

DEVELOPMENT OF INTERACTIVE MULTIMEDIA BASED ON DISCOVERY LEARNING TO IMPROVE HOTS LEARNING OUTCOMES IN NATURAL AND SOCIAL SCIENCES SUBJECTS IN ELEMENTARY SCHOOLS

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Abstract

This research aims to develop interactive multimedia using the Discovery Learning approach to enhance higher-order thinking Skills (HOTS) learning outcomes in Elementary Schools (ES). The novelty lies in the development of current interactive multimedia teaching materials aligned with an independent curriculum, tailored to students' learning styles. The study was conducted in ES Pesisir Selatan Regency, West Sumatra, encompassing five (5) ES. The research followed the ADDIE model, involving the Analysis, Design, Development, Implementation, and Evaluation stages. During Analysis, needs were identified through interviews, observations, and questionnaires. Design involved planning media with concept maps to align with learning objectives. Development focused on creating interactive multimedia based on Discovery Learning, including Validation, Focus Group Discussion (FGD), and Testing. In Application, validity, and practicality were assessed through school trials. Effectiveness was tested through limited distribution and N-Gain Score analysis. Evaluation encompassed formative and summative assessments. Validity analysis confirmed the suitability of content, media design, and language usage, with scores averaging 92%. Practicality analysis revealed high practicality levels among both teachers (94.5%) and students (91.11%), indicating ease of use and effectiveness in learning. Effectiveness testing demonstrated significant improvement in learning outcomes, with an N-Gain Score of 0.83 and 81.34% effectiveness. The discussion further elaborated on the development process, emphasizing the stages of Analysis, Design, Development, Implementation, and Evaluation. Overall, the interactive multimedia teaching materials proved valid, practical, and effective in enhancing HOTS learning outcomes, offering an innovative approach to ES.

Keywords: Interactive Multimedia, Discovery Learning, Higher-order Thinking Skills (HOTS), Elementary Schools (ES), ADDIE Model.

1. INTRODUCTION

The world is currently entering the 21st-century, the era of Industrial Revolution 4.0. Other characteristics of the 21st-century are the abundance of information, available anytime and anywhere, increasingly rapid computerization, automation replacing routine tasks, and the ability to communicate anytime, anywhere. The Industrial Revolution 4.0 certainly has various challenges, including preparing human resources (HR) who have interdisciplinary skills that are important to be able to compete globally. The educational era influenced by the Industrial Revolution 4.0 is called Education 4.0 and is characterized by the use of computerized innovation or digital frameworks in every educational cycle. This system allows the continuity of the education system without obstacles. Purwanto et al (2023) said that in welcoming the Industrial Revolution 4.0 era, education is expected to have the option to produce graduates who have 21st-century skills and can master technological developments so that they can compete globally. The presence of technology can make learning active, creative, innovative, and interesting so that various correlational relationships can be established between teachers, students, media, and learning resources.

Utilizing this technology as a tool in learning will be very useful in improving student learning achievement.

The curriculum in Indonesia is always changing to improve and adapt educational programs to suit the demands of society, both around and outside the student environment (Putri & Khairat, 2023). The needs of society itself are always dynamic, the needs of students also develop dynamically following the development of society. The society is aware of the changing needs of students. The needs of this dynamic society also greatly influence education which is undergoing major changes so that students can get what they need. Hidayah et al (2022) added that the curriculum developed by the Indonesian government is independent. In the independent curriculum, students can study science and technology independently.

Learning media is very necessary so that learning can be more active, creative, innovative, and fun. Learning media is something that must be present during teaching and learning activities in the classroom. The use of media as a link between teachers and students is intended so that the concepts conveyed by the teacher can be understood optimally by students (Rachmadtullah et al., 2023). Anggaira et al (2024) stated that apart from being a conveyor of learning information/messages, media can increase student interest so that it can lead to reciprocal interactions between students, motivation, interest, and student independence when teaching and learning activities take place. The use of media in the classroom can also improve student learning outcomes compared to previous results. The involvement of media use during learning can also be intended as a form of teacher creativity in delivering meaningful learning experiences for students. The use of media in the classroom can also overcome students' boredom while studying. One of the media based on Information and Communication Technology (ITC) is interactive multimedia. Interactive multimedia is media that helps and facilitates students' understanding of learning by making learning situations and conditions in the classroom more interesting and effective (Ilham & Krimadinata, 2023). Interactive multimedia is a computer program that can function as a learning medium in the classroom which contains digital content containing a combination of audio, reading, images, video, and animation to form a unified whole. Multimedia learning can certainly convey learning concepts more interestingly, not just appearing in one direction, so that students can learn independently without depending on other people, and can learn to understand the concepts of the subjects they are studying directly using a computer.

The use of the Discovery Learning model enables effective and efficient learning in ES, one of the important factors is the learning innovation carried out by teachers for students (Andayani, 2020). After that, it becomes an obligation of a driving school and other parties to help the learning process, have good knowledge, skills, and educational knowledge, as well as motivation and commitment from all parties involved in the driving school. Developing innovative and creative learning requires the development of interactive multimedia with a valid and reliable multimedia-based Discovery Learning model that involves parents, teachers, experts, and stakeholders. This is where Discovery Learning plays an important role in carrying out this research. Ozdem-Yilmaz & Bilican (2020) explained Discovery Learning is a learning approach where students are encouraged to actively seek and discover knowledge through direct experience and exploration. With Discovery Learning, students are faced with situations where they have to think critically, formulate

hypotheses, and explore new concepts. This encourages students to develop independent thinking skills, creativity, and perseverance in solving problems.

One of the subjects that is the focus of developing higher-order thinking Skills (HOTS) is natural and social sciences in ES. Increasing HOTS in science subjects plays an important role in developing students' critical, analytical, creative, and innovative thinking abilities. However, in practice, science learning is still carried out conventionally with teachers dominating the delivery of the material, so students tend to be passive in the learning process (Nurhatmanti et al., 2021). To overcome these challenges, the development of interactive multimedia teaching materials using the Discovery Learning approach is an attractive solution for increasing student HOTS. Discovery Learning is a learning approach where students are encouraged to actively seek and discover knowledge through direct experience and exploration. By using interactive multimedia, such as video, animation, audio, and images, science learning can be presented in a more interesting and varied way. This will help increase student interest, motivation, and involvement in learning to support HOTS development.

