Ekoland: The Development of Android-Based Learning Media Using iSpring Suite to Improve the Understanding of Ecosystem Material in Elementary School

Badawi✉1, Purie Nawa Utami1, Elizar1, Rohmani1, Masitoh2 & Meutia Rachmatia3

1 Elementary School Teacher Education Department, Universitas Muhammadiyah Kotabumi, North Lampung, Indonesia

2 Indonesian Language and Literature Education Department, Universitas Muhammadiyah Kotabumi, North Lampung, Indonesia

3 English Education Department, Universitas Muhammadiyah Kotabumi, North Lampung, Indonesia

✉ badawi.stkip@gmail.com

Abstract. This research aimed to develop science teaching media in the form of learning applications that use the help of iSpring Suite. The development of ecosystem material science learning applications is made to maximize the use of smartphones owned by students and reduce the various negative impacts of using Android in learning. The Research and Development (R&D) method using a procedural model, was applied in this research. The data collection instruments in this study were validation sheets, student response questionnaires, and test questions. The test subjects in this study were 48 fifth-grade students at Ibnu Rusyd Islamic Elementary School. The Ekoland learning media feasibility test result is 71.95% from the percentage criteria of 61% -80% which shows very feasible results. and declared feasible because it is greater than 61%. The effectiveness level of Ekoland learning media is 93.75% from the percentage criteria of 61% -80% which shows decent results, and it is said to be effective because it is greater than 80%. Based on the results of the study, it is stated that the development of Ekoland learning media developed with android-based using the iSpring Suite application influences the increase in student learning outcomes in understanding ecosystem material in science learning and can provide a positive response from the use of android that maximizes the benefits of using android in education. Research has had a positive impact on improving science learning in schools, showing that Ecoland has a positive impact on students' learning outcomes and understanding of ecosystems.

Keywords: Android-based Learning, Ecosystem Material, Elementary-Level, iSpring Suite, Teaching Media Development

1. Introduction

Education is a crucial aspect in determining the future of every student, fostering critical thinking, and enhancing valuable skills to support the development of an intelligent nation (Salina et al., 2020). The quality of education is influenced by human resources. According to a UNESCO education index reported by Cable News Network (CNN), Indonesia is ranked 108th in the world in terms of education (Alamsyah et al., 2023; Ferdiman et al., 2023). The low quality of education in Indonesia is attributed to inefficiencies in learning, a lack of student understanding, a curriculum centralized around teachers, and students' disinterest in learning that tends to use dull learning media (Byusa et al., 2022). A solution is needed to address these existing student issues, and one of them is through the use of engaging interactive learning media (Potter, 2023). The current education landscape is undergoing a paradigm shift from conventional to technology-based learning. Students tend to be more responsive to learning methods that leverage technology, and the use of mobile devices such as Android smartphones can enhance student engagement (Taylor et al., 2018). Taking into account the issues faced by students as described, the use of technology by students necessitates

learning that supports technology use to facilitate students in their education. An interactive learning media with technology that can be integrated into students' Android devices is required. The development of integrated media on Android can enhance students' learning interest, thereby improving their understanding of the subject matter. This approach fosters critical thinking skills among students, influencing the development of a skilled workforce.

1.1. Problem Statement

With the advancement of technology, it is essential to ensure that students have an adequate level of digital literacy (Andreani & Ying, 2019; De Paula, 2021). Engaging learning media can enhance students' interest and motivation in learning (Alamsyah et al., 2023). Students need interactive learning media that align with technological advancements and cater to their preferences and daily use, such as the use of Android in learning (Dezuanni, 2018). Developing Android-based learning media can help improve students' technology skills from an early age, providing them with a better understanding of using smart devices and educational applications (Forsler & Guyard, 2023; Hakiki et al., 2022). Android-based learning media can offer more interactive and engaging content for students (Nurhasanah et al., 2023). Educational applications and games can be designed to boost student engagement and make the learning process more enjoyable (Salina et al., 2020). Through the utilization of technology, creating Android-based learning media can provide solutions to enhance the quality of education, including instant feedback, monitoring student progress, and personalized learning according to students' needs (Laseinde & Dada, 2023; Latif et al., 2023).

