Development of Natural Sciences Learning Media Based on Science Literacy on the Topic of Solar System in Elementary School

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Abstract: The lack of learning media that enables students to learn makes it challenging to understand the learning material. This research aims to describe the design process of solar system multimedia products and determine the validation results of solar system multimedia products according to the results of expert reviews and individual trials. This development research uses the ADDIE (Analysis, Design, Development, Implementation, Evaluation) method. Data collection uses a questionnaire method. The research results show that the learning media developed has a very feasible category, with the results of student responses being very feasible with an overall average percentage of 95% and the results of teacher responses getting a percentage of 89.3% with a very feasible category. This demonstrates how well-suited the learning resources created for the solar system are for use as classroom instruction. According to the research, learning materials could be a solution for creating science learning materials that improve and ease students' comprehension, particularly regarding solar system content.

Abstrak: Kurangnya media pembelajaran yang membuat siswa dalam belajar membuat siswa sulit memahami materi pembelajaran. Penelitian ini bertujuan untuk mendeskripsikan proses rancang bangun dari produk multimedia sistem tata surya dan mengetahui hasil validasi produk multimedia sistem tata surya menurut hasil review para ahli dan uji coba perorangan. Penelitian pengembangan ini menggunakan metode ADDIE (Analysis, Design, Development, Implementation,Evaluation). Pengumpulan data menggunakan metode kuesioner. Berdasarkan hasil penelitian menunjukkan media pembelajaran yang dikembangkan memiliki kategori sangat layak, dengan hasil dari Hasil respon peserta didik yang sangat layak dengan hasil rata-rata keseluruhan presentase sebesar 95% dan hasil dari respon guru mendapatkan presentase sebesar 89,3% dengan kategori sangat layak. Hal ini menunjukkan bahwa media pembelajaran yang di kembangkan dalam materi sistem tata surya sangat layak untuk digunakan sebagai bahan ajar dalam kelas. Penelitian meyakini bahwa media pembelajaran yang dikembangakan ini dapat jadi solusi dalam pengembangan media pembelajaran IPA yang memudahkan dan meningtkatkan pemahaman peserta didik khususnya pada materi sistem tata surya.

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A. Introduction

Education is a technique to promote human behavior toward more favorable outcomes and is a way to develop each person's potential from infancy to old age. In order to enhance each person's knowledge, abilities, and experience, education plays a crucial role. According to Chapter II Article 3 of Law of the Republic of Indonesia No. 20 of 2003 concerning the National Education system, which outlines the goals of national education, national education's role is to ensure that students can develop their skills in order to create a respectable national character and civilization as an endeavor to educate the nation's life. Generally speaking, pupils need to possess three skills: psychomotor skills (attitude), practical skills (attitude), and cognitive skills (knowledge). Education developed in line with the growth of students' skills and competencies is considered good. As technology advances, it will also lead to technology usage at all educational levels, including elementary, middle, and even university. However, several issues still plague Indonesian education today, particularly in underprivileged institutions, including low teacher quality, poor student accomplishment, and inadequate infrastructure. A teacher's quality combines the personal qualities, abilities, and knowledge they bring to the classroom. Higher education levels in a nation are positively correlated with higher-quality human resources that can propel that nation forward and inspire pride.

As the driving force behind raising the standard of education, teachers are crucial to the improvement of human resources as well as the provision of suitable facilities and infrastructure for learning. The ability to make the most of learning material is one of a good teacher's skills. According to the findings of a learning process, students must constantly engage with the available learning resources to meet more successful learning objectives. This indicates that the learning process defines how to improve the quality of education (Retnowati et al., 2019).

Open media, or learning aids, are the most widely produced educational resources. The most crucial element that is inextricably linked to education is learning media. The media plays a crucial role when helping students meet specific learning goals. By using learning media, students can quickly obtain an adequate level of learning and material from the teacher. Even though comprehension is different, the advancement of the learning process is likewise impacted by increasingly sophisticated technological innovations.

The digital age is currently in Indonesian society. This circumstance, particularly schooling, impacts numerous facets of life. Every person needs to improve at competing in a more extensive range of situations, particularly in the current digital world. The demands of the 21st century require education to adapt to changing times.

Scientific literacy skills are one of the competencies required to navigate the contemporary digital world. The ability to identify a problem, learn new information, explain scientific occurrences, and make evidence-based decisions about scientific matters is known as scientific literacy.