Based on the explanation above, this research aims to produce interactive multimedia using the Discovery Learning approach with science content that is valid, practical, and effective to support the achievement of HOTS learning outcomes in elementary schools. Where the novelty of this research is that the researcher developed interactive multimedia teaching materials that are current developments and used an independent curriculum in developing these interactive multimedia teaching materials. Then the researcher acts as an active teacher and provides a learning process that favors students according to their respective learning styles. Researchers conducted research at driving schools in Pesisir Selatan Regency - West Sumatra Regency which consists of 5 driving ES including ES 03 Malepang, ES 14 Laban, ES 03 Kampung Tengah Bayang, ES 16 Pasar Sungai Tunu, and ES 09 Labuhan Tanjak.

2. METHODS

This research produces products and tests product effectiveness. The product developed in this research is interactive multimedia with Discovery Learning based on a combination of the Macromedia Flash 8 application and a word wall on natural and social sciences learning content that is valid, practical, and effective. The development model used in this research is the ADDIE model. The ADDIE development model is a model developed by Raiser and Mollenda. ADDIE is an abbreviation for Analysis, Design, Development, Implementation, and Evaluation (Kia et al., 2020). Kadakia & Owens (2020). state that this development model is structured programmatically with a systematic series of activities to solve learning problems related to learning resources that suit students' needs and characteristics. This helps researchers in knowing what steps researchers must take to develop product designs in the form of interactive multimedia teaching materials Macromedia Flash 8. The ADDIE design development model consists of five systemic stages, namely analysis, design, development, implementation, and evaluation.

2.1 Development Procedure

- Analysis: The stage where researchers carry out a needs analysis by collecting information through interviews, observations, and questionnaires with teachers and students, to obtain information related to the problems experienced by the school to be researched and solutions to solving problems from the school. to be

- researched. To find out the real conditions/situations in the school to be researched, the author first conducted an initial interview with the class IV teacher, then continued with observation, and then filled out a needs analysis questionnaire by teachers and students. Collecting data or information is very useful for developing the products that researchers develop.
- Design: The planning (design) stage aims to design media equipped with concept maps according to learning outcomes and the flow of learning objectives that have been determined. Product development is carried out through several steps, namely:
 - 1) Reviewing material adjustments to support learning outcomes;
 - 2) Identifying the aspects contained in learning outcomes; and
 - 3) Developing media which is expected to be a means of constructing student knowledge.
 - Development: The development stage aims to produce interactive multimedia-based products based on Discovery Learning on science content that is valid, practical, and effective. The development stage includes Validation, Focus Group Discussion (FGD); and Testing.
 - Application:
 - 1) In practice: This validity test stage was revised and then tested in schools to determine its practicality. A product is said to be practical if it is easy to use in learning. Practicality is seen from several aspects, namely ease of use, the required implementation time should be short, fast, and precise, the attractiveness of the media attracts students' interest, is easy to interpret by experts, and has high equivalence, so it can be used as a substitute for variations. So, practicality is the level of practicality of the media when used in the learning process to find out the extent of ease of use, benefits, and efficiency of learning time. The practicality of the media is assessed by teachers by providing media assessments that are easy and can help teachers in the learning process. Practicality carried out by students to see the ease of students in the learning process using media; and
 - 2) Effectiveness: After being validated and carrying out practicality tests in class V ES 03 Malepang, ES 14 Laban, ES 03 Kampung Tengah Bayang, ES 16 Pasar Sungai Tunu, and ES 09 Labuhan Tanjak Pesisir Selatan Regency, interactive multimedia based on Discovery Learning on natural and social sciences content valid and practical. To test the effectiveness of the media, this media will be distributed on a limited basis to check the level of effectiveness in other class groups. This will ensure that the media developed is not only theoretically effective but can also work well in practice in a wider learning environment. The effectiveness test procedure is applied to one class or one group by taking into account the similarity of abilities and learning resources possessed by research planning subjects in ES Pesisir Selatan Regency. The effectiveness test was carried out using the *N-Gain Score*.
 - Evaluation: Arisanti & Adnan (2021) state that this stage is related to the results of the assessment of the product being developed. At this evaluation stage, two evaluations must be carried out.

- 1) Formative evaluation is carried out during the program, namely when collecting data at each stage that has been passed. This formative evaluation explains the quality of the product being developed, whether improvements have been made to the product being developed or not; and
- 2) A summative evaluation is carried out at the end of the program to determine its effect on student learning outcomes and the quality of learning more broadly (Maryunda & Desyandri, 2021). This stage is also the final revision stage of the product developed by the researcher, based on input, suggestions, and criticism of the instrument in the form of a questionnaire by validator experts, teachers, and students as well as the researcher's notes at the product implementation stage. This stage is carried out so that the product being developed can be used effectively for learning in schools. Product trials were carried out with limited trials in 3 meetings at class V ES 03 Malepang, ES 14 Laban, ES 03 Kampung Tengah Bayang, ES 16 Pasar Sungai Tunu, and ES 09 Labuhan Tanjak Pesisir Selatan Regency. The criteria used in selecting schools and test classes are the condition of students who meet the author's needs, where schools and classes have not used multimedia-based interactive multimedia in science content.

2.2 Data Type

The type of data taken in this research is primary data in the form of product validation results provided by the validator and trial implementation data. In this trial, data was taken in the form of

- 1) The results of observations of media application from observers;
- 2) The results of the teacher's response to the media used; and
- 3) Student responses after the media was tested and student learning outcomes include assessments of attitudes, knowledge and skills.

2.3 Data Collection Instrument

The data collection instruments used in this development research are as follows:

- Validation Instrument: Validation instruments– are used to determine the validity of the product designed and filled in by the validator. The validation instrument includes a media validation sheet which consists of assessing the suitability of content, language, and graphics.
- Practicality Instrument: This instrument– is used to collect media practicality data, this instrument consists of analysis of learning implementation results, teacher response questionnaire, student response questionnaire, and media use observation sheet.
- Effectiveness Instrument: The effectiveness instrument is used to collect data on the effectiveness of the media being developed. The effectiveness instruments used are as follows:
 - 1) Student Activity Observation Sheet: The student activity observation sheet is used to obtain data about student activities during the learning process which is carried out by two observers using an observation sheet; and
 - 2) Student learning outcomes: Learning outcomes are used to obtain the data needed to determine the percentage of student success after participating in

learning using interactive multimedia based on Discovery learning in natural and social sciences content. Learning outcomes include assessment of aspects of attitudes, knowledge, and skills.

The data collection instruments described above were validated first by an expert validator before use. Arikunto (2010) stated that good evaluation data that matches reality is called valid data. Meanwhile, Uno et al (2001) stated that construct validity shows the extent to which an instrument can measure the meanings contained in the material to be measured. Instrument validation is carried out based on several aspects of concern, namely instructions for filling out the instrument sheet used, statements made on the instrument sheet adjusted to the indicators and learning objectives, the assessment format is easy to understand, and the language used is according to the *Pedoman Umum Ejaan Bahasa Indonesia (PUEBI)*.

