solving performance. *Interactive Learning Environments*, *26*(6), 803–814. https://doi.org/10.1080/10494820.2017.1412990.

Cole, J., & Feng, J. (2015). Effective strategies for improving writing skills of elementary English language learners. *Chinese American Educational Research and Development Association Annual Conference*, 1–25. https://eric.ed.gov/?id=ED556123.

Dewanti, P., Supuwiningsih, N. N., & Saridewi, D. P. (2021). Utilizing Educational Technologies to Optimize Student and Teacher Learning at Dharma Laksana Mataram Orphanage. *Journal of Innovation and Community Engagement*, *2*(1), 11–20. https://doi.org/10.28932/jice.v2i1.3601.

Dewi, N. R., Yanitama, A., Listiaji, P., Akhlis, I., Hardianti, R. D., Kurniawan, I. O., & Rumah, P. P. (2021). *Pengembangan Media dan Alat Peraga: Konsep & Aplikasi dalam Pembelajaran IPA*. Penerbit Pustaka Rumah C1nta.

Haataja, E., Garcia Moreno-Esteva, E., Salonen, V., Laine, A., Toivanen, M., & Hannula, M. S. (2019). Teacher's visual attention when scaffolding collaborative mathematical problem solving. *Teaching and Teacher Education*, *86*. https://doi.org/10.1016/j.tate.2019.102877.

Hamdani, A. D., Nurhafsah, N., & Silvia, S. (2022). Inovasi Pendidikan Karakter Dalam Menciptakan Generasi Emas 2045. *JPG : Jurnal Pendidikan Guru*, *3*(3), 170–178. http://ejournal.uika-bogor.ac.id/index.php/jpg/article/viewFile/7291/3738.

Handayani, S. L. (2022). ANIMA-LIE: Android-Based Learning Media on Animal Life Cycles Materials for Elementary School. *Jurnal Ilmiah Sekolah Dasar*, *6*(2), 287–294. https://doi.org/10.23887/jisd.v6i2.45359.

Harefa, D., Sarumaha, M., Fau, A., Telaumbanua, T., Hulu, F., Telambanua, K., Sari Lase, I. P., Ndruru, M., & Marsa Ndraha, L. D. (2022). Penggunaan Model Pembelajaran Kooperatif Tipe Jigsaw Terhadap Kemampuan Pemahaman Konsep Belajar Siswa. *Aksara: Jurnal Ilmu Pendidikan Nonformal*, *8*(1), 325. https://doi.org/10.37905/aksara.8.1.325-332.2022.

Höft, L., & Bernholt, S. (2019). Longitudinal couplings between interest and conceptual understanding in secondary school chemistry: an activity-based perspective. *International Journal of Science Education*, *41*(5), 607–627. https://doi.org/10.1080/09500693.2019.1571650.

Irwandi, & Fajeriadi, H. (2019). Pemanfaatan Lingkungan sebagai Sumber Belajar untuk Meningkatkan Minat dan Hasil Belajar Siswa SMA di Kawasan Pesisir, Kalimantan Selatan. *BIO-INOVED : Jurnal Biologi-Inovasi Pendidikan*, *1*(2), 66–73. https://ppjp.ulm.ac.id/journal/index.php/bino/article/view/7859.

Isnandar, S., Sutomo, B., Pratama, N. A., & Nanda, A. P. (2022). Game Mengenal Huruf Berbasis Android Menggunakan Mit App Inventor Untuk Anak Usia 4-7 Tahun Perkembangan teknologi dan yang pesat memberikan pengaruh yang kuat pada berbagai bidang kehidupan, salah edukasi. Game berjenis edukasi ini bertujuan untuk mema. *Alih Teknologi Sistem Informasi (JATSI*, *1*(1), 1–8. https://doi.org/10.37301/cerdas.v10i2.169.