The use of Android in Indonesia, based on Global System for Mobile Communications Association (GSMA) Intelligence data, indicates a total of 370.1 million device connections as of the beginning of 2022, exceeding the total population of Indonesia (Alamsyah et al., 2023). The internet penetration rate reached 73.7 percent of the population in early 2022 (Kominfo, 2022). The use of smartphones has reached elementary to junior high school-aged children, accounting for 40.87% among elementary school children and 59.89% among junior high school children (Kominfo, 2022). This data highlights the high usage of Android among elementary school students, but unfortunately, the high usage is not accompanied by effective utilization (Dezuanni, 2018; Kahne & Bowyer, 2019). This challenge calls for solutions to enhance student learning and improve the proper use of Android (De Paula, 2021). The development of interactive Android-based learning media becomes a viable option. The use of learning media on Android can enable students to learn in any condition they prefer (Ferdiman et al., 2023).

Science learning is considered challenging for students to grasp. The difficulty arises from the abstract nature of science education (Qiu et al., 2023). Science requires visualization in learning, as it often involves describing objects in nature (Rohmani et al., 2021). Lack of proper visualization in science education results in a limited understanding of the material among students. In the context of ecosystem material in science learning, students often struggle to comprehend the taught material due to the insufficient use of media and visualization by teachers (Privitera et al., 2023). Science education requires supporting components to provide opportunities for critical thinking in the surrounding environment. A study conducted at Ibnu Rusyd Islamic Elementary School in North Lampung showed that more than 65% of respondents, consisting of 48 students, still faced difficulties in understanding ecosystem material, including types of ecosystems, animals inhabiting each ecosystem, and determining the benefits of ecosystems in life.

The integration of Android media in science education can create a more dynamic, interactive, and relevant learning experience for students (Fischer et al., 2023). Android media allows the use of images, animations, and videos to visualize abstract science concepts. This visualization aids students in understanding the material better, particularly in topics involving natural processes or complex concepts (Booton et al., 2023). The evolving technology in education leads to a reformation by leveraging technology in the learning process (Videnovik et al., 2024). One such technology is iSpring Suite, which can be used to create interactive learning media. iSpring Suite is e-learning content authoring software that provides various features for creating presentations, online courses, and interactive learning

materials. iSpring Suite enables users to include images, audio, and video in learning materials (Fitriati & Megawati, 2021).

Addressing the challenges in science learning, specifically in the ecosystem material, involves developing interactive (Laseinde & Dada, 2023). Android-based learning media using the iSpring Suite application integrated with Microsoft PowerPoint. The use of multimedia provides variety and helps students with different learning styles (Nurhasanah et al., 2023). Introducing interactive learning media integrated into Android facilitates students in studying, and with the availability of visualization in the developed media, students find it easier to understand abstract science learning. The development of interactive learning media based on Android is expected to facilitate students' understanding of learning, stimulate learning interest, and improve student learning outcomes in science, particularly in the ecosystem material.

1.2. Related Research

The existence of learning media development applied to Android is expected to increase motivation in learning (Taylor et al., 2018). Based on the benefits and usefulness, it is necessary to develop learning media that students will use to improve learning outcomes and reduce the tendency to use monotonous teaching media (Booton et al., 2023). Learning media developed through interactive applications can make students more active in participating in the learning process. The implementation of learning media development applied to smartphones is expected to enhance motivation in learning.

Previous research conducted by Carenina (Widyawati et al., 2022), which tested 7th-grade junior high school students in developing interactive learning media using iSpring Suite 10 on social arithmetic material, yielded a testing result of 90.99%, falling into the valid and highly practical category. This study resulted in interactive learning media that improved students' understanding of social arithmetic material. Additionally, another research conducted by Sulistyorini (Sulistyorini & Listiadi, 2022) in developing iSpring Suite 10 learning media based on Android for adjustment material in vocational schools with 11th-grade accounting students at Mojoagung Vocational School obtained a 92.37% interpretation considered suitable by experts and received a 90.6% result with an interpretation considered suitable by student responses. This indicates a positive response from students in the development of learning media that meets their needs in understanding adjustment learning journals. purpose of this research is to develop science learning media to increase the learning motivation of elementary school students to take advantage of the use of Android as a learning media by being made with the help of the iSpring Suite 10 application and Website 2 APK Builder for Ecosystem material.

The research involving the development of learning media has shown significant value in enhancing students' interest in learning and their comprehension skills, as demonstrated in two previous studies. This has sparked the researcher's interest in developing learning media. The previous researchs focused on subjects at the middle and high school levels but did not include subjects at the elementary school level. This research aims to enhance the understanding of elementary school students, which is crucial for early comprehension of science subjects, particularly ecosystem topics that have not been utilized in learning development materials before. Those elements that can differenciate this research and previous research. The development of integrated media on Android is also an advantage in this research, as students no longer need to search for computers or laptops that may not be universally accessible, making it easier for them to access the developed media as an alternative learning tool.