2.4 Data Analysis Technique

- Validity analysis: The results of the validity (feasibility) of the product being developed are obtained from the analysis of the validation sheet which has been assessed by an expert validator. Data from expert validators such as criticism, input, and suggestions will be analyzed and used as a reference so that the product developed becomes better. The measurement scale uses a 5 (five) scale. Next, the scores obtained for each aspect of the assessment will be added up and the average calculated. The average validation score is obtained from the total validation score divided by the number of aspects assessed.
- Practical Analysis: Obtained by analyzing data obtained from teacher and student response questionnaires. In this study, a measurement scale with a scale of 5 (five) was used. The practicality test data for the products developed were analyzed using percentages (%).
- Effectiveness Analysis: The effectiveness of the product that researchers develop is obtained from the analysis of test results given to students. Product effectiveness testing was carried out using a research design, one group pretest-posttest design. Where the research design method is to give students an initial test, then they are given treatment, and after that, they are given a final test. The initial test is a test of student learning outcomes that is distributed to students before being given treatment in the form of integrated thematic learning activities using interactive multimedia teaching materials based on the Science, Technology, Engineering, Art, and Mathematics (STEAM) approach. After being given treatment, students are again given a final test, namely the same student learning outcomes test questions to work on. The results of the two tests are analyzed and their effectiveness is determined using the *N-Gain Score*. The *N-Gain Score* is used to determine the effectiveness of products developed in integrated thematic learning from student learning outcomes which can be seen from the differences in the results of the initial test and the final test. To analyze the initial test and final test, the effectiveness of the product developed in integrated thematic learning was calculated using the *N-Gain Score*. Where the results obtained are in the form of a percentage. Then the calculation results are matched with the effectiveness assessment criteria by Hake (1999). The results of these calculations can also be compared with the effectiveness assessment criteria according to Meltzer (2002).

3. RESULTS

3.1 Results of the Design Stages

The design stage aims to design media equipped with concept maps according to learning outcomes and the flow of learning objectives that have been determined. Product development is carried out through several steps, namely:

- 1) Reviewing material adjustments to support learning outcomes;
- 2) Identifying the aspects contained in learning outcomes; and
- 3) Developing media which is expected to be a means of constructing student knowledge.

Based on the analysis at the definition stage, interactive multimedia teaching materials Macromedia Flash 8 and Wordwall based on the discovery learning model were designed. The teaching materials were adjusted to the learning outcomes and flow of learning objectives set by the curriculum and then arranged according to the stages of the Discovery Learning model in class IV ES. Material designed using interactive multimedia Macromedia Flash 8 and Wordwall. Teaching materials are equipped with colorful figures that are interesting to students. The figures used in teaching materials are obtained from various sources, including books and the Internet. The type of writing font in this teaching material is Times New Roman. The font size used is 10-14. Each lesson in this teaching material contains learning outcomes, flow of learning objectives, learning objectives that students will achieve, materials, enrichment, and ice-breaking. More clearly, the preparation of teaching materials is explained as follows.

- Cover or Background: On the cover or background of interactive multimedia teaching materials Macromedia Flash 8 and Wordwall based on the Discover Learn model, there is the identity and title of the teaching materials. This is included to provide information about the overall content of the teaching materials. On the cover of the teaching materials, a menu is displayed containing learning outcomes, the– flow of learning objectives, learning objectives, material that directs the learning objectives that will be conveyed by the teacher. The menu title uses Times New Roman writing type size 14. The Merdeka curriculum text indicates that learning is based on the latest curriculum, namely the Merdekabelajar curriculum. There is a volume button to increase and soften the sound of the teaching materials and an off button to close the application when it has been used. The design of the cover for the teaching materials that was designed can be seen in Fig 1 below.



Figure 1: Cover of Teaching Materials After Revision (in Indonesian)

- Learning Outcomes: The learning outcomes presented in the teaching materials aim to explain the learning outcomes that will be achieved by students. Learning outcomes provide a brief overview of the overall learning achievements in learning materials. In the description of learning outcomes, the Times News Roman writing type is used with size 14. The design of the word's learning outcomes can be seen in Fig 2 below.

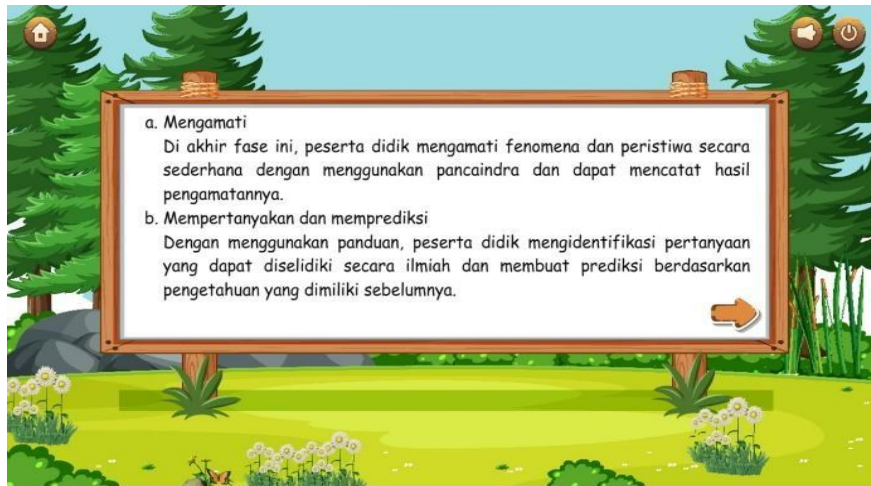


Figure 2: Design of Learning Outcomes (in Indonesian)

- Flow of Learning Objectives: The flow of learning objectives in teaching materials guides teachers and students to achieve Learning Outcomes at the end of a phase. Each point in the learning objectives flow is arranged chronologically based on the sequence of learning over time. The type of writing used is Times New Roman with size 12. The design of the instructions for use that has been designed can be seen in Fig 3 below.