Ivanović, M., Putnik, Z., Komlenov, Ž., Welzer, T., Hölbl, M., & Schweighofer, T. (2013). Usability and privacy aspects of moodle: Students' and teachers' perspective. *Informatica (Slovenia)*, *37*(3), 221–230. https://www.informatica.si/index.php/informatica/article/download/451/455.

Lampropoulos, G., Siakas, K., & Anastasiadis, T. (2019). Internet of Things in the Context of Industry 4.0: An Overview. *International Journal of Entrepreneurial Knowledge*, *7*(1), 4–19.

https://doi.org/10.2478/ijek-2019-0001.

Langum, V., & Sullivan, K. P. H. (2020). Academic writing, scholarly identity, voice and the benefits and challenges of multilingualism: Reflections from Norwegian doctoral researchers in teacher education. *Linguistics and Education*, *60*(December 2020,), 100883.1-10. https://doi.org/10.1016/j.linged.2020.100883.

Lapitan, L. D., Tiangco, C. E., Sumalinog, D. A. G., Sabarillo, N. S., & Diaz, J. M. (2021). An effective blended online teaching and learning strategy during the COVID-19 pandemic. *Education for Chemical Engineers*, *35*, 116–131. https://doi.org/10.1016/j.ece.2021.01.012.

Legina, N., & Sari, P. M. (2022). Pengembangan Media Pembelajaran Interaktif Articulate Storyline Berbasis Keterampilan Berpikir Kritis pada Pembelajaran IPA bagi Siswa Sekolah Dasar. *Jurnal Paedagogy*, *9*(3), 375. https://doi.org/10.33394/jp.v9i3.5285.

Liu, C., & Chung, K. K. H. (2022). Effects of fathers' and mothers' expectations and home literacy involvement on their children's cognitive–linguistic skills, vocabulary, and word reading. *Early Childhood Research Quarterly*, *60*(3), 1–12. https://doi.org/https://doi.org/10.1016/j.ecresq.2021.12.009.

Mahadi, U. (2021). Komunikasi pendidikan (urgensi komunikasi efektif dalam proses pembelajaran. *JOPPAS: Journal of Public Policy and Administration Silampari*, *2*(2), 80–90. https://doi.org/10.31539/joppa.v2i2.2385.

Mailani, E., Setiawati, N. A., Surya, E., & Armanto, D. (2022). Implementasi Realistics Mathematic Education dalam Meningkatkan Keterampilan Berfikir Tingkat Tinggi/HOTS pada Siswa Sekolah Dasar. *Jurnal Basicedu*, *6*(4), 6813–6821. https://doi.org/10.31004/basicedu.v6i4.2855.

Majid, N. A. (2017). The importance of teachers' interpersonal communication skills in enhancing the quality of teaching and learning. *World Applied Sciences Journal*, *35*(6), 924–929. https://doi.org/10.5829/idosi.wasj.2017.924.929.

Marshman, E., Singh, C., Marshman, E., Singh, C., Smith, C. M., Housh, T. J., & Hill, E. C. (2020). *Developing math games media using scratch language Developing math games media using scratch language*. https://doi.org/10.1088/1742-6596/1657/1/012064.

Mohammadi, M., Abbasian, G.-R., & Siyyari, M. (2022). Adaptation and validation of a critical thinking scale to measure the 3D critical thinking ability of EFL readers. *Language Testing in Asia*, *12*(1). https://doi.org/10.1186/s40468-022-00173-6.

Mukhtar, S., & Putri, K. Y. S. (2021). Technology integrated on media literacy in economic studies on higher education. *Journal of Social Studies Education Research*, *12*(1), 95–123. https://www.learntechlib.org/p/219409/.

Munzil, M., Affriyenni, Y., Mualifah, S., Fardhani, I., Fitriyah, I. J., & Muntholib, M. (2022). Development of problem based learning based e-modules in the form of flipbooks on environmentally friendly technology materials as an independent learning material for students especially online learning. *Jurnal Pendidikan Sains Indonesia*, *10*(1), 37–46. https://doi.org/10.24815/jpsi.v10i1.21807.

