Development of the E-Lintar Mobile App with Integrated Songs on Fifth Graders' Understanding of Food Chains

Annisa Khoirul Barokah[*]**, & Putri Yanuarita Sutikno**
Elementary School Teacher Education Study Program, Universitas Negeri Semarang, Indonesia

Abstract: This study was motivated by students' challenges in understanding learning concepts in food chain material, which is often considered abstract and filled with new terms that are difficult to understand. Difficulties in distinguishing the roles of producers, consumers, and decomposers, as well as remembering the flow of the food chain, are the main obstacles for students. The objective of this study is to develop and evaluate the effectiveness of the E-Lintar Mobile App with integrated songs as an interactive, engaging, effective, and enjoyable learning medium that can enhance students' understanding of the taught material, thereby improving learning outcomes. This study employed the Research and Development (R&D) method with the ADDIE model, with 30 fifth-grade students as the subjects. Data collection was conducted through tests and non-tests, then analyzed using normality tests, t-tests, and N-Gain calculations. The results showed that this application is highly feasible for use, with a feasibility rating of 95% from subject matter experts, 94% from media experts, 98.75% from teachers, and 96.09% from students. The effectiveness of the application was proven through a t-test on a small group with a significance value (2-tailed) of $0.000 < 0.05$, while on a large group with a significance value (2-tailed) of $0.000 < 0.05$, the results showed a significant difference between the pretest and posttest results. The N-Gain test results for the small group were 0.7207, categorized as high, while the large group achieved 0.7518, also categorized as high. This study contributes to the innovation of technology-based learning media that supports students' critical thinking skills and facilitates teachers in integrating multimedia. Thus, the E-Lintar Mobile App with integrated songs supports concept understanding, improves memory, and creates a more engaging and interactive learning environment for science education, particularly on the topic of food chains at the elementary school level.

Keywords: e-lintar mobile app, songs, sience, problem-based learning.

▪ **INTRODUCTION**

Natural and Social Sciences is a branch of science that studies various aspects of living things and highlights the dynamics of human behavior, both personally and in a social context. By taking this course, students are expected to understand various aspects of life and be able to manage the natural and social environment wisely and prudently. Natural and Social Sciences learning emphasizes the process of investigation and problem solving (Akben 2020). Natural and Social Sciences is a combination of natural sciences and social sciences. This combination is designed so that students can understand and manage both sciences in an integrated manner (Meylovia and Alfin Julianto 2023). Combining natural and social sciences makes learning more relevant to real life. Students can also develop important skills such as communication, critical thinking, innovation, and teamwork. Natural and Social Sciences focus on learning experiences that support the development of students' abilities (Iftikhar 2024). The implementation of the Merdeka Curriculum integrates Science and Social Studies as Natural and Social Sciences. This integration is expected to encourage an increase in students' interest in learning, curiosity, and the development of critical thinking, creativity, and various other essential skills

(Fitriani et al. 2020a). Natural and Social Sciences play a crucial role in fostering students' curiosity about natural phenomena around them. Students' curiosity drives them to study natural mechanisms and their connections to human life. Therefore, researchers are interested in further examining Natural and Social Sciences. However, given the broad scope of Natural and Social Sciences, which covers various aspects, such as social and natural aspects, this study is limited to the scope of science learning.

Science is a field of study with its own characteristics that has undergone rapid development. This science studies various natural events that are real, both as facts and as events that are causally related (Mulyasari, Arga, and Altaftazani 2022). According to the 2022 Programme for International Student Assessment (PISA) survey conducted by the Organisation for Economic Co-operation and Development (OECD), literacy levels in reading, mathematics, and science are measured globally. The results indicate that although Indonesia's ranking has improved, students' science literacy skills remain low (Luzyawati et al. 2025). Therefore, efforts are needed to improve the quality of education, especially in science at the elementary school level, where natural and social science subjects teach various concepts related to the environment and the surrounding nature (Sund and Gericke 2020). Science discusses facts about the universe but is often considered difficult because it requires logic, reasoning, conceptual understanding, memorization, and complex mathematical calculations. Science is often considered difficult by elementary school students, especially because of the many abstract concepts and scientific principles that must be understood. This poses a challenge in science learning, including learning about food chains in fifth grade, where the learning outcome is for students to investigate how the interdependence between biotic and abiotic components can affect the stability of an ecosystem in the surrounding environment. The food chain involves abstract concepts such as the roles of producers, consumers, and decomposers. Science learning is often considered difficult by students, mainly because the material is presented in an uninteresting way and there is little hands-on experience. These difficulties make it hard for students to understand the material, distinguish the roles of each component, and remember the relationships between terms. As a result, students often lose focus during learning and are less motivated to study science. As a result, concepts such as food chains are difficult to understand, which leads to poor learning outcomes. Therefore, the use of interactive educational media that can directly engage students is essential to help them understand the material. These difficulties emphasize the importance of teachers' creativity in developing learning media.

Many students find it difficult to distinguish between concepts such as producers, consumers, and decomposers, as well as to remember the order or role of each term in the food chain. During the learning process, some students show a lack of attention to the material being taught, which leads to boredom. On the other hand, teachers tend to use limited learning media such as printed books, LCD projectors, and other simple media. The use of limited media can cause students to show low interest and lack of participation during the learning process. As a result, their ability to face challenges and develop conceptual understanding has not developed optimally. Previous research also revealed that the lack of utilization of technology-based learning media can reduce the effectiveness and attractiveness of learning (Abdulrahaman et al. 2020). Rapid technological advances have led to the emergence of learning media that are more practical, simple, and in line with the times (Dwidarti, Zamzani, and Prabowo 2025). In

this regard, it is important to implement innovative and effective learning media. It is hoped that students will find it easier to understand the concept of the food chain through an approach that is more engaging and easier to comprehend. In this context, the developed media is the E-Lintar application, which uses songs to teach the food chain concept for fifth-grade students.