One of the abilities needed to function in the modern digital world is scientific literacy. The ability to identify a problem, learn new information, explain scientific

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occurrences, and make evidence-based decisions about scientific matters is known as scientific literacy.

The issue that arises. Based on the description above, researchers developed science and science learning media based on scientific literacy on solar system material. The Solar System is a collection of celestial bodies consisting of the Sun and all objects bound by its gravitational force. These objects include eight known planets with elliptical orbits, five dwarf planets, 173 identified natural satellites, and millions of other celestial objects (meteors, asteroids, comets). Solar system material in science and science learning is one of the science literacy topics that is important but complicated for students to master (Aulia, 2023; World Today News, 2023).

The current urgency and issues led to the selection of this scientific literacy-based development. The issue at SDK Boba is the dearth of educational resources that can aid in the processing and reception of information, which impacts students' literacy abilities, particularly in the scientific domain. These issues make it crucial to provide science and science learning materials based on scientific literacy about the solar system that can be utilized as a teaching tool for students. Research and Development (R&D) is the form of research that is employed based on the issues that have been researched. The ADDIE development approach, which consists of Analysis, Design, Development, Implementation, and Evaluation, is used in research on creating science literacy-based science learning materials about the solar system. An entire class of sixth-grade kids at SDK Boba served as the research subjects for this study. Science and technology learning materials based on scientific literacy about the solar system are the focus of this development research.

Validation sheets and questionnaires for instructor and student responses were used to obtain the data. The first stage of this research, called "Analysis," consists of a needs analysis to identify the goals of creating learning media as well as a material analysis involving learning outcomes, learning objectives, and the flow of learning objectives by the curriculum used by the school, precisely material about the solar system (Fadhilah & Guspatni, 2023).

Planning the learning media concept and making sure the solar system learning materials align with the learning objectives constitute the second stage, design. In this instance, the study creates learning media products that align with the solar system, which is the teaching material. Development, research, and validity testing by three experts—Media, Material, and Language Experts—make up the third stage. Testing the product and having potential users—students and teachers—complete answer surveys constitute the fourth step of implementation. The evaluation stage is the last one. In order to ascertain the product's degree of validity and practicality and determine whether or not it is appropriate for use in science education, an evaluation is conducted at this point based on the findings of the practicality test conducted by teachers and students and the feasibility test conducted by the validators.

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B. Method

Research and Development (R&D) research and development approaches are used in this study. Sugiyono (2016) states that research and development methods (R&D) are techniques used to create a product and evaluate its efficacy. According to the study, research and development (R&D) procedures are used to create and validate a product that may be employed in educational activities (Yayuk et al., 2018; Bayés & Iglesias, 2019). This approach can be characterized as a procedure for creating a new product or refining an existing one to account for it.

The ADDIE design methodology was used in the research and production of this instructional resource. The ADDIE model is a general approach model and can make it easier for a program designer, educator, and instructor to create an effective, efficient, and engaging learning program. In line with research (Abdullah et al., 2022) states that the ADDIE model consists of an analysis stage (analysis), planning stage (design), development stage (development), implementation stage (implementation), and evaluation stage (evaluation). These five stages are carried out systematically and sequentially, and each stage of the ADDIE model is evaluated to produce a product worth using (Hajar et al., 2023).