1.3. Research Objectives

From the studies that have been conducted, the development of learning media among elementary school students is still rarely and slowly developed and integrated in improving student learning outcomes (Armansyah et al., 2019). The development of interactive learning media can improve student learning outcomes and the quality of education in Indonesia. Seeing the excellent potential in the feasibility of developing learning media, researchers are encouraged to research and develop Android-based applications with the help of the

iSpring Suite 10 device in elementary schools in science learning subjects to provide convenience to educators and students.

2. Theoretical Framework

The theoretical studies used by researchers in research to develop interactive learning media include explanations of (1) Interactive learning media, (2) Android, (3) iSpring Suite, and (4) Science learning in elementary schools.

2.1. Interactive Learning Media

Interactive learning media is a form of instructional media that allows active engagement from users, typically students, in the learning process. This media is designed to promote two-way interaction, where students not only receive information but also participate directly in learning through interactive activities (Andreani & Ying, 2019; Hakiki et al., 2022). Students have control over the course of learning, enabling them to choose the level of difficulty, learning speed, and focus on the material. Real-time responses from learning media provide immediate feedback on students' actions or answers, creating a dynamic learning experience (Ferdiman et al., 2023).

Interactive visualization is a key element in this learning media, utilizing images, animations, and interactive videos to explain concepts (Booton et al., 2023). Simulations and educational games are introduced to provide practical experiences in understanding specific concepts. Flexibility and accessibility are also focal points, allowing students to access materials from various devices and locations (Dezuanni, 2018). Furthermore, interactive elements are embedded in learning materials to test understanding and encourage student reflection. Collaboration among students is encouraged in interactive learning media, creating an environment where students can interact and learn from each other in a digital context. Monitoring student progress becomes more straightforward, providing teachers with the ability to offer timely feedback and support student development (Kahne & Bowyer, 2019). By combining all these elements, the use of interactive learning media aims to create an engaging, dynamic learning experience that enhances understanding and retention of learning materials.

2.2. Android

Android is a mobile operating system developed by the Open Handset Alliance (OHA), a consortium led by Google. This operating system is specifically designed for mobile devices such as smartphones, tablets, and other smart devices (Alamsyah et al., 2023). Android is based on the Linux kernel and provides an open and customizable software environment (Salina et al., 2020). One of Android's main features is the freedom for developers to access and modify the source code openly, allowing for continuous innovation. Android is also known for its intuitive user interface, multitasking capabilities, smart notifications, and tight integration with smart services (Byusa et al., 2022). Its success has made Android one of the most popular mobile operating systems globally, supporting a variety of devices and embracing a broad ecosystem.

Android plays a significant role in the modern learning world, providing various utilities that enrich the learning experience (Forsler & Guyard, 2023). The use of educational applications on the Android platform enables students and teachers to access interactive learning resources, instructional videos, and various educational apps designed to facilitate the learning process (Booton et al., 2023). Android also offers easy access to e-books and digital learning materials, enabling students to read and learn anywhere and anytime. Quiz and exam applications on Android can assist in formatively assessing students' understanding, while the use of interactive media such as simulations and educational games can make learning more enjoyable and engaging (Sari et al., 2019).

2.3. iSpring Suite

iSpring Suite is one of the tools that can be used to create learning media (Forsler & Guyard, 2023). iSpring Suite 10 is an external software used in making learning media. iSpring Suite 10 integrates with Microsoft PowerPoint (Booton et al., 2023; Fitriati & Megawati, 2021). iSpring Suite 10 has several features for creating presentation slides of various shapes, formats, and visualizations. You can also use iSpring Suite 10 to create various quizzes. iSpring Suite 10 can convert files to PowerPoint, Flash, MP4, Video, HTML5, and mobile media formats (Laseinde & Dada, 2023). Features included in the software. iSpring Suite can support the creation of scientific learning media that facilitate learning from PowerPoint, which will be HTML5 files.

The iSpring Suite application can convert Microsoft PowerPoint form presentation files into Flash in SCORM/AICC format, a format widely used by NGO e-learning (Forsler & Guyard, 2023). The media format created by iSpring Suite is HTML, which can be converted into a mobile application. iSpring Suite software application is available free or paid (premium). iSpring Suite software is constantly developing more effective and user-friendly features. By using various interesting features that make it easier for educators to make the learning process more interesting, interactive, and effective (Hanisah et al., 2022).