The E-Lintar application, which stands for Interactive E-Learning Food Chain, serves as a flexible learning platform for students, free from time and location constraints. The E-Lintar application is an interactive technology-based learning platform specifically designed to help students understand the concept of food chains in an enjoyable and interactive way. E-Lintar Mobile App integrates multimedia elements such as food chain materials, educational videos, student stimuli, educational songs, and interactive quizzes, which not only provide a multisensory learning experience but also make it easier to master complex material. Through its features, the app is designed to facilitate a more dynamic and engaging learning process, helping students simplify complex concepts such as the roles of producers, consumers, and decomposers, as well as the relationships between components of the food chain, while enhancing their understanding and interest in science. Technically, the E-Lintar Mobile App with integrated songs can be accessed through digital devices such as laptops, Chromebooks, or smartphones. In a multisensory way, the E-Lintar application aims to improve student achievement, stimulate interest in learning, and optimize the science learning process in elementary schools.

The E-Lintar Mobile Application was developed using iSpring Suite, a software application that functions as an e-learning tool, as it is capable of presenting material in the form of interactive presentations while supporting teaching and learning activities (Shurygin et al. 2021). The application greatly facilitates users in creating innovative learning materials, which can contribute to increasing student engagement and enthusiasm in the classroom learning process (Wong, Kwong, and Pegrum 2018). iSpring Suite can be published or saved in HTML5 format, allowing it to be opened and run on various devices, including Android/mobile phones and computers (Zulifah et al. 2021). This makes learning more effective and increases students' motivation in the classroom because teachers can deliver learning information efficiently and interactively (Elida, Ananda, and Sari 2024), which supports the learning process in the classroom by making abstract and complex concepts simple and easy to understand for students. This innovative approach offers an alternative solution to address declining student interest and understanding in the learning process by providing a dynamic virtual learning environment that stimulates students' curiosity, thereby transforming the learning process into an active and innovative one. The success of a learning process can be achieved through the various features available in the E-Lintar mobile application, one of which is educational songs.

The educational song titled "Rantai Makanan" is included in the E-Lintar mobile application, which helps increase interest in learning, explains the material in more detail, evokes positive feelings, fosters appreciation for aesthetics, and instills meaningful values in learning (Bella, Respati, and Karlimah 2021). The educational songs in the E-Lintar application are an innovative learning tool developed to help students master the material on food chains through a clearer, more enjoyable, interactive, and non-monotonous approach (Sari and Sutikno 2024). The lyrics of the songs contain information about the components, definitions, and examples of food chains in ecosystems. This educational

song aims to help students remember the material and solve problems related to food chains. The main advantage of this application lies in the use of educational songs created by the researchers themselves, which make difficult concepts easier to remember. In addition to being entertaining, adding songs to learning also helps students memorize abstract terms and new information more easily (Makarima and Sutikno 2024). This educational song can also help sharpen students' creativity and skills in understanding learning material (Hadi et al. 2022). The use of songs as a medium is effective in improving students' psychomotor skills, which is also supported by cognitive and affective aspects in the learning process (An-Nisa and Sutikno 2024). Singing together in learning can be an effective approach to creating a more lively and cheerful learning environment, which can motivate students to be more enthusiastic and actively involved in classroom activities (Nurhayati et al. 2024). In addition, singing activities for children contribute to improving memory and stimulating creativity (Sutikno et al. 2024). The use of media containing educational songs can foster students' interest and encourage their active involvement in absorbing lesson material. Through this approach, classroom learning becomes more student-centered, allowing students to be more actively involved and better able to remember the concepts taught (Wadiyo et al. 2024).Thus, the educational songs in the E-Lintar mobile application are expected to facilitate students in remembering the concepts of the food chain through a lighter, more entertaining, and enjoyable approach to learning.

In implementing the E-Lintar mobile application, a Problem-Based Learning (PBL) approach was used, designed to hone students' skills in formulating solutions to problems they face (Aslan and Duruhan 2021). The PBL approach provides students with the opportunity to gain a deeper understanding through problem-solving, as well as develop critical thinking skills and the ability to analyze systematically through the search for solutions to problems faced (Han, et al., 2024). Through Problem-Based Learning, students are encouraged to learn by being directly involved in solving problems that occur in their surroundings. This approach makes the learning process in the classroom more meaningful because students also play an active role in the process of finding alternative solutions and understanding concepts better (Fitriani et al. 2020). The researchers chose to develop interactive media based on Problem-Based Learning (PBL) because PBL provides great opportunities for students to be more actively involved in understanding concepts more thoroughly, practicing critical thinking skills, and building good analytical and problem-solving skills. Additionally, students are encouraged to gather relevant information, discuss it with peers, and connect it to relevant experiences, making learning more meaningful, enjoyable, interactive, and applicable for students (Shang et al. 2025). The PBL approach encourages students to learn independently and collaboratively in groups, which in turn fosters active collaboration and communication skills among students (Sistermans 2020). In the implementation of this model in food chain material, students will be presented with problems related to the topic. As an innovation in implementing the PBL approach in elementary schools, the researcher developed the E-Lintar application, an interactive PBL-based learning application equipped with various educational features, such as materials, stimuli for students, learning videos, worksheets, quizzes, and educational songs. During the learning process, teachers act as facilitators, providing initial stimuli through the application, guiding discussions, and encouraging students to argue based on data and their experiences. Thus, the application of PBL

through E-Lintar not only makes learning more active, contextual, and enjoyable but also develops students' independence, collaboration, and higher-order thinking skills.

The purpose of this study is to design, evaluate the feasibility and effectiveness of the E-Lintar mobile application equipped with educational songs in the use of a problem-solving learning model. The focus is on improving the learning outcomes of fifth-grade students regarding food chain material in the concept of science. The E-Lintar application, as an interactive medium, is designed to offer a more active, engaging, and interactive learning environment through various features available within it, such as food chain topics, stimuli, worksheets, educational videos, quizzes, and educational songs that can strengthen memory and help students understand the concept of the food chain in a more enjoyable and practical way. With the PBL approach, students are encouraged to actively solve contextual problems in their daily lives, which can stimulate critical thinking, creativity, collaboration, and problem-solving skills to be developed optimally. Therefore, this study focuses on three main aspects: describing the development process of the E-Lintar Mobile App with integrated songs on the topic of food chains for fifth-grade elementary school students, evaluating the application's feasibility based on assessments from various experts, such as media experts, subject matter experts, as well as the responses of students and teachers, and measuring the effectiveness of the E-Lintar Mobile App with integrated songs in improving the learning outcomes of fifth-grade students on the food chain material. It is hoped that the findings of this study can contribute to the development of technology-based learning media, which will help teachers clarify conceptual understanding and support students to better solve problems in science learning at the elementary school level. As an interactive medium, this application offers a more engaging learning experience through its various features. Meanwhile, the educational songs included help reinforce students' memory and facilitate understanding of the concepts taught. The combination of interactive technology and educational songs creates a more enjoyable, efficient, and engaging learning experience, encouraging active student participation in every learning session.