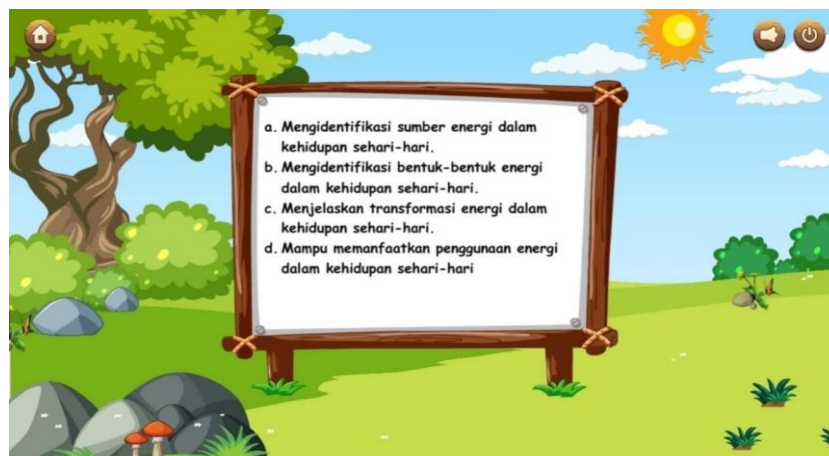


Figure 3: Learning Objective Flow Design (in Indonesian)

- Material: Material is created to make it easier for students to understand the material that will be studied that day. The material contains natural and social sciences learning which guides students in completing learning outcomes and the flow of learning objectives about natural and social sciences. The material uses Comic Sans, while the images shown are adapted to natural and social sciences material in class IV ES. Design The material that has been designed can be seen in Fig 4 below.



Figure 4: Design Learning Materials (in Indonesian)



Figure 5: Design of Learning Materials (in Indonesian)

- Enrichment: Enrichment is useful to make it easier for teachers to know to what extent the learning material presented has been absorbed by students. Enrichment knows what students must achieve in each lesson, while the activity steps tell students how to complete this enrichment activity. For more clarity, you can see Fig 6 below.

TUGAS 1

- Tujuan Pembelajaran:
Siswa dapat mengidentifikasi ragam transformasi energi pada kehidupan sehari-hari dengan benar.
- Perhatikan bentuk energi di bawah ini!

Energi Kinetik	Energi Panas	Energi Cahaya	Energi Bunyi	Energi Listrik	Energi Kimia
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- Langkah-langkah kegiatan
 - * Carilah transformasi energi yang ada di sekolah dan di rumahmu! Dengan petunjuk: carilah sesuatu yang bergerak, menghasilkan panas, cahaya, bunyi dan listrik. Amati energi apa yang dibutuhkan benda-benda tersebut.
 - * Tuliskan benda serta transformasi energi yang kalian temukan pada buku catatanmu. Perhatikan cara penulisan pada tabel berikut ini.

Nama Benda	Transformasi Energi
Lampu	Energi listrik menjadi energi cahaya

* Presentasikanlah hasil temuannya kepada teman satu kelas. Tuliskan benda atau transformasi energi yang tidak kalian temukan

Figure 6: Enrichment Design (in Indonesian)

- Profile: Profiles are created to make it easier for students to find information from authors and learning topics. The profile contains information on the composition of teaching materials, phases of teaching materials, and learning topics. This profile uses Times New Roman writing with size 12, while the photo image on the side indicates a photo of the author of the teaching materials, namely Wiwik Maladerita. The profile that has been designed can be seen in Fig 7 below.



Figure 7: Profile Design (in Indonesian)

- Ice-breaking: Ice-breaking is created to refresh students before starting learning. Ice-breaking contains activities in the form of movements in the form of finger exercises, body movements aimed at fitness and student focus on learning. Ice-breaking contains videos of activities that have been carried out in class and followed by puppet students which are linked to YouTube. The ice-breaking that has been designed can be seen in Fig 8 below.

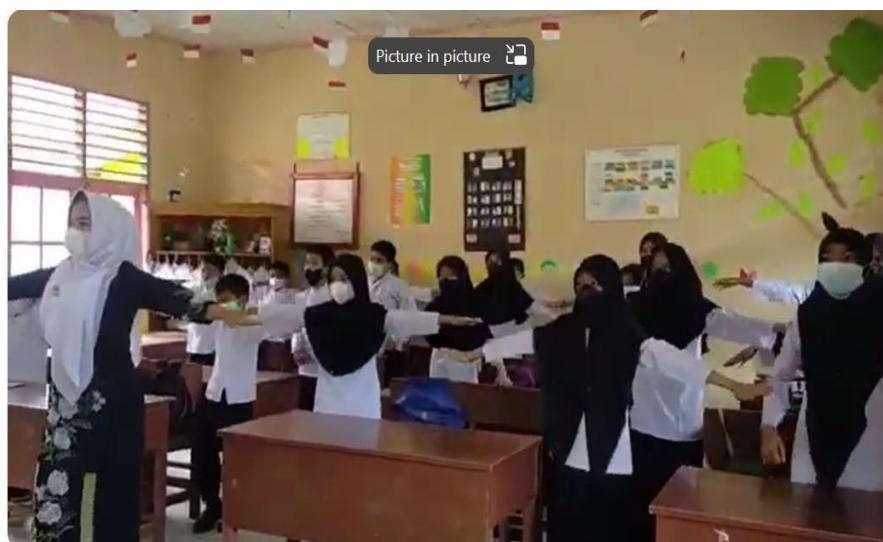


Figure 8: Ice-breaking Design (in Indonesian)

- Quiz: The quiz was created to find out the extent of students' understanding of the material that has been studied in the interactive multimedia teaching materials that the researcher developed. Researchers created quizzes that were very interesting

using the online-based Wordwall application. For this Wordwall to be connected directly to the Macromedia Flash 8 application, the researchers coded the button so that when pressed, the button would directly connect to the Wordwall. The advantage of this Wordwall is that it makes it easier for researchers to find out the number of correct, false, and scores obtained by students. It makes it easier for researchers to find out which students are fast in working on questions because in this application there is a timer for working on questions. The quiz that has been designed on Wordwall can be seen in Fig 9-13 below:



Figure 9: The Initial Appearance of Wordwall



Figure 10: Wordwall Question View

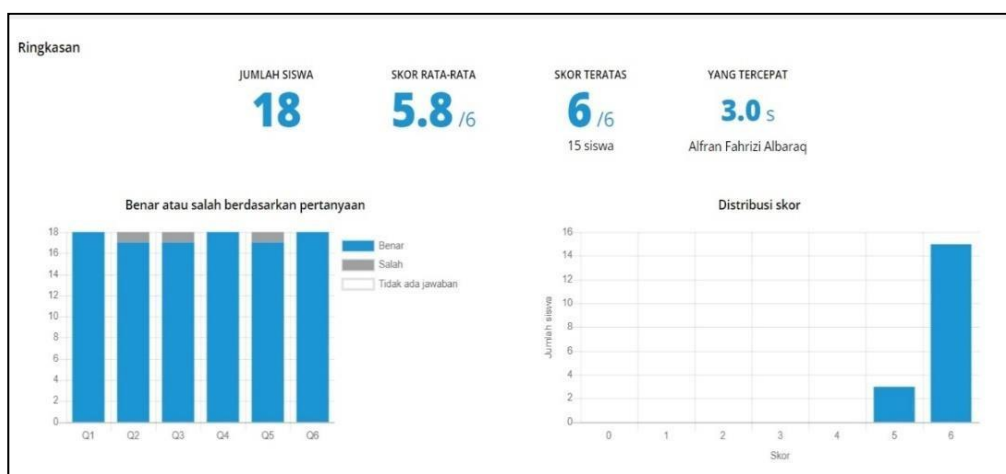


Figure 11: Display of Student Suspension Numbers on Wordwall

Papan Peringkat

Peringkat	Nama	Skor	Waktu
ke1	Alfran Fahrizi Albaraq	6	17.9
ke2	Rivaldi	6	18.7
ke3	Adinda Pratiwi	6	19.1

Tampilkan lainnya ▾

Hasil berdasarkan pertanyaan

URUTKAN MENURUT Nomor Benar Salah

Pertanyaan	Benar	Salah
1 ▶ Energi adalah	18	0
2 ▶ Matahari merupakan sumber energi yang sangat besar bagi makhluk hidup di bumi. Matahari merupakan sumber energi ...	17	1
3 ▶ Pada saat cuaca panas kita dapat menggunakan kipas angin untuk menyejukkan ruangan. Pada penggunaan kipas angin terjadi perubahan energi listrik menjadi ...	17	1
4 ▶ Menghemat energi adalah perilaku yang sangat baik. Dengan menghemat energi akan membawa dampak positif bagi kehidupan. Berikut ini merupakan aksi penghematan energi yang dapat dilakukan di rumah.	18	0
5 ▶ Sebagian besar energi yang kita gunakan berasal dari ...	17	1
6 ▶ Nadia mendorong sepedanya menaiki suatu bukit. Dari manakah Nadia mendapatkan energi untuk mendorong sepedanya tersebut?	18	0

Figure 12: Display of Student Score Rankings on Wordwall

Hasil berdasarkan siswa

URUTKAN MENURUT Pengajuan Nama Benar + Waktu

Siswa	Telah dikirimkan	Benar	Salah	Waktu
▶ Engla Pratama	16.47 - 3 Jan 2024	6	0	2:17
▶ Cici Pinasthi	16.50 - 3 Jan 2024	5	1	51.4
▶ KURNIA DEWA	16.51 - 3 Jan 2024	6	0	26.6
▶ Muhammad Arya Rizki	16.52 - 3 Jan 2024	5	1	25.5
▶ Alfran Fahrizi Albaraq	16.54 - 3 Jan 2024	6	0	17.9
▶ Aldo Dirgantoro	16.56 - 3 Jan 2024	6	0	30.0
▶ Natasha Mawarini	16.58 - 3 Jan 2024	6	0	50.7
▶ Berliana Indah Putri	17.00 - 3 Jan 2024	6	0	1:01
▶ Violin Dina Dewita	17.02 - 3 Jan 2024	5	1	56.0
▶ Alya Suci Pramadani	17.03 - 3 Jan 2024	6	0	37.3
▶ Dela Adi Sucipta	17.05 - 3 Jan 2024	6	0	34.6
▶ Hamdani Rhamadana	17.07 - 3 Jan 2024	6	0	35.8
▶ Rahmanto Haidil	17.09 - 3 Jan 2024	6	0	24.5
▶ Putri Rianti	17.10 - 3 Jan 2024	6	0	31.0
▶ Cheltsi Apdila	17.12 - 3 Jan 2024	6	0	20.0
▶ M. Rizki	17.13 - 3 Jan 2024	6	0	21.7
▶ Adinda Pratiwi	17.14 - 3 Jan 2024	6	0	19.1
▶ Rivaldi	17.15 - 3 Jan 2024	6	0	18.7

Figure 13: Dashboard View in Teacher Account in Wordwall

3.2 Development Results

At this stage the aim is to produce interactive multimedia teaching materials Macromedia Flash8 and Wordwall based on the Discovey Learning model that are valid, practical and effective, so that they are suitable for use in the learning process. This development stage consists of three stages, namely: validation, FGD, product testing. The following will present the results of each stage:

3.2.1 Teaching Material Validation Results

Material expert validity test data was obtained from 3 people, consisting of 2 lecturers and 1 person from ES. The two lecturers have the title of Professor and actively teach at UNP. Two lecturers who are experts on the material, namely Mr. Prof. Dr. Azwir Anhar, M.Si (V1 = Validator 1) who is an expert in the field of natural sciences and Mrs. Prof. Dr. Maria Montessori, M.Ed, M.Si (V2 = Validator 2) is an expert in the field of social sciences. Then, one driving teacher, namely Mrs. Muldifia Rajab, M.Pd (V3 = Validator 3). The instrument that researchers used was a material expert validation questionnaire. Here the validator only examines the material aspects of the product the researcher is developing. Based on the data presented in Table 1 above, it can be seen that the score value for each statement ranges from 3 to 5 which is in the quite

good and very good categories. Then the overall average validity in the material aspect is 91.7 with a Very Good category. This means that the content of the teaching materials has shown conformity between the content and learning outcomes and the flow of learning objectives, student development, learning materials, and has made it easier for students to learn the material. The results of the assessment of interactive multimedia teaching materials based on material aspects can be seen in Table 1 below.

Table 1: Results of Validation of Material Aspects

No	Rated Aspect	Validator Score			Amount	Rates	Category
		V1	V2	V3			
1	Material accuracy with learning achievement	5	4	4	13	86,7	Very Good
2	Suitability of material to the flow of learning objectives	5	4	5	14	93,3	Very Good
3	Suitability of material with learning module	4	4	5	13	86,7	Good
4	Suitability of topic to material	5	5	5	15	100	Very Good
5	Language usage	4	4	5	13	86,7	Good
6	Order of material presentation	5	5	5	15	100	Very Good
7	Explanation of the material accompanied by writing	5	4	5	14	93,3	Very Good
8	Explanation is easy to understand	5	4	4	13	86,7	Very Good
9	Explanation of material is short, concise, clear	5	4	5	14	93,3	Very Good
10	Attract students' interest and attention	4	5	5	14	93,3	Very Good
11	Suitability to the student's situation	4	4	5	13	86,7	Good
12	Provide students with learning opportunities	4	5	5	14	93,3	Very Good
13	Help students understand the lesson	4	5	5	14	93,3	Very Good
14	Increase learning motivation	4	5	5	14	93,3	Very Good
15	Relevant to the material students study	5	5	5	15	100,0	Very Good
16	Active student involvement in lessons	3	5	5	13	86,7	Very Good
17	The teaching materials developed are easy for students to accept	4	4	5	13	86,7	Good
18	Having an impact on students in the form of learning improve student learning outcomes	4	5	5	14	93,3	Very Good
19	Facilitating teachers in the learning process	4	5	4	13	86,7	Very Good
20	Helps the learning process	5	5	4	14	93,3	Very Good
Amount		88	91	96	275	1833,3	
Rates		92			13.8	92	
Rates (percentage)		92 %					Very Good

The next aspect assessed at the validation stage of teaching materials is the media or graphic aspect presented in the form of Table 2 below.