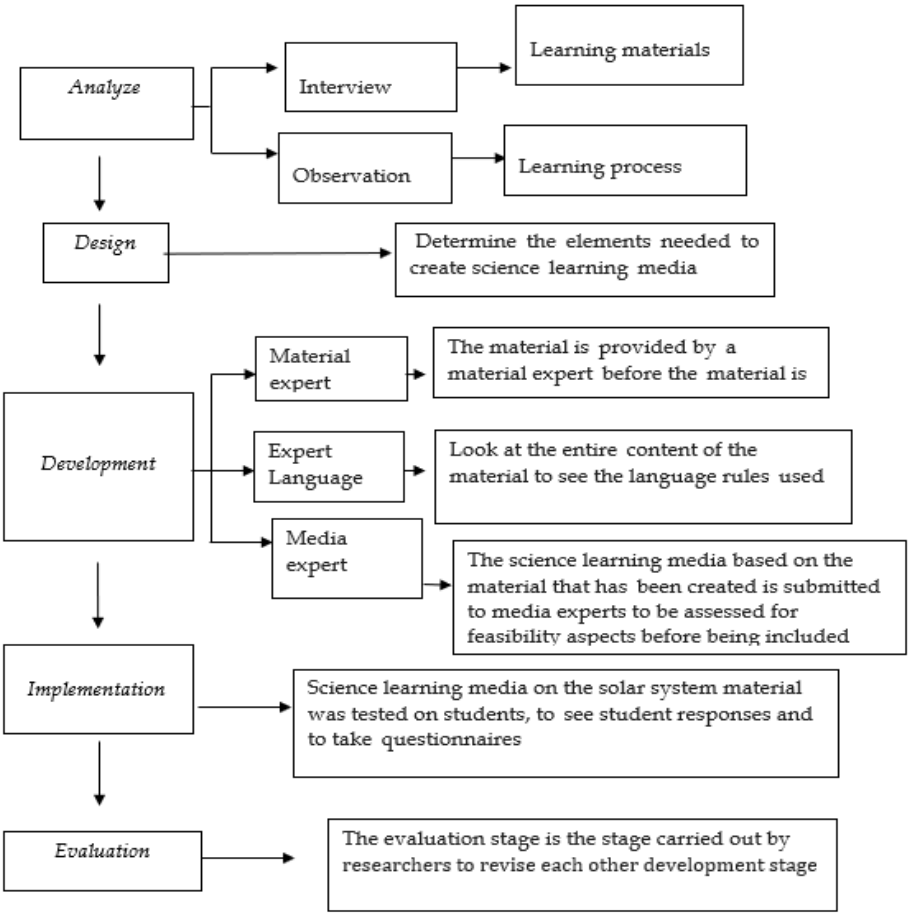

Figure 1. ADDIE Model Development Flow

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The data-gathering method uses instruments such as evaluation tests, questionnaires, and validation sheets in this study. The validity of the science learning resources in the content is assessed using the validation sheet. The language and content have been modified to reflect the developmental stage of the pupils. Questionnaires assess the usefulness of teaching resources, while the impact of science learning resources on solar system content is assessed through evaluation tests. Two methods of data analysis are used in this study: qualitative and quantitative evaluation.

Before the instructional materials are tested, media, material, and language specialists provide feedback and recommendations for product enhancements in the qualitative section. Meanwhile, quantitative research uses questionnaire scores (expert validation questionnaire, teacher response questionnaire, and student questionnaire and scores). The test subjects in this research were class VI students at SDK Boba, South Golewa District. The total number of class VI students is 19, and 10 students were used as a trial. The quantitative data analysis process is carried out using the formula described as follows (Jainuri et al., 2023).

$$NP = R/SM \ X100\%$$

Information:
NP = Percent value sought or desired
R = Initial score obtained
SM = Maximum score that can be achieved
100 = Fixed number (Bahtiar et al., 2024)

The percentage values that have been calculated are then compared with the percentage interpretation table on the Likert scale attached in Table 1 below.

Table 1. Percentage Interpretation of Likert Scale Results

No	Interpretation	Percentage
1	Very inadequate	1%-20%
2	Not feasible	21%-40%
3	Fairly decent	41%-60%
4	Worth	61%-80%
5	Very decent	81%-100%

Source: Lurenand colleagues (2023)

Validation sheets and teacher and student answer questionnaires about the appropriateness of science learning materials derived from modified National Education Standards (BSNP) were utilized by researchers to gather data. Table 2 displays the instructor and student answer surveys as well as the validation grid table.

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Table 2. Expert Validation Grid for Science Learning Media on Solar System Material

No	Validator	Assessment Aspects	Indicators
1.	Material expert	Introduction	3
		Contents of the material	4, 5, 6, 7, 8, 9, 10, 11, 12,
		Language	13, 14, 15
2.	Media expert	Cover	1, 2
		Appearance	3, 4, 5, 6, 7, 8, 9, 10, 11, 12
		Contents	13, 14, 15
3.	Linguist	Straightforward	1, 2, 3
		Conformity to language rules	4, 5, 6, 7, 8, 9, 10, 11, 12
		Suitability to student development	13, 14, 15

Source: BSNP (2008)

Table 3. Teacher and Student Response Questionnaire Grid

No.	Assessment Aspect	Indicator Item	Number Value
1.	Feasibility of presentation	1, 2	10
2.	Eligibility of content	3, 4, 5, 6, 7, 8, 9, 10, 11, 12	50
3.	Eligibility of content	13, 14, 15	15
	Total score		55

Source: BSNP (2008)

C. Result and Discussion

Result

During the analysis stage (Analyze), researchers examine the requirements, practicality, and needs for creating educational media. Six components comprise the analysis: curriculum analysis, needs analysis, syllabus analysis, frequently used learning media, lesson materials, and learning process analysis. Researchers typically do the following stages of analysis: curriculum analysis, needs analysis, learning media, learning process analysis, learning material analysis, and syllabus analysis.