▪ **METHOD**
Participants

This study was conducted at SDN Jatiroyom 02, Pemalang Regency. The population used in this study were fifth-grade students at SDN Jatiroyom 02. This study involved 30 students from fifth grade at SDN Jatiroyom 02 as participants. Of these students, 9 participated in the small group trial, while 21 participated in the large group trial. In selecting participants, this study used purposive sampling, which is a method of selecting samples based on criteria relevant to the research objectives. There were various criteria, including students who were smart, average, and needed guidance. This approach was chosen because it allowed researchers to select samples that were appropriate to the focus and objectives of the study and were considered most relevant and representative in achieving the desired results in this study. Purposive sampling was used to focus on individuals with specific characteristics that could provide deeper insights into the research object (Ames, Glenton, and Lewin 2019). Thus, it is hoped that this study can provide new and deeper insights into the effectiveness of the learning application developed by the researcher.

Research Design and Procedure

This study applied the Research and Development (R&D) method using the ADDIE model, which consists of five steps, namely analysis, design, development, implementation, and evaluation (Sugiyono 2022). The first process begins with an analysis of the existing needs in the classroom, namely the students and teachers, followed by the design of the concept and structure of the learning media, then continued with the development and testing stages, which are implemented in the learning process, and finally evaluated to assess its effectiveness and make improvements to the learning media if necessary. The ADDIE model is used because it has an organized and flexible approach, with a focus on continuous evaluation. This approach ensures that the developed learning application is more effective, relevant to students' needs, and capable of improving the quality of the learning process.
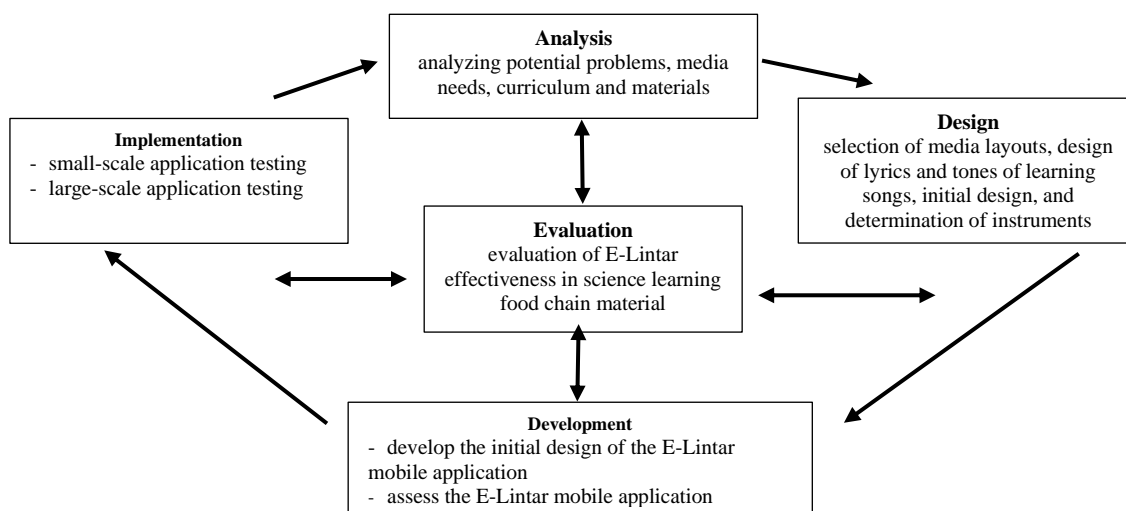
Analysis
analyzing potential problems, media needs, curriculum and materials

Implementation
- small-scale application testing
- large-scale application testing

Design
selection of media layouts, design of lyrics and tones of learning songs, initial design, and determination of instruments

Evaluation
evaluation of E-Lintar effectiveness in science learning food chain material

Development
- develop the initial design of the E-Lintar mobile application
- assess the E-Lintar mobile application

Figure 1. ADDIE model stages

During the analysis stage, various important aspects are carried out. First, problem analysis is conducted by collecting data through interviews, observations, questionnaires, and student test results to identify obstacles in learning. Second, media needs analysis is conducted by gathering information from teachers and students through questionnaires and literature studies to determine the features required in the learning media. Aligning learning outcomes and learning objectives is the purpose of reviewing the curriculum implemented in schools, such as the Merdeka Curriculum. To ensure that the developed learning media is optimal, analysis is also conducted to adapt and select relevant materials.

The design stage involves compiling products based on the results of previous analyses, namely the results of problem analysis, media requirements, curriculum, and material analysis. This process includes selecting the appropriate layout for the learning media, creating educational song lyrics and harmonious melodies, developing a preliminary design, and determining the instruments that support the effective use of media in learning. The model used in this study is PBL, which includes five steps, namely student orientation to the problem, organizing student learning, guiding groups/individuals, developing work products, and analyzing and evaluating the problem-solving process.

In the development stage, the initial design of the learning application, which includes educational songs and supporting instruments, is refined to suit the learning needs in the classroom. The developed media were then assessed by experts in the field of subject matter and media to evaluate their suitability and relevance to the learning objectives. Based on the feedback provided by these experts, improvements were made to ensure that the learning application was optimal and effective before being implemented in the learning process for students.

In the implementation stage, the learning application was tested to see its effectiveness in helping students understand the food chain material. The learning sessions were conducted twice, namely learning sessions 1 and 2. The application contains material, learning videos, stimuli, worksheets, educational songs as memory aids, and interactive quizzes. Before implementation, the application was validated by media and material experts to ensure its quality and suitability. The testing was conducted through small-scale and large-scale trials. The small-scale trial aimed to identify shortcomings before implementation on a large scale, while the large-scale trial assessed the impact of the application on students' understanding. Its effectiveness was analyzed by comparing the results of the pretest and posttest. Additionally, feedback questionnaires from teachers and students were collected as evaluation materials regarding the suitability and appeal of this educational media.