Table 2: Results of Validation of Media Aspects

No	Rated Aspect	Score	Category
1	Appropriate use of background in learning media	4	Good
2	Accuracy election layout interactive (navigation icon)	5	Very good
3	The combination of background colors with text, images and attractive navigation displays	5	Very good
4	Learning videos according to the material	5	Very good
5	The animation used supports the attractive quality of the display of each frame	5	Very good
6	Simple and charming	4	Good
7	Suitability of audio selection (narrative sound effects, background sound)	4	Good
8	Suitability of visual development selection (layout design, typography, color)	4	Good
9	Accuracy in selecting moving media (animation)	4	Good
10	Character selection compatibility	5	Very good
11	Appropriate font size selection	5	Very good
12	Suitability of text size and animation	5	Very good
13	Compatibility of the animation illustration with the material	5	Very good
14	Clarity color illustration animation	5	Very good
15	Text/learning material displayed in media is clear and easy to understand	4	Good
16	Text used in accordance with PUEBI	5	Very good
17	Media can increase learning motivation	4	Good
18	Media can increase interest in learning	4	Good
19	Media can improve learning outcomes	4	Good
20	Media can help child in learning process	5	Very good
Amount		91	
Rates (percentage)		91%	Very Good

Based on the Table 1 above, it can be seen that each question on the media aspect has a range of scores that are in the good and very good categories. Meanwhile, the average validity of media aspects as a whole is 91% in the Very Good category.

For linguistic validity test data, it was obtained from one language expert lecturer, namely Mrs. Prof. Dr. Agustina, M. Hum. He is a Professor who is currently actively teaching at Universitas Negeri Padang. The instrument that researchers used was a linguist validation questionnaire.

Here the validator only examines the language aspect of the product that the researcher is developing. The results of the assessment of interactive multimedia teaching materials based on the language aspect can be seen in Table 3 below.

Table 3: Results of Validation of Linguistic Aspects

No	Rated aspect	Score	Category
1	Language Facility	4	Good
2	The text is interesting to the point of interest in listening	5	Very good
3	Appropriateness (related to words and sentences, short length and paragraph structure)	5	Very good
4	Language rules are used well and correctly	4	Good
5	Clarity of Information in the text	5	Very good
6	Sentence structure accuracy	4	Good
7	Sentence effectiveness	5	Very good
8	Terminology	4	Good
9	Accuracy in word selection in composing sentences	5	Very good
10	Clarity of Information in the text	5	Very good
11	Grammatical accuracy	4	Good
12	Accuracy of punctuation	4	Good
13	Accuracy of punctuation	5	Very good
14	Accuracy of writing words	5	Very good
15	Correct use of letters	4	Good
16	Use of communicative language	5	Very good
17	The use of PUEBI is good and true	4	Good
18	The arrangement and structure of sentences in a coherent paragraph	5	Very good
19	The words chosen are types of words that are short and straightforward and are well known to students	5	Very good
20	Use of basic language according to student development	5	Very good
Amount		92	
Rates (percentage)		92%	Very Good

The next assessment of teaching materials is reviewed from the linguistic aspect. Each aspect based on each statement in the assessment aspect has an average value of 4 which is in the Very Good category. In the linguistic aspect as a whole it is 3.69 in the Very Good category. Thus it can be said that the language used in teaching materials is in accordance with the rules of good and correct Indonesian, the language used is clear, the language used is simple, straightforward and easy to understand and is communicative, interactive and attractive in appearance. The next assessment of teaching materials is reviewed from the linguistic aspect. Each aspect based on each statement in the assessment aspect has an average value of 4 which is in the Very Good category. In the linguistic aspect as a whole it is 92% in the Very Good category. Thus it can be said that the language used in teaching materials is in accordance with the rules of good and correct Indonesian, the language used is clear, the language used is simple, straightforward and easy to understand and is communicative, interactive and attractive in appearance. Which can be seen in Table 4 below.

Table 4: Validation Recap

No	Rated aspect	Price Validation	Category
1	Validator Ahli Materi	92%	Very Good
2	Validator Ahli Media	92%	Very Good
3	Validator Ahli Linguistik	92%	Very Good
Rates		92%	Very Good

From Table 4 above, the overall score values for validating teaching materials are 92%, which is included in the Very Good category. So it can be concluded that producing interactive multimedia teaching materials is assisted by applications Macromedia Flash 8 and Wordwall model-based Discovery Learning This ES is valid.

3.2.2 FGD Teaching Material Results

After validating the product, the next stage was that the researcher conducted an FGD in the field, the implementation of which involved every teacher of class V in the five elementary schools where the research was conducted. The instrument that the researcher used was an FGD questionnaire which was distributed to class V teachers. The following are the results obtained from the questionnaire, namely that the teaching materials that the researcher developed were categorized as Very Good in Table 5 below.

Table 5: FGD on Teaching Material Results

No	Name of Driving School	Mark
1	ES14 Fight	92
2	ES03 Marriages	89
3	ES03 KampungTengah	87
4	ES16PasarSungaiTunu	95
5	ES09 Labuhan Tanjak	90
Amount		453
Rates		91%
Rates (percentage)		Very Good

3.2.3 Testing Teaching Materials

After carrying out the validation steps, the researchers then carried out product trials at an elementary school, namely ES 14 Laban. For this trial, researchers carried out stages such as conducting research. At this trial stage the researchers also carried out the practicality and effectiveness stages. The process begins with giving Pre-test, implementation of material provision activities using the teaching materials developed by the researcher, and ends with Post-test.