Design is the second step in the ADDIE methodology. Based on the findings of the earlier investigation, researchers started creating the science learning materials that would be created. Determining the components required for the learning media on the solar system content, such as creating the media framework and theme net, is the next step in this design process. In addition, scientists gathered references for creating science education materials about the solar system.

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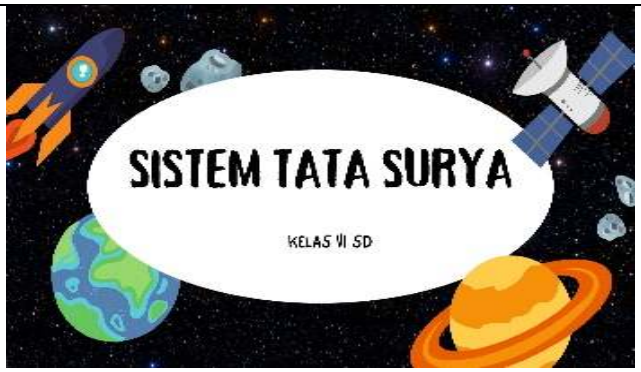
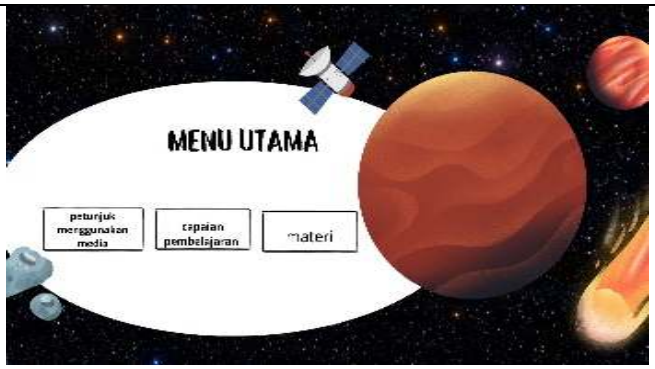
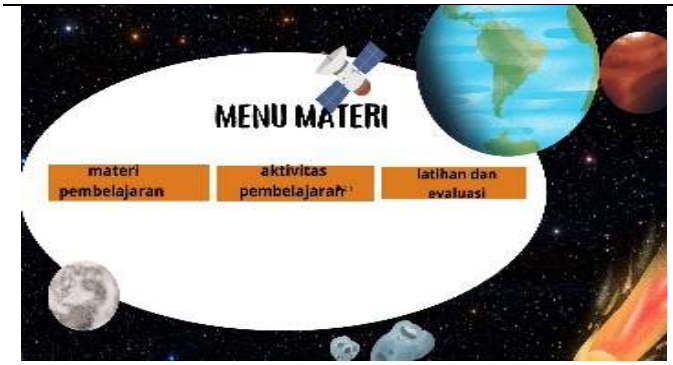
Table 4. Cover of Science Learning Media on the Solar System Material

Appearance	Display Function
	The material's title appears on the cover and is directed to SDK Boba students.
	Instructions for Using Media, Learning Outcomes, and Learning Materials are the three menus that make up this primary menu display.
	Show usage guidelines for media, section functions to show media consumption, and a Back Button to return to the main menu.
	The material menu display also presents scientific literacy-based learning stages, namely identifying problems from the material solar system, new knowledge, scientific phenomena, and also the conclusion.