The evaluation stage involves analyzing the results of questionnaires collected from teachers and students. The information gathered is used to identify aspects that need improvement and the strengths of the learning media that has been designed. The results of this evaluation form the basis for refining the media so that it can be used more optimally.

Data Collection Techniques

In this study, data was collected using test and non-test methods. Non-test techniques included observation and interviews aimed at identifying the obstacles faced by students, as well as the distribution of questionnaires to identify the needs of students and teachers regarding learning facilities, expert validation, and user responses or feedback regarding the feasibility of the application. The questionnaire distribution to media experts covered four aspects, with the first and second aspects consisting of four questions, while the third and fourth aspects consisted of five questions. The questionnaire distribution to subject matter experts covered three aspects, with the first aspect consisting of three questions, the second aspect consisting of four questions, and the third aspect consisting of eight questions. The distribution of questionnaires on teachers' responses or feedback regarding the feasibility of the application consists of 16 questions, and the distribution of questionnaires on students' responses or feedback consists of 11 questions.

Meanwhile, the testing technique uses pretest and posttest with a total of 25 multiple-choice questions. The tests were used to measure the effectiveness of the E-Lintar Mobile App with integrated songs in improving students' learning achievement in science lessons on the food chain before and after implementing learning using the E-Lintar Mobile App with integrated songs implemented with the Problem-Based Learning (PBL) model. The questions in the pretest and posttest were valid and reliable, with good question discrimination and difficulty levels categorized as difficult, moderate, adequate, and easy.

Data Analysis Techniques

The research instruments were validated by developing pretest and posttest questions that had been assessed by experts and tested for validity, reliability, discriminating power, and level of difficulty. Next, the validation questionnaires and responses from teachers and students were analyzed using a Likert scale, where the data obtained were calculated based on the frequency of respondents' answers and expressed as a percentage. The data analysis process also involved evaluation by subject matter experts and media experts to assess the quality and suitability of the developed learning media (Marpanaji, Mahali, and Putra 2018). This assessment was analyzed using a Likert scale, with the involvement of media and subject matter validators. The percentage of suitability from both aspects, including student and teacher responses, to determine the level of suitability of the application was classified based on the percentage of the assessment, namely: 81%–100% falls into the highly feasible category, 61%–80% is considered feasible, 41%–60% is classified as moderately feasible, 21%–40% is categorized as less feasible, and 0%–20% is categorized as not feasible (Riduwan 2010). Learning outcome data was analyzed by comparing pretest and posttest results to assess the level of effectiveness.

The E-Lintar Mobile App with integrated songs was used to deepen students' understanding of the basic concepts of science learning. The effectiveness of this media was analyzed through several stages, namely normality test, paired-sample t-test, and N-Gain test. The paired-sample t-test was used to see if there was a significant difference between the pretest and posttest scores in the same group, assuming that the data was normally distributed. Meanwhile, the N-Gain test was used to measure the extent of improvement in average scores after using the E-Lintar application. N-Gain values were categorized into three levels: low (< 0.3), moderate ($0.3 \leq \text{N-Gain} < 0.7$), and high ($\geq 0.7$) (Isdianti, Nasrudin, and Erman 2021).

▪ **RESULT AND DISSCUSSION**

Analysis Stage

Based on preliminary research on potential problems, the researcher conducted observations and interviews with fifth-grade teachers at SD Negeri 02 Jatiroyom. It was found that technology-based learning media were not being utilized to their full potential, and the media used were still not interactive enough. Learning tended to focus on the role of the teacher, which resulted in a lack of dynamic and enjoyable learning atmosphere. In addition, student learning outcomes in science and social studies, particularly regarding the food chain, were still low. The food chain involves abstract concepts such as the roles of producers, consumers, and decomposers. Science is often considered difficult by students (Sahin and Yilmaz 2020), mainly because the material is presented in an uninteresting manner and there is a lack of direct experience. These difficulties make it hard for students to understand the material, distinguish the roles of each component, and remember the relationships between terms. As a result, students often lose focus during learning and are less motivated to study science. Consequently, concepts such as food chains are difficult to understand, which impacts low learning outcomes.

Furthermore, based on media needs analysis, the researcher distributed a media needs questionnaire to teachers and students. The results of the questionnaire for teachers and students showed that 100% of respondents agreed with the development of the E-

Lintar application assisted by songs that are tailored to learning outcomes and objectives and presented in an interesting way with the addition of learning songs, learning videos, and interactive quizzes as an effort to strengthen students' understanding of the learning topics (Rachmavita 2020) tailored to their needs using straightforward and simple language and bright color harmonization. Therefore, the developed product is the E-Lintar song-assisted application to improve learning outcomes in the concept of the essence of science. Another study mentions that interactive learning media can support the improvement of students' thinking skills and make it easier for them to grasp abstract concepts (Kotevsk and Tasevska 2017).

Design Stage

In this stage, the media is designed based on the results of the analysis and questionnaires of teachers and students as a reference for development. In the design process, aspects of design, content, and language are considered to ensure that the resulting media meets the needs of students. The design begins with determining the design theme, compiling content that includes material, educational videos about the food chain, additional information, and interactive quizzes. The researchers then design the layout using the Canva application, which facilitates the creation of interactive learning materials through its graphic design features, thereby supporting an effective and optimal learning environment (Erden Kocaarslan and Rıedler Eryaman 2024). This design will be developed into an interactive learning application using the iSpring Suite application. The design is created with an attractive layout, bright colors suitable for elementary school students, and clear, easy-to-read fonts.

During the design phase, the interactive learning media was created using iSpring Suite in the form of an E-Lintar Mobile App with integrated songs. This iSpring Suite-based media was designed to produce an attractive and educational interface that encourages student participation and understanding during the learning process (Ainiyah et al. 2024). This educational media is accompanied by educational songs, in line with humanistic theory emphasizing the importance of self-understanding. Elementary school students tend to enjoy enjoyable learning experiences, such as singing in interactive applications (Robinson 2024).