The iSpring Suite application creates various opportunities for educators to create online and offline-based e-learning using Microsoft PowerPoint presentation applications (Fitriati & Megawati, 2021). iSpring Suite is designed to support e-learning, including media in various formats to record and synchronize video presenters, add Flash and YouTube videos, import or record audio, create your navigation, and create a very attractive look for learning media, such as creating attractive designs (Fitriati & Megawati, 2021). In addition, iSpring Suite can support the presentation of learning assessments in various formats True or False, Double Answers, Matching (Agree), Order (Sequence), Numerical (Number), Fill in the Blank, Short Answers), essays (description), etc.

2.4. Science Learning in Elementary School

Science involves understanding scientific concepts, exploring natural phenomena, and observing various natural events. In the context of elementary school education, Science covers various topics such as the properties of matter, plants, animals, the environment, and basic scientific processes (Booton et al., 2023). Learning can also be viewed as a programmatic teacher activity in instructional design to make students program in instructional design to make students learn actively, emphasizing the provision of learning resources (Rohmani et al., 2021). Learning in elementary schools since the use of the 2013 curriculum, learning in elementary schools has become thematic learning, namely the combination of various subjects in one theme (Fitriati & Megawati, 2021). The themes discussed in thematic learning are reviewed from various subjects, for example, the theme "Living Things," which is reviewed from the subjects of Science, Mathematics, Social Studies, Indonesian to Art (Privitera et al., 2023). Theme learning will not provide breadth in the use of the curriculum, offering many opportunities to facilitate students' productivity.

Based on the scope of material contained in science learning in elementary schools that study living things and their life processes. So, based on the scope of material in the scope, this study will discuss ecosystem material contained in theme 5 in grade 5. An ecosystem is the scope of habitation of all types of living things in the universe. Ecosystems have two components: abiotic components, non-living components that exist in living places or ecosystems, and biotic components, which are living components that exist in ecosystems.

3. Method

3.1. Research Design

The research conducted is a type of research and development also known as research and development. The development of Android-based learning media as an alternative to problem-solving assisted by I Spring Suite uses Sugiyono's (2020) development research steps with nine stages of research and development, including 1) the potential and problem

finding stage; 2) the information gathering stage; 3) the product design stage; 4) the design validation stage; 5) the design improvement stage; 6) the design trial stage; 7) the design revision stage; 8) the usage trial stage; and 9) the final product revision stage (Rohmaini et al., 2020).

3.2. Participant

In order to obtain a feasible product, the process involves two material expert validators, two media expert validators, and two practitioners. The subjects of this research were 48 students of 5th-grade students at Ibnu Rusyd Islamic Elementary School in North Lampung. The sample was selected based on observations and ownership of good facilities at the school. Students at Ibnu Rusyd Islamic Elementary School already have personal Androids, and the school is equipped with a WiFi signal which makes internet connections easier. Based on this, the researchers agreed to use Ibnu Rusyd Islamic Elementary School in grade 5 as the sample and research location.

The data collection technique used was pre-research observation which was carried out by collecting interview results from students and teachers. Interviews were conducted to obtain information about learning media that can be used in elementary schools in ecosystem material at the school. Interviews were conducted on Thursday, 02 February 2023 at 09.30 with 10 students being interviewed and two homeroom teachers.

The research instruments used were validation assessment sheets, learner response questionnaires, and test questions. The validation assessment sheet is a questionnaire for five indicators with an assessment using a Likert scale—test questions related to ecosystem material contained in theme five thematic learning in elementary schools. As well as the use of validity tests and reality tests which are used to test the questions tested in the Ekoland application.

3.3. Data Analysis

To obtain the results of a valid learning media development innovation, Android-based learning media to increase students' understanding of theme five ecosystem material for grade 5 elementary schools requires a validity test. The validity test is used to test the product development results calculated as a percentage based on Sugiyono, that the product criteria are said to match the valid criteria if the percentage validity test results show results greater than or equal to 61% (Sugiyono, 2016). In order to calculate the percentage of product validity, the following is the calculation of the validity test results.

$$P(\%) = \frac{\sum data\ collection\ result\ score}{criterion\ score}\ X\ 100\%$$