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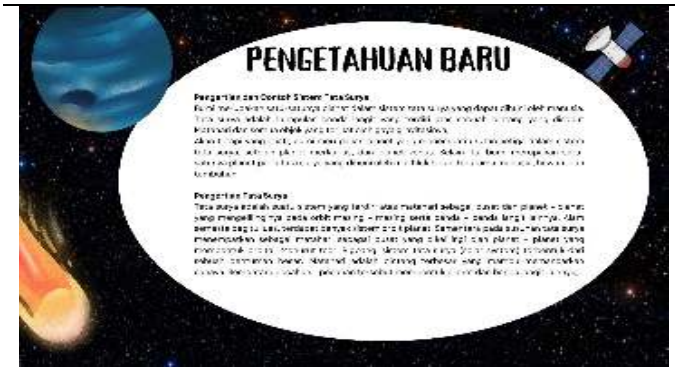
Appearance	Display Function
	New information on the solar system may be found in the Material Menu Display. This view serves to present several choice of material according to achievement targeted learning and A button Back to return to the main course
	The learning menu is displayed in the activity. Discussion activity groups can be shown in this view, and a menu home allows you to return to the material menu.

The stage of development is when the product is realized. At this point, science learning materials about the solar system are being created in compliance with the created design. First, the subject instructor, an expert in the subject matter, is given the science learning media material to revise. The linguist will then review the content to ensure the language rules are proper. This process keeps going until all language rules in the content are accepted. Following this, media specialists were invited to evaluate the science education materials created using the media based on their appropriateness and to offer comments and recommendations for revisions and enhancements (Syarifatunnisa, 2023). This process keeps going until the learning media is deemed appropriate for instruction.

Only the school selected as the research site is included in the implementation stage. At this point, learning is conducted using the developed learning materials. In order to debate learning material, students are advised to form groups and focus on the overall content. The researcher next gave the students a questionnaire to complete in order to assess the degree of appropriateness of the produced media. The following exercise is a practical way to use the created educational materials.

Everything that has been prepared will now be set up so that it may be used to achieve the desired outcome. The implementation phase of this study was conducted using small-scale trials to get feedback from educators and learners on the created learning materials. The trial process was conducted at SDK Boba, a single school.

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Every other stage of development is revised throughout the evaluation stage. This stage ensures that the science education materials are created to suit and apply to various educational institutions. The content offered in creating science-based educational materials is called the "solar system." A questionnaire that addressed several topics about how the content was presented in the produced science learning media was distributed to the validators to gather the results of the evaluation of the learning media validation. On a scale of 1 to 5, each questionnaire question is rated (Irwansyah et al., 2020; Abdullah et al., 2020). There are 24 questions that will be validated by materials, design, and language experts, who, in this case, are science teachers at SDK Boba. The evaluation results from these experts are presented in Table 5.

Table 5. Expert Validation Results on Science Learning Media with Solar System Material

No	Validator	Assessment Aspects	Earned Value	Amount	Score	Predicate
1.	Material expert	Introduction	5	62	97%	Very worthy
		Contents of the material	43			
		Language	14			
2.	Media expert	Cover	8	76	95%	Very worthy
		Appearance	53			
		Contents	15			
3.	Linguist	Straightforward	14	74	92,5%	Very worthy
		Conformity to language rules	45			
		Suitability to student development	15			

According to Table 4, the material expert's response to the material learning media on the human solar system obtained a 92% score with a very feasible predicate. The design expert's evaluation of the solar system material learning medium, which obtained a 95% score with a very feasible category, served as the basis for the validity results.

Then, in the linguist's response to the use of language in science learning media, the solar system material received a score of 92.5% in the very appropriate category. Researchers tested the reactions of science teachers and class VI pupils at SDK Boba to ascertain the degree of usefulness of this learning resource. Tables 6 and 7 display the results of practicality tests.

Table 6. Teacher Assessment Questionnaire on Learning Media for Solar System Material

No.	Assessment Aspects	Value Obtained	Total Value
1.	Feasibility of presentation	9	10
2.	Eligibility of content	45	50
3.	Language eligibility	13	15
	Amount	67	75
	Score	89,3%	
	Predicate	Very worthy	

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With a score of 90% in the highly appropriate category, Table 7 demonstrates that science teachers responded well to learning materials. Additionally, pupils received a 95% score in the highly appropriate category for their responses to the assessment of using learning media. Table 6 below shows data on how students responded to learning materials.