Development Stage

The development process begins with creating a storyboard using Canva, which serves as a framework for designing the learning flow, visual layout, and interactive elements. Elements such as images, short videos, simple animations, and audio content, including songs, are collected and integrated into the iSpring Suite application. The E-Lintar Mobile App with integrated songs can be accessed via the following link: https://elintar.vercel.app/ . For the song-assisted E-Lintar application displaying food chain material, please see below:

The first page contains the title of the interactive learning media, E-Lintar (E-Learning Interaktif Rantai Makanan) Mobile Application with integrated songs with the title 'Rantai Makanan'. The media display is presented with bright images and colors so that it is suitable for elementary school students. The initial display also contains a 'play' button which, when clicked, will take you to the next section.
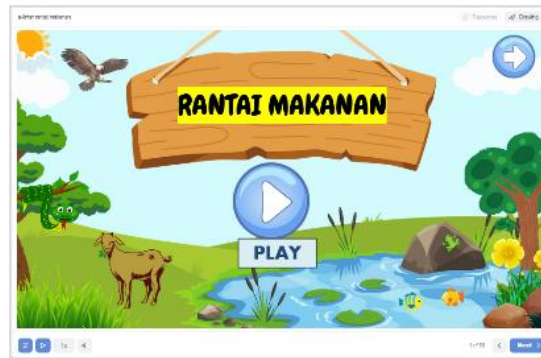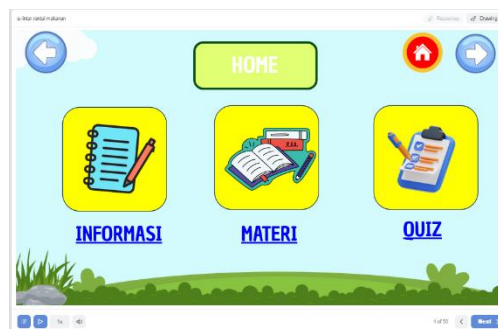
Figure 2. Initial display

Figure 3. 'home' screen

The home screen is the main menu screen containing information, materials, and quizzes. The information section contains the developer's profile, topics and objectives, learning objectives, and references. The materials section contains learning materials, educational videos, children's songs about the food chain, and worksheets. The quiz section contains interactive quizzes about the food chain.

Figure 4. Material menu display

The design of this material menu is an example of a menu display for material on food chains. The material menu contains various displays, ranging from the definition of food chains, components of food chains with definitions and examples, to examples of various food chains in various ecosystems. Before starting the material, the E-Lintar application presents stimuli in the form of images and questions to prompt students'

interest in the food chain material, which in this case is related to the PBL learning model, where students can solve a problem.

Figure 5. Learning video menu display

The learning video display contains interesting learning videos with images, animations, and bright colors that are relevant to the food chain material, so that students can gain a deeper understanding of the food chain material. The learning videos utilize the Canva application to design the videos.

Figure 6. Display of the children's song about the food chain

The song media was created using Canva to design the video, resulting in an audiovisual format. The music used in the song was created with the assistance of the Suno app. The song video was designed using food chain materials, accompanied by animations and images that align with the song lyrics. The moving lyrics are also displayed within the video to help students sing along. The lyrics of the song titled "Rantai Makanan" are as follows:

Ayo kawan, kita belajar bersama,
Komponen yang ada dalam rantai makanan.
Produsen itu tumbuhan hijau,
Konsumen satu itu konsumen primer atau herbivora,
Konsumen dua itu konsumen sekunder atau karnivora,
Konsumen tiga konsumen tersier juga karnivora,
Pengurai itu jamur dan bakteri,
Hati senang telah belajar,
Tentang rantai makanan dalam ekosistem.
Yuk, jaga alam dan lingkungan kita,
Agar rantai makanan tetap terjaga!

Ayo kawan, kita belajar bersama,
contoh rantai makanan dalam sawah,
produsen itu tanaman padi
konsumen satu itu tikus yang memakan padi,
konsumen dua itu ular yang memangsa tikus,
konsumen tiga itu elang yang memangsa ular,
pengurai itu jamur dan bakteri
Hati senang telah belajar,
Tentang rantai makanan dalam ekosistem.
Yuk, jaga alam dan lingkungan kita,
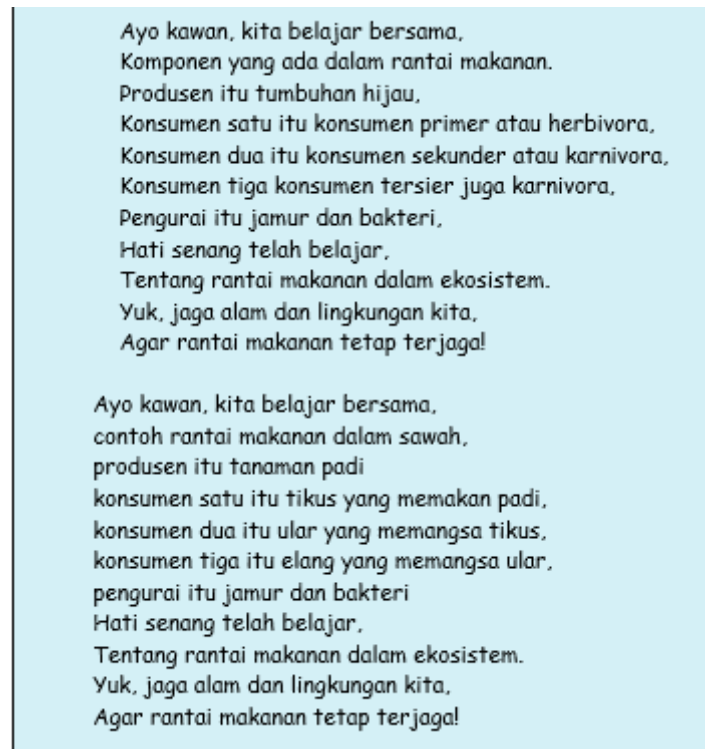Agar rantai makanan tetap terjaga!