In practice: Practicality is carried out to determine the extent to which the teaching materials developed are practical in their use in the classroom. The instrument used is a teacher and student practicality questionnaire, namely:

- 1) Teacher: Practicality trial data for interactive multimedia teaching materials were obtained directly from four class IV teachers from driving elementary schools who had previously filled out teacher practicality questionnaires. For the results of the ES 14 Laban teacher practicality analysis, see Appendix 16, page 296. Based on the data above, the overall score obtained from the teacher practicality test is 92%, this states that the interactive multimedia teaching materials developed are in the very practical category; and
- 2) Student: Practicality trial data for interactive multimedia teaching materials were obtained directly by students using a student practicality questionnaire instrument. The variables for testing the practicality of interactive multimedia teaching materials for students are ease of use of the product, usefulness and appearance. For the results of the practicality analysis of ES 14 Laban students, see Appendix 19 on page 301. Based on the data above, the overall score obtained from the teacher practicality test is 89.7%, this shows that the interactive multimedia teaching materials developed are categorized as very practical. The following data on the results of students and teachers practicality in the trial can be seen in Table 6 and Table 7 below.

Table 6: Results of Teacher Practicality at Trial Schools

No	Statement	Score	Category
1	Easy to use	5	Very good
2	The instructions for teaching materials are in the form of assisted interactive multimedia <i>Macromedia Flash 8</i> days <i>Wordwall</i> easy to understand	4	Good
3	Useful navigation display	4	Good
4	The learning flow is easy to understand	5	Very good
5	Teaching materials increase students' learning motivation	5	Very good
6	Teaching materials increase students' interest in learning	5	Very good
7	Teaching materials can improve student learning outcomes	5	Very good
8	Teaching materials can help students in the learning process and can become	5	Very good
9	Text and images in teaching materials in the form of assisted interactive multimedia <i>Macromedia Flash 8</i> and <i>Wordwall</i> makes it easier for teachers to help students understand the material	5	Very good
10	Display animation, sound, images, video and navigation on teaching materials in the form of assisted interactive multimedia <i>Macromedia Flash 8</i> and <i>Wordwall</i> attract.	3	Very good
Amount		46	
Rates		92	
Rates (percentage)		92%	Very good

Table 7: Results of Practicality of Students in Trial Schools

User (Student)	%	Category
Class IV ES 14 Laban	89,7	Very Practical

- Effectiveness: Effectiveness is carried out to find out to what extent the teaching materials developed are effective in increasing student learning outcomes. To test the effectiveness of the researchers, they carry it out through learning evaluation, namely by using instruments. Pre-test and Post-test. Based on the results of comparing the two values above, the result value Pre- test obtained an average of 34.50 and at time Post-test increased to 89.25 after using the product that the researchers developed. Results from Post-test this also shows that there is an increase in student learning outcomes after using this interactive multimedia teaching material. This can be seen from the achievement of these values which are above the Minimum Completeness Criteria (MCC). It can be concluded that the results of this trial were successful and the further research process can be carried out. The following data on effectiveness results in trials can be seen in the following Table 8 below.

Table 8: List of Values Pre-test and Post-test ES 14 Laban

No	Pre-test	Post - test	Post- test- Pre- test	Shoes Ideal (100) - Pre-Test	N-Gain Score	N-Gain Score Percent	
1	N	25	90	65	75	0,87	86,67
2	DA	35	85	50	65	0,77	76,92
3	RGR	45	95	50	55	0,91	90,91
4	DA	25	100	75	75	1,00	100,00
5	ON	50	100	50	50	1,00	100,00
6	VS	20	80	60	80	0,75	75,00
7	FOR	30	90	60	70	0,86	85,71
8	THE	40	90	50	60	0,83	83,33
9	WE BUY	50	95	45	50	0,90	90,00
10	AAA	40	100	60	60	1,00	100,00
11	AS	35	80	45	65	0,69	69,23
12	ASP	35	90	55	65	0,85	84,62
13	YEARS	50	75	25	50	0,50	50,00
14	AFR	25	85	60	75	0,80	80,00
15	WITH	35	90	55	65	0,85	84,62
16	APY	45	95	50	55	0,91	90,91
17	DPN	40	85	45	60	0,75	75,00
18	FAR	15	90	75	85	0,88	88,24
19	FNP	15	95	80	85	0,94	94,12
20	GAP	35	75	40	65	0,62	61,54
Amount	690	1785	1095	1310	16,67	1666,81	
Rates	34,50	89,25	54,75	65,50	0,83	83,34	
Rates (percentage)					High	Effective	

3.3 Discussion

The discussion regarding the results of the development research that has been carried out will be explained further, especially those related to the development process, validity, practicality, and effectiveness of the learning tools developed. For more details, it can be explained as follows. This interactive multimedia teaching material uses the ADDIE development model with 5 development stages. The stages used in the process of creating interactive multimedia teaching materials are:

- Level Analysis: At this stage, the researcher carries out several analyses that are needed in the school that will be used as a research site. Where researchers do this by collecting information through preliminary studies. The results of the information from this preliminary study will be the basis for researchers to carry out analysis. This analysis includes needs analysis, curriculum analysis, student analysis, and material analysis. The researcher has explained this stage in detail on page 102 and page 121.
- Level Design: At this stage, the researcher designs a product development project. The activities that researchers carry out at this design stage start from designing the product design, material content, and presentation. The researcher has explained this stage in detail on page 103 and page 124.
- Level Development: At this stage, the researcher carried out a feasibility test of the product being created, by validating the product being developed with validators who were media, material, and language experts. After that, the researcher made revisions according to comments and suggestions from validator experts FGD and

product trials. The researcher has explained this stage in detail on page 103 and page 132.

- Level Implementation: At this stage, the researcher conducted research at the school. Trials were carried out in small/limited groups and large/wide groups. The researcher has explained this stage in detail on page 103 and page 143.
- Evaluation Stage: At this stage, two evaluations must be carried out, formative and summative evaluation. These two evaluations had been carried out at previous stages. The researcher has explained this stage in detail on page 104 and page 148.

3.3.1 Validity of Development of Interactive Multimedia Teaching Materials With Discovery Learning on Natural and Social Sciences Content to Support the Achievement of HOTS Learning Outcomes in the Mobilization of ES

Validity comes from the English word validity which means validity and truth. Mao et al (2024) say that the higher the validity of a product, the better the conclusions drawn and the greater the level of meaningfulness in terms of its use. Sugianto et al (2023) divide validity into 3 types, namely

- 1) Construct validity concerns each development of 152 aspects of thinking as stated in specific instructional objectives;
- 2) Content validity which discusses whether the content reflects the content of the curriculum that should be measured; and
- 3) Criterion validity which means it has validity if there is conformity with certain criteria.