Ningsih, I. H., Winarni, R., & Roemintoyo, R. (2019). The Importance Of Early Reading Learning In The Face Of 21st Century Education. *AL-ASASIYYA: Journal Of Basic Education*, *3*(2), 196. https://doi.org/10.24269/ajbe.v3i2.1879.

Odondi, W. (2024). Empowering equality: Advancing quality education in the contemporary global landscape. *Future in Educational Research*, *2*(1), 40–48. https://doi.org/10.1002/fer3.26.

Oktaviana, E., & Yudha, C. B. (2022). Tecnological Pedagogical Content Knowledge (TPACK) dalam pembelajaran abad ke-21. *Social, Humanities, and Educational Studies (SHES): Conference Series*, *5*(2), 57–64. https://doi.org/10.20961/shes.v5i2.58305.

Oktavianingtyas, E., Salama, F. S., Fatahillah, A., Monalisa, L. A., & Setiawan, T. B. (2018). Development 3D Animated Story As Interactive Learning Media With Lectora Inspire And Plotagon On Direct And Inverse Proportion Subject. *Journal Of Physics: Conference Series*, *1108*(1). https://doi.org/10.1088/1742-6596/1108/1/012111.

Pandansari, P., & Gafur, A. (2016). Pengembangan Multimedia Interaktif Untuk Pembelajaran Desain Busana di SMK. *Jurnal Inovasi Teknologi Pendidikan*, *3*(2), 237. https://doi.org/10.21831/jitp.v3i2.11014.

Payu, C. S., Mursalin, M., Abbas, N., Umar, M. K., Yusuf, F. M., & Odja, A. H. (2022). Development of Guided Inquiry Learning Model Based on Critical Questions to Improve Critical Thinking on the Concept of Temperature and Heat. *Journal of Humanities and Social Sciences Studies*, *4*(2), 174–180. https://doi.org/10.32996/jhsss.2022. 4.2.21.

Praheto, B. E., Andayani, Rohmadi, M., & Wardani, N. E. (2020). The effectiveness of interactive multimedia in learning Indonesian language skills in higher education. *Rupkatha Journal on Interdisciplinary Studies in Humanities*. https://doi.org/10.21659/rupkatha.v12n1.34.

Pratama, R., Alamsyah, M., Siburian, M. F., Marhento, G., & Jupriadi, J. (2023). Pemanfaatan Canva Sebagai Media Pembelajaran IPA di Madrasah Aliyah. *EduBiologia: Biological Science and Education Journal*, *3*(1), 40–46. https://doi.org/10.30998/edubiologia.v3i1.16070.

Rasheed, R. A., Kamsin, A., & Abdullah, N. A. (2020). Computers & Education Challenges in the online component of blended learning : A systematic review. *Computers & Education*, *144*(September 2019), 103701. https://doi.org/10.1016/j.compedu.2019.103701.

Sagala, P. N., & Widyastuti, E. (2022). Development of Junior High School Mathematics E-Modules Based on Project Based Learning Integrated by Merdeka Belajar. *Proceedings of the 6th Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2021)*, *591*(Aisteel), 891–897. https://doi.org/10.2991/assehr.k.211110.200.

Saputri, D. Y., Rukayah, R. R., & Indriayu, M. I. (2018). Integrating Game-based Interactive Media as Instructional Media: Students' Response. *Journal of Education and Learning (EduLearn)*, *12*(4), 638–643. https://doi.org/10.11591/edulearn.v12i4.8290.

Satria, E., & Sopandi, W. (2022). Creating Science Online Learning Media Using Scratch App Block Programming. *KnE Social Sciences*, *372–384*. https://doi.org/10.18502/kss.v7i6.10639.

Schmidt, D. A., Thompson, A. D., Koehler, M. J., & Shin, T. S. (2014). Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *CIE 2014 - 44th International Conference on Computers and Industrial Engineering and IMSS 2014 - 9th International Symposium on Intelligent Manufacturing and Service Systems, Joint International Symposium on "The Social Impacts of Developments in Informat*, *42*(2), 2531. https://doi.org/10.1080/15391523.2009.10782544.