Figure 7. Lyrics of the food chain song

The challenges faced by students include difficulty distinguishing concepts such as producers, consumers, and decomposers, as well as remembering the order or role of each term in the food chain. The song lyrics contain information about the components, definitions, and examples of food chains in ecosystems. This educational song aims to help students remember the material and solve problems related to the food chain. Additionally, the song enhances students' enthusiasm for learning, makes the learning process more enjoyable, and actively involves students. It is hoped that this educational medium can increase participation, understanding, and support the implementation of the Merdeka Curriculum. This educational song is implemented using the PBL model at stage 2, which involves organizing students to learn. Thus, the educational song can serve as an innovative and non-monotonous medium that makes students happier, easier to understand concepts, and improves their memory.
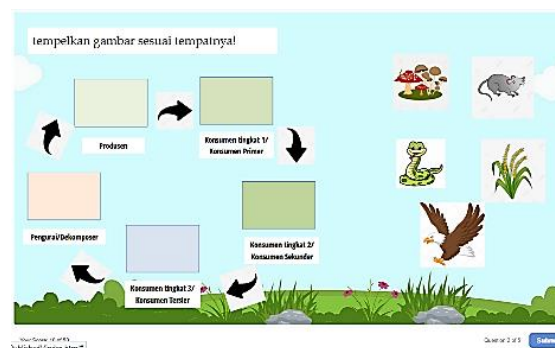

Figure 8. Quiz display

The evaluation section presents interactive questions where students can play while learning. To ensure student understanding, this media is equipped with interactive quizzes whose results can be seen after completing the quiz.

In this E-Lintar Mobile App with integrated songs, the features are very complete, ranging from material features, learning videos, children's songs about the food chain, LKPD, interactive quizzes, and stimuli for students. In this application, the material is also presented in two lessons, lesson 1 and lesson 2. Thus, this application offers a variety of very comprehensive features.

After the development process was completed, the E-Lintar Mobile App with integrated songs underwent validation by subject matter experts and media experts to assess its suitability. Feedback and recommendations from the experts were used as a reference for improvements by the researchers. Media validation aims to assess the suitability of the product based on the alignment of the design with the learning topic, practicality, flexibility, durability, visual appeal, and ease of use. The media validation score reached 94%, indicating that the media is highly suitable for use. Content validation covers aspects such as content alignment with the curriculum, difficulty level appropriate for students' thinking stages, and the integration of content in supporting the learning process. The initial content validation score was 85% and falls into the highly suitable category. After revisions, which included refining learning objectives, improving the sequence of learning scenarios, adjusting the evaluation grid and questions, adding Student Worksheets (LKPD), and adding stimuli to the media, the final score increased to 95%. Thus, the material in the learning media is consistent with the scope of Natural Sciences, particularly on the topic of food chains, and is therefore classified as highly suitable.

During the development stage, an educational media application called E-Lintar Mobile App with integrated songs, was successfully created and deemed suitable by media and content experts. This aligns with the challenges faced by students, such as difficulty distinguishing concepts like producers, consumers, and decomposers, as well as remembering the sequence or role of each term in the food chain. The lyrics of the songs in the application contain information about the components, definitions, and examples of food chains in ecosystems. This educational song aims to help students remember the material and solve problems related to food chains. Additionally, the song enhances students' enthusiasm for learning, makes the learning process more enjoyable, and actively involves students. It is hoped that this educational media can increase participation, understanding, and support the implementation of the Merdeka Curriculum. This educational song is implemented using the PBL model in syntax 2, which is organizing students to learn. Thus, educational songs can be used as an innovative and non-monotonous medium that makes students happier, easier to understand concepts, and improves their memory. Interactive learning applications can make the learning process more meaningful and improve student understanding (Corral Abad et al. 2021). This statement aligns with Ausubel's theory, which emphasizes the importance of prior understanding as a foundation for comprehending new material (Pes, F., Sciarrone, F., & Temperini 2023).

Implementation Stage

After the product has been declared feasible by experts through a validation process, the next stage is implementation in the field. The product is then tested in learning activities using the Problem-Based Learning (PBL) model. This approach has proven to be very effective and has had a positive impact on developing students' critical, creative, and collaborative thinking skills. With this approach, students are trained to assess, observe, and find good solutions to real problems faced by students, thereby helping them to understand the material more deeply and develop a more reflective and innovative mindset in learning (Kardoyo et al. 2020). The trial conducted at SD Negeri Jatiroyom 02 in grade fifth was carried out in two stages, namely a trial on a small group consisting of 9 students and a large group consisting of 21 students. According to (Arikunto 2013), the number of respondents for small groups can range from 4-14 respondents, while for large groups it can range from 15-50 respondents. The trial was conducted in a structured manner with direct supervision by the researcher to ensure that every feature of the application functioned optimally without any obstacles. After the learning session, teachers and students provided feedback on the use of the E-Lintar application with songs.

The activity involved fifth-grade students and fifth-grade teachers at SD Negeri Jatiroyom 02, with questionnaire responses showing the evaluation results from teachers and students on the use of the E-Lintar Mobile App with integrated songs, with a score of 98.75% from teachers and 96.09% from students, with an average score of 96.48%, both of which fall into the 'very suitable' category. This assessment is reinforced by validation results from subject matter and media experts, as well as positive feedback from teachers and students, making the application highly suitable as a technology-based learning medium. The effectiveness of the application was then measured through pre-tests and post-tests to assess improvements in students' understanding of food chain concepts in the context of science education. The testing was conducted using multiple-choice questions. Initially, students completed 25 questions as a pretest to assess their initial understanding, where students still struggled to distinguish concepts such as producers, consumers, and decomposers, as well as remembering the order or role of each term in the food chain. After that, they participated in two learning sessions, namely Learning Session 1 and Learning Session 2, using the E-Lintar Mobile App with integrated songs. The lyrics of the songs contain information about the components, definitions, and examples of food chains in ecosystems. These educational songs aim to help students remember the material and solve questions related to food chains. Additionally, the songs enhance students' enthusiasm for learning, making the learning process more enjoyable, and actively involving students. It is hoped that this learning medium can increase participation, understanding, and support the implementation of the Merdeka Curriculum. The educational song was implemented using the PBL model in the second stage, which involves organizing students to learn. Thus, the educational song can serve as an innovative and non-monotonous medium that makes students happier, easier to understand concepts, and improves their memory.