Table 7. Student Response Questionnaire on Science Learning Media on Solar System Material

No	Assessment Aspect	Number of Subjects & and Marks Obtained									
		S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**
1.	Feasibility of presentation	10	9	10	9	10	9	8	10	10	10
2.	Eligibility of content	45	50	47	45	50	50	50	45	50	50
3.	Language eligibility	14	14	15	14	15	14	15	15	14	14
	Amount	**69**	**73**	**72**	**69**	**70**	**73**	**73**	**70**	**74**	**74**
	Presentation	**92%**	**97%**	**96%**	**92%**	**93%**	**97%**	**97%**	**93%**	**99%**	**99%**
	Total score	**95%**									
	Category	Very worthy									

Discussion

Research and development (R&D) methods were used to create science learning materials on the solar system (Farris, 2024; Akgunduz & Mesutoglu, 2021). Teaching resources that help the learning process convey the material's content are necessary for implementing an active learning process. The ADDIE paradigm (analysis, design, development, implementation, and evaluation) is used to create science instructional materials about the solar system.

The first phase was the analysis phase, which involved assessing needs through direct observation activities and conversations with the class VI teacher at SDK Boba. This phase was the first step in creating science learning materials about the solar system. This is done in order to get the information required to conduct additional development.

The second step is the design stage, which is completed by developing a preliminary product design and gathering information from a variety of reference sources and the identified learning. The product is then created with an eye-catching design to encourage pupils to participate more actively and enthusiastically in-class activities.

A validation test with specialists is conducted to ascertain the acceptability of the teaching material utilizing science learning media on the solar system material after the third stage, which is the development stage concerning the proposed product, is completed. The product can then be made available to learners if it has passed the validation test and been improved to the point where it is deemed practical. According to the validation results of experts, canvas-based electronic books are appropriate for class VI odd semester courses on solar system content.

The next stage is the implementation stage or limited trial, which was carried out on SDK Boba students in class VI, as many as 10 students out of a total of 19 students. This activity aims to determine the response of students and teachers to science learning media

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on solar system material and to determine the response generated to the quality of learning, which includes interactions in the learning process, effectiveness, interest, and enthusiasm of students.

The last step is evaluation, which involves examining research findings from teacher and student surveys based on the execution of a few trials. The teacher's response received a percentage of 89.3% in the very appropriate category, while the student responses obtained a very appropriate response with an overall average percentage of 95%. The replies from the children are based on research by Putrisli and Airlanda (in Sulaeman et al., 2023), which found that 93% of elementary school pupils were interested in reading when an e-book of stories about the rain process was developed. Apart from that, research conducted by Krenadi and Salimi (in Sulaeman et al., 2023) on the development of science learning media on solar system material for class VI elementary school science content obtained a percentage of 99.55%.

In order to enhance learning outcomes for class VI elementary school pupils, Rukman & Samsudin (2022) also conducted the same research, using contextual-based module teaching materials aided by learning media on solar system content. They achieved a 95% success rate. According to the research findings, 87.25% of students responded that the science learning materials were well received and that the development of learning materials is appropriate for usage and can aid students in understanding the subject matter.

Based on student responses in small group trial activities and validation tests, the learning media produced can motivate students in learning (Ernawati & Sukardiyono, 2017), and the resulting media can channel messages and stimulate thoughts, feelings, and attention. Moreover, students' willingness to participate encourages a deliberate learning process (Suryani et al., 2018).

D. Conclusion

The ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development paradigm is used in this study to create science instructional materials. The first step in gathering the information required for the development process is a requirements analysis conducted at the school using interviews and observations. Following data collection, the next step is the design of learning materials. This is followed by creating electronic teaching materials verified by three specialists: media experts, language experts, and material experts.

Videos and other learning resources are presented in this digital teaching resource, which can encourage students to participate more actively and enthusiastically in class. Additionally, schools use this science learning resource. Evaluation is the last step, completed by sending questionnaires to science professors and students.

The study's findings demonstrate that student answers suggest that scientific learning materials on the solar system can be used to enhance students' comprehension of science instruction at SDK Boba. The created items fall into the following categories: highly valid, practical, and effective in enhancing students' comprehension.

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Media experts provided 95% of the validity data, which was classified as highly valid; material experts provided 89.3%, which was also classified as very valid. Therefore, solar system media is appropriate for learning based on the findings of the two validators. After that, the teacher's response scored 89.3% on the practicality test, classifying it as extremely practical. However, the trial's 95% response rate from students was classified as extremely practical.

It was determined that science learning materials are beneficial for teaching based on the answers to the questionnaires given to teachers and students. N-Gain increased by 92.5% in the high category as a result of the efficacy trial, which was derived from the learning outcomes and had an average pre-test score of 97% and an average post-test score of 95%. Conse uently, science learning materials are helpful for the educational process.

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