Shabri, M., Hajar, I., & Setiawan, D. (2017). Learning Media Assessment By Media Expert Validator on Social Science Learning Based on Learning Model of Examples Non Examples To Improve Critical Thinking Ability on V Grade Students At Primary School 1 Jangka District, Bireuen Regency, Indonesia. *International Journal of Education, Learning and Development*, *5*(8), 18–29. https://ejournal.unhasy.ac.id/index.php/ijpse/article/view/3319.

Sopandi, D., & Andina Sopandi, N. (2021). *Perkembangan Peserta Didik*. Deepublish.

Sudarman, Riyadi, R., & Astuti, R. F. (2020). *Development of Interactive Learning Multimedia to Increase Understanding of Basic Skills Teaching Procedures*. *432*(Esic 2019), 132–136. https://doi.org/10.2991/assehr.k.200417.030.

Sutardi, D., Sari, W. K., & Priyopradono, B. (2022). Visualization of Science Literacy in Learning Based on STEM at Natural Schools Bengkulu Indonesia. *Jurnal Georafflesia*, *7*(2), 196–203. https://doi.org/10.32663/georaf.v7i2.3166.

Suwiantini, L. A., Jampel, I. N., & Astawan, I. G. (2021). Learn Energy Sources with Interactive Learning Multimedia. *Jurnal Ilmiah Sekolah Dasar*, *5*(1), 119. https://doi.org/10.23887/jisd.v5i1.35000.

Taştan, S. B., Mehdi, S., Davoudi, M., Masalimova, A. R., Bersanov, A. S., Kurbanov, R. A., Boiarchuk, A. V, & Pavlushin, A. A. (2018). The Impacts of Teacher's Efficacy and Motivation on Student's Academic Achievement in Science Education among Secondary and High School Students. *EURASIA Journal of Mathematics Science and Technology Education*, *14*(6), 2353–2366. https://doi.org/10.29333/ejmste/89579.

Utomo, M. G. N., Degeng, I. N. S., & Praherdiono, H. (2022). Pengembangan Kartu Dengan Teknologi 3D Augmented Reality Sebagai Media Visual Tematik Untuk Siswa Kelas VI SD. *JKTP: Jurnal Kajian Teknologi Pendidikan*, *5*(2), 162–171. https://doi.org/10.17977/um038v5i22022p162.

Widianto, A. . (2021). Pemanfaatan Media Pembelajaran Berbasis Teknologi Informasi. *Journal of Education and Teaching*, *2*(2), 213–224. https://www.jurnal.stkippgritulungagung.ac.id/index.php/jipi/article/view/4121.

Yang, S., Fichman, P., Zhu, X., Sanfilippo, M., Li, S., & Fleischmann, K. R. (2020). The use of ICT during COVID -19 . *Proceedings of the Association for Information Science and Technology*, *57*(1), 1–5. https://doi.org/10.1002/pra2.297.

Young, T., Hazarika, D., Poria, S., & Cambria, E. (2018). Recent trends in deep learning based natural language processing. *Ieee Computational IntelligenCe Magazine*, *13*(3), 55–75. https://doi.org/10.1109/MCI.2018.2840738.

Yulando, S., Sutopo, S., & Franklin Chi, T. (2019). Electronic Module Design and Development: An Interactive Learning. *American Journal of Educational Research*, *7*(10), 694–698. https://doi.org/10.12691/education-7-10-4.

Zubaidah, S. (2019). STEAM (Science, Technology, Engineering, Arts, and Mathematics): Pembelajaran untuk Memberdayakan Keterampilan Abad ke-21. *Seminar Nasional Matematika Dan Sains*, *September*, 1–18. https://doi.org/https://doi.org/10.14697/jkase.2012.32.6.1072.