After the lesson, students took a post-test with the same 25 questions to assess their improved understanding. The post-test results were used to measure students' understanding of the food chain after using the E-Lintar application assisted by songs. An analysis of the pre-test and post-test data was conducted using a normality test to determine whether the data was normally distributed or not. If the significance value was

greater than 0.05, the data was considered normal. However, if the value was equal to or less than 0.05, the data was considered abnormal. Since the sample size was less than 50 people, the Shapiro-Wilk test was used. This analysis process was conducted using the SPSS application. In the large group, the pretest Sig. value was 0.639 and the posttest Sig. value was 0.344, indicating that the data had a normal distribution because the significance value exceeded 0.05. In the small group, the pretest Sig. value was 0.914 and the posttest Sig. value was 0.701, indicating that the data had a normal distribution because the significance value exceeded 0.05. Thus, the analysis can be continued using the paired sample t-test to examine the increase in students' understanding of the food chain after using the E-Lintar Mobile App with integrated songs in the Problem-Based Learning model.

The paired sample t-test on the large group obtained a mean score of -40.19048, then a Std. Deviation score of 6.63038, a Std. Error Mean score of 1.44687, and a comparison between the pretest and posttest showed a Sig. (2-tailed) of 0.000, which is less than 0.05. The Paired Sample t-test on the small group yielded a mean score of -36.88889, a standard deviation of 5.57773, and a standard error mean of 1.85924. The comparison between the pretest and posttest showed a Sig. (2-tailed) of 0.000, which is less than 0.05. This indicates a significant improvement. Therefore, Ho is rejected and Ha is accepted, indicating that the E-Lintar Mobile App with integrated songs is effective in improving students' understanding of food chain material. Furthermore, the effectiveness of the product was measured using the N-Gain test, the results of which can be seen in Figure 9.
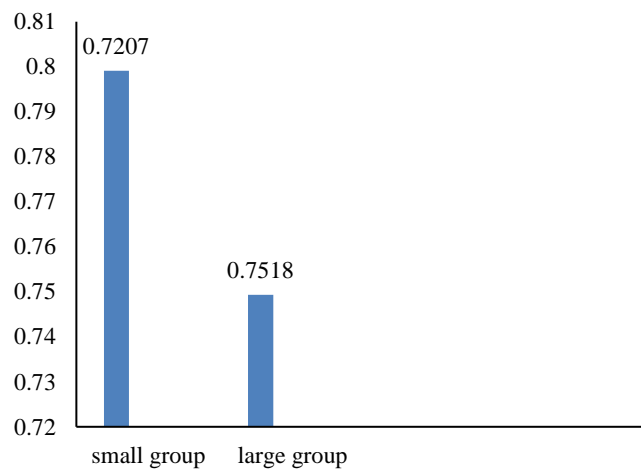

Figure 9. N-Gain results

The N-Gain test on the large group produced a score of 0.7518, while the small group produced a score of 0.7207, indicating a significant increase between the pretest and posttest. With a value of more than 0.7, this improvement is categorized as high, indicating that the E-Lintar Mobile App with integrated songs is effective in improving student learning outcomes. In the implementation stage, the results showed that the E-Lintar Mobile App with integrated songs was effective in learning for fifth-grade students

at the elementary school level using the Problem-Based Learning (PBL) approach. With this approach, students can gain a better understanding of concepts through problem solving provided by the teacher. This method supports students in understanding the material being studied by solving problems, increasing their involvement, and training critical thinking skills (Benedicto and Andrade 2022). According to Vygotsky's theory, students' understanding develops as they solve problems (Inayati 2022).

Evaluation Stage

In the evaluation stage, all tests from experts, teachers, and students on the E-Lintar Mobile App with integrated songs on food chain material were analyzed for improvement to make it more optimal. The evaluation results showed that learning with the E-Lintar Mobile App with integrated songs on food chain material made students more enthusiastic, especially when seeing interesting illustrations and animations. Visualization and songs helped them understand the concept of the food chain more easily and enjoyably. Not only that, but the various interactive features in this application encourage deeper exploration by students, making learning more interesting, varied, interactive, and enjoyable. The E-Lintar Mobile App with integrated songs has proven to be effective in improving fifth-grade students' understanding of the topic of food chains in science. The use of educational songs in learning makes it easier for students to remember and understand the material in a more innovative, interesting, and enjoyable way. This is supported by previous research which states that the use of technology-based applications in learning can increase student engagement and motivation, and learning outcomes can increase significantly (Klimova 2019). Songs in learning have also been proven to be effective in improving children's cognitive and psychomotor development. This creates a more enjoyable, innovative, interactive, active, and meaningful learning environment (Supartini et al. 2020).

Learning can become more engaging, interactive, and easier to understand by using the E-Lintar app with song assistance. This Android-based app effectively supports teachers in delivering lesson content in an interactive manner, enhancing learning quality by avoiding monotonous teacher-centered instruction, and motivating students to achieve higher goals (Elida et al. 2024). The E-Lintar Mobile App with integrated songs was developed using modern technology to support digital-based learning innovation (Kusmaryono and Maharani 2025). This technology-assisted application is designed to be interactive, creating multimedia content that includes various features, such as images, text, audio, video, and animation, making it easier for users to present interactive and engaging material that encourages enthusiasm and participation from students in learning activities. Educational songs used in the learning process can stimulate students' enthusiasm for learning and strengthen their understanding of the material in a more enjoyable way (Robinson 2024). Problem-Based Learning was used in this research approach, which involves students in developing their own understanding, collaborating, improving critical thinking skills, and formulating logical and active solutions to real problems (Ismail et al. 2018).

During the learning process using the E-Lintar Mobile App with integrated songs and the Problem-Based Learning approach, several unexpected findings were discovered that provided new insights into the learning process. One of them was the students' enthusiasm for educational songs, which were initially thought to be just an additional

teaching aid. Surprisingly, the songs became the primary catalyst for students in discussing and reflecting on concepts related to the food chain. Nearly all students spontaneously sang the lyrics of the song titled "Rantai Makanan" within the E-Lintar application to explain the concepts of producers, consumers, and decomposers to their peers, demonstrating that songs not only reinforce memory but also facilitate communication among students in understanding the material. In addition, most students who were previously passive in conventional learning showed active participation when accessing the E-Lintar Mobile App with integrated songs. Students were more courageous in trying to answer quizzes and discuss in groups because of the more enjoyable learning environment. This indicates that the use of interactive media can help reach students who are less responsive in conventional learning.