Validity is needed to test a research. The word "valid" is often interpreted as precise, correct, authentic, and valid, so the word validity can be interpreted as accuracy, correctness, authenticity, or legality (Zarog, 2023). Research products that have been developed are said to be valid if they meet certain criteria. According to Plomp et al (2010), the characteristics of a product are said to be valid if the product can reflect the spirit of knowledge (state-of-the-art knowledge). This is what is called validation (content validity). Furthermore, the product components must be consistent with each other (construct validity). Therefore, the validation carried out on this research product emphasizes content and construct.

Validation of teaching materials was carried out based on several aspects, namely the material aspect which received an average score of 92% in the Very Good category. This means that the teaching materials developed have demonstrated suitability between the content with learning outcomes and flow of learning objectives, student development, the need for teaching materials, and the truth of the substance of the material, and have provided additional insight to students. Apart from that, interactive multimedia teaching materials Macromedia Flash 8 and Wordwall model-based Discovery Learning. Then from the media aspect, validation results were obtained with an average of 91% including 153 Very Good category. This shows that the media can be read, is good for layout, and uses attractive images and designs. Initially, according to the validator, there were several colors used that were not suitable or harmonious. Based on input from validators, several revisions were made regarding this matter. So in the end the media presentation used is Very Good.

The validation of linguistic aspects obtained an average of 92% which is included in the Very Good category. This means that the language used in teaching materials is by good and correct Indonesian language rules, the use of teaching materials is clear, the language used is simple, straightforward, easy to understand, and communicative and interactive. Overall interactive multimedia teaching materials materials Flash 8 and Wordwall model-based Discovery Learning are already valid according to the validator.

3.3.2 Practicality of Developing Interactive Multimedia Teaching Materials with Discovery Learning on Natural and Social Sciences Content to Support the Achievement of HOTS Learning Outcomes in the Mobilization of ES

After the validity testing stage, it was revised and then tested in schools to determine its practicality. According to Megahati et al (2018), practicality considerations can be seen from several aspects, namely ease of use, the time required for implementation, preferably short, fast, and precise, can attract student interest is easy to interpret by expert teachers and other teachers, and has high equivalence, so it can be used instead of variations. Furthermore, according to Plomp et al (2010), a product can be said to be practical if it can be used easily by teachers and students by development objectives. So, practicality is the level of practicality of teaching materials when used in the learning process.

Teaching materials that have been declared valid are then tested to see the level of practicality in their use. The trial was carried out in class IV ES 14 Laban. After that, the research process continued in four elementary schools, namely ES 05 Malepang, ES 03 Kampung Tengah, ES 16 Pasar Sungai Tunu, and ES 09 Labuhan Tanjak. Based on the results of the analysis of student responses, it can be concluded that in general students feel motivated and helped in the learning process. The teaching materials used are very practical for students, which can be seen from the average student response of 91.11% in the very practical category. The results of the teacher's response to the use of teaching materials are also not much different from the student's response. In general, the teacher responds that the teaching materials that have been developed by researchers are very helpful in learning Natural and Social Sciences in class IV ES. This teaching material is considered an innovation in the learning process, as seen from the average teacher response of 94.5%, it is very practical. Based on the results of interviews with teachers and students, it can be concluded that the use of teaching materials is quite easy to use in learning. Apart from that, the color design and layout can attract students' interest enough to fully understand the teaching material.

3.3.3 Effectiveness of Developing Interactive Multimedia Teaching Materials with Discovery Learning On Natural and Social Sciences Content to Support the Achievement of HOTS Learning Outcomes in the Mobilization of ES

Effectiveness can be achieved if the teaching materials have been declared valid and practical, meaning the impact, influence, and results they produce (Poerwadarminta, 1976). Elbyaly & Elfeky (2023) states that the effectiveness test is the suitability between the person carrying out the task and the intended target. The process of implementing the program to achieve these goals is designed in an atmosphere that is conducive and attractive to students.

In this research, to test the effectiveness of the researchers, the researcher carried it out through the learning evaluation route and the product evaluation route.

For learning evaluation pathways use Pre-test and Post-test, while the product evaluation route is through an open teacher and student evaluation questionnaire. Based on the results of the effectiveness test through the learning evaluation route, it shows the average learning outcomes after the trial Pre-test and Post-test show very good results. This can be seen from the comparison of the results Pre-test and Post-test, where the average of the resulting values Pre-test of 35.30. Then, after doing it Post-test increased with an average score of 88.36. Next, these values are analyzed using tests N-Gain. The results of the N-Gain test show the N-Gain score is 0.83 in the high category and N-Gain Score the percent is 81.34 which is categorized as quite effective. Meanwhile, the results of the effectiveness test through the product evaluation route show that there are 156 obstacles faced by teachers and students both related to the learning process and the products that researchers develop during the research process. Based on the results of this data analysis, it can be concluded that multimedia teaching materials are interactive Macromedia Flash 8 and Wordwall model-based Discovery Learning It can be said to be effective because it produces teaching materials that have increased student activity and learning outcomes. This can be seen from the attractive appearance of the teaching materials so that students are more enthusiastic about studying the material. Apart from that, students also stated that they did not need too much direction while completing each activity sheet in the teaching materials.

CONCLUSION

The research conducted on the development of interactive multimedia teaching materials with Discovery Learning for Natural and Social Sciences content aimed to ascertain various aspects, including validity, practicality, and effectiveness. The development process followed the ADDIE model with five stages: Analysis, Design, Development, Implementation, and Evaluation. The validity assessment was comprehensive, covering construct validity, content validity, and criterion validity.

The research products were considered valid as they aligned with instructional objectives and curriculum content and demonstrated consistency among components. The validation process involved expert input and resulted in high scores across material, media, and linguistic aspects. Following validity testing, the practicality of the teaching materials was evaluated. Practicality considerations included ease of use, time efficiency, student engagement, and usefulness for teachers. Trials conducted in multiple ES showed that both students and teachers found the materials highly practical, contributing to motivation and learning outcomes.

Effectiveness testing focused on the impact of the teaching materials on learning outcomes. Pre-test and Post-test assessments revealed significant improvement in student performance, with a high N-Gain score indicating effectiveness. Additionally, feedback from teachers and students highlighted increased engagement and reduced need for guidance during activities, indicating the materials' effectiveness in facilitating learning.

Overall, the research concluded that the developed interactive multimedia teaching materials effectively supported the achievement of HOTS learning outcomes in Natural and Social Sciences, demonstrating validity, practicality, and effectiveness in enhancing the learning process.

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