This study examines the nature of science in the context of learning, which is tailored to the needs and abilities of students. The nature of science involves four main components, namely product, process, attitude, and technology (Mufidzah 2024). As a product, science produces facts, principles, and concepts that can be applied in everyday life. Science as a product is reflected in the material presented in the E-Lintar application and the song lyrics that explain the food chain and its components, based on the findings of previous scientists. This material covers the concept of the food chain, its components, and examples of food chains in various ecosystems. Science as a process refers to a series of steps taken to obtain and understand knowledge. In science, knowledge is not only composed of facts and concepts but also the result of a search process to gain understanding, as well as drawing conclusions from facts or theories that are then generalized by scientists. Science as a process can be said that the learning process does not stop at theory alone but involves interactive activities for students in the E-Lintar Application, such as completing interactive quizzes that help students understand how energy transfers in food chains across various ecosystems, understand the roles of producers, consumers, and decomposers, as well as the flow of energy in ecosystems. This process encourages students to actively engage and think critically while studying the material. Not only that, but it also plays a role in shaping scientific attitudes in students, such as curiosity, precision, and the ability to think objectively in solving problems. These attitudes are part of the essence of science as an attitude, which develops naturally during the learning process in the classroom. A deeper understanding and systematic thinking are scientific attitudes that play a very important role in the science learning process (Aguilera and Perales-Palacios 2020). This approach supports holistic science learning, as emphasized by (Lee 2022) that science education should not only focus on content but also involve the scientific process and the development of scientific attitudes through meaningful and contextual experiences. The nature of science as technology is related to how scientific concepts are used practically in daily activities that involve the use of technology. The E-Lintar Mobile App with integrated songs is an example of the use of technology in learning in the nature of science, where food chain material is presented interactively and easily understood by students in learning it. With its various digital features, the application simplifies the concept of the food chain into something simpler and easier to understand through visual displays and interactive activities that support student comprehension. This demonstrates how the use of technology in classroom learning can enhance the effectiveness and efficiency of the learning process in a fun, active, and innovative way.

The four dimensions of science must be present in the science learning process so that students gain a comprehensive understanding of the material. The E-Lintar Mobile App with integrated songs serves as an innovative learning medium that combines food chain material with songs to increase student engagement in the learning process. The E-Lintar Mobile App with integrated songs not only teaches material but also makes it easier for students to understand concepts in a fun and interesting way. With various features such as slides, materials, stimuli, learning videos, worksheets, educational songs, and interactive quizzes, this application supports more interactive learning. This study supports previous findings that interactive learning media help students understand the material better and support learning that is tailored to individual abilities (Indah Septiani et al. 2020). The use of interactive media in the learning process also makes learning more effective, interesting, and supports students in understanding the material well (Alyusfitri et al. 2024). The Problem-Based Learning (PBL) model used in this study significantly contributes to learning success by enhancing students' understanding and training their critical thinking skills and alternative problem-solving approaches (Kardoyo et al. 2020).

The E-Lintar Mobile App with integrated songs makes classroom learning more interactive, engaging, and highly enjoyable. For teachers, this application can be integrated into teaching modules from initial activities to core activities. Teachers can use songs to start lessons and provide problem-based stimuli in the form of images and questions within the E-Lintar Mobile App with integrated songs to deepen students' understanding of the food chain concept. Other activities, such as interactive quizzes within the application and group discussions, can also help develop students' critical thinking and collaborative skills in solving problems. For schools, this research finding highlights the need for support in developing relevant and easily accessible digital learning media for teachers and students, as well as training for teachers in utilizing learning technology in the classroom to make learning more varied and less monotonous. This support will strengthen an innovative, creative, interactive, and contextual learning environment at the elementary school level. With interactive multimedia, students gain a dynamic and exploratory learning experience. Not only that, this application can also be accessed anytime with the internet, giving students the flexibility to learn independently or repeat material outside of class hours to better understand the material. The Problem-Based Learning model motivates students to learn material independently and hone their critical thinking skills, as well as find logical, active, and collaborative solutions among students to contextual problems. The E-Lintar Mobile App with integrated songs, increases student engagement by making them active in building their understanding. Its advantage lies in the use of animations, images, audio, and videos that help explain abstract concepts more clearly than verbal or textual explanations. In line with Edgar Dale's theory, learning through simulation can increase memory retention by up to 90% because students are directly involved in the learning process. One of the challenges in using the E-Lintar Mobile App with integrated songs is its reliance on a stable internet connection, making it difficult to use in areas with limited internet access. Future research is recommended to develop an offline version so that interactive multimedia can still be accessed without relying on an internet connection. With this feature, learning becomes more flexible, including in areas without internet access. Additionally, this research contributes to the development of multimedia that supports students' problem-solving skills and assists teachers in integrating technology into the learning process.

▪ **CONCLUSION**

Based on the results of the research and discussions, it can be concluded that the E-Lintar Mobile App with integrated songs obtained a very good level of feasibility, with a rating of 95% from subject matter experts, 93.75% from media experts, 98.75% from teachers, and 96.09% from students. The N-Gain test showed the effectiveness of the application in the high category, while the t-test showed a significant difference between the pretest and posttest scores. This indicates that the E-Lintar application is effective in improving students' learning outcomes, particularly in the subject of food chains. The use of songs in this application helps students with more interactive learning styles, facilitates concept understanding, and enhances problem-solving skills. Therefore, the E-Lintar Mobile App with integrated songs has been successfully developed, is highly feasible, and effective as a science learning medium for fifth-grade students at SDN Jatiroyom 02. This study makes an important contribution to leveraging educational technology to create more engaging and student-centered learning experiences. The E-Lintar Mobile App with integrated songs has limitations, namely its dependence on a stable internet connection, making it difficult to use in areas with limited internet access. Additionally, the application is influenced by factors including teachers' skills in technology-based teaching and students' skills in accessing technology. Future research is recommended to develop an offline version so that interactive multimedia can still be accessed without relying on a network. With this feature, learning becomes more flexible, including in areas without internet access. For further research, it is recommended to test this medium in various learning environments and develop more comprehensive implementation strategies, so that many students can benefit from the application. Additionally, this research contributes to the development of multimedia that supports students' problem-solving skills and assists teachers in integrating technology into learning.

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