In addition to the products developed must be valid, the products developed must be practical to be used as learning support for students. In order to determine the level of practicality of the results of the product developed, a follow-up test is needed, namely the product practicality test (Rohmani et al., 2020). Test the product's practicality in the form of learning media developed by conducting a practicality test by giving an angler to tested students. Learning media development can be said to be practical if the average percentage who answers "Yes" is above the percentage of 61% (Sugiyono, 2016). To calculate the practicality test of product development using the following formula.

$$P = \frac{sum\ of\ answers\ yes}{sum\ of\ answers}\ X\ 100\%$$

Products must be valid and practical in product development, and the learning media developed must be effective for learning. The development of learning media can be effective if the percentage of calcal completeness (KK) of students is above 80% (Sugiyono, 2016). In order to calculate the completeness of the classical results of student learning outcomes using the development of learning applications by calculating using the following equation.

$$KK = \frac{\sum Completed}{\sum Not\ Completed} \times 100\%$$

3.4. Validity and Reliability

In the research and development of the product has been developed in the form of Android-based learning media, this product tested on class 5 students with the aim of finding out the usefulness of media developed on ecosystem material in improving student learning outcomes. The analysis used includes the following.

3.4.1.Test of Validity

Validation test is a test used to test the validity of the questionnaire that will be judged. In other words, an item has high validity if the item score is in line with the total score. To measure the validity of the test items, the product moment correlation formula is used as follows.

$$r_{xy} = \frac{N \sum xy - (\sum xy)(\sum xy)}{\sqrt{\{N \sum x^2 - (\sum X)^2\}\{\sum y^2 - (\sum y)^2\}}}$$

3.4.2. Test of Reliability

In order for an instrument to be said to be reliable, the results of repeated measurements remain the same. To find the reliability coefficient of the test items, the following reliability formula is used.

$$r_{11} = \left(\frac{n}{n-1}\right)\left(\frac{s^2 - \sum pq}{s^2}\right)$$

4. Findings

In the research that has been carried out it produces a product in the form of a learning media application called "EKOLAND", which discusses the theme of a 5th-grade 5th-grade elementary school in the form of science learning material that discusses the Ecosystem of living things based on Android applications that are assisted in making using iSpring Suite 9 with development carried out with nine stages of research and development. The following is a description based on nine stages of research and development of learning media application products that are assisted in making with iSpring Suite 9 based on Android applications.

4.1. Results of the Potential and Problem-Finding Stage

At this stage, to find out the potential problems, researchers conducted observations by conducting semi-structured interviews with one of the class teachers at Ibnu Rusyd Islamic Elementary School and ten students in grade 5. The ten students interviewed were considered to have represented other students because the students selected by the teacher were participants with high, medium, and low levels of academic achievement. Based on the results of the analysis of interviews with students and teachers that have been conducted, it was found that the potential problems and expectations expressed by students and teachers that the media used in ecosystem material, one of which is the development of learning media that can be easily accessed and makes it easier to understand learning material.

Based on this, researchers innovate to develop learning media products with Android applications that students can access anywhere and anytime as an alternative learning media support. It is also based on almost all students can access and play on smartphones. The development of this learning application is intended to facilitate educators and students in learning science in elementary schools. In addition, this product is made with the aim that students can more easily understand ecosystem material and learn independently at any

time inside and outside the classroom. Because almost all students own Android, this provides the potential to be able to develop innovative learning applications based on and utilizing Android.

## 4.2. Results of the Information Gathering Stage

Based on the findings of the potential problems that researchers have found, further information gathering is carried out related to innovation with the application of learning using smartphones. This is based on the use of smartphones that students favor. To improve understanding of the material, interactive learning media is developed in the form of media using learning applications that can be accessed on Android. The study of learning media is carried out in order to get references for interesting learning applications. Then, the next stage is to design products that will be developed as learning media for students.

4.3. Results of the Product Design Stage

Information obtained from the previous stage becomes a reference in the product design stage. The Android-based learning media application is designed through 2 stages, namely the initial design of the display in the form of a storyboard then proceed to the function design of each button or menu that has been made. Making the initial design using Microsoft Word application, while the realization of the design into a website-based quiz game application uses the Atom text editor application. The layout and appearance of the Android-based learning media application development results are described as follows.

4.3.1. *Planning The Layout Design of the Learning Media Application*

The planning stage for the layout design of making learning applications is in the form of a through visual sketch of the learning media development application in the form of a storyboard. The figure 1 are whown a visual form of an Android-based learning media application development layout assisted in making it with iSpring Suite.

Layout of the initial appearance of learning media	Layout of the main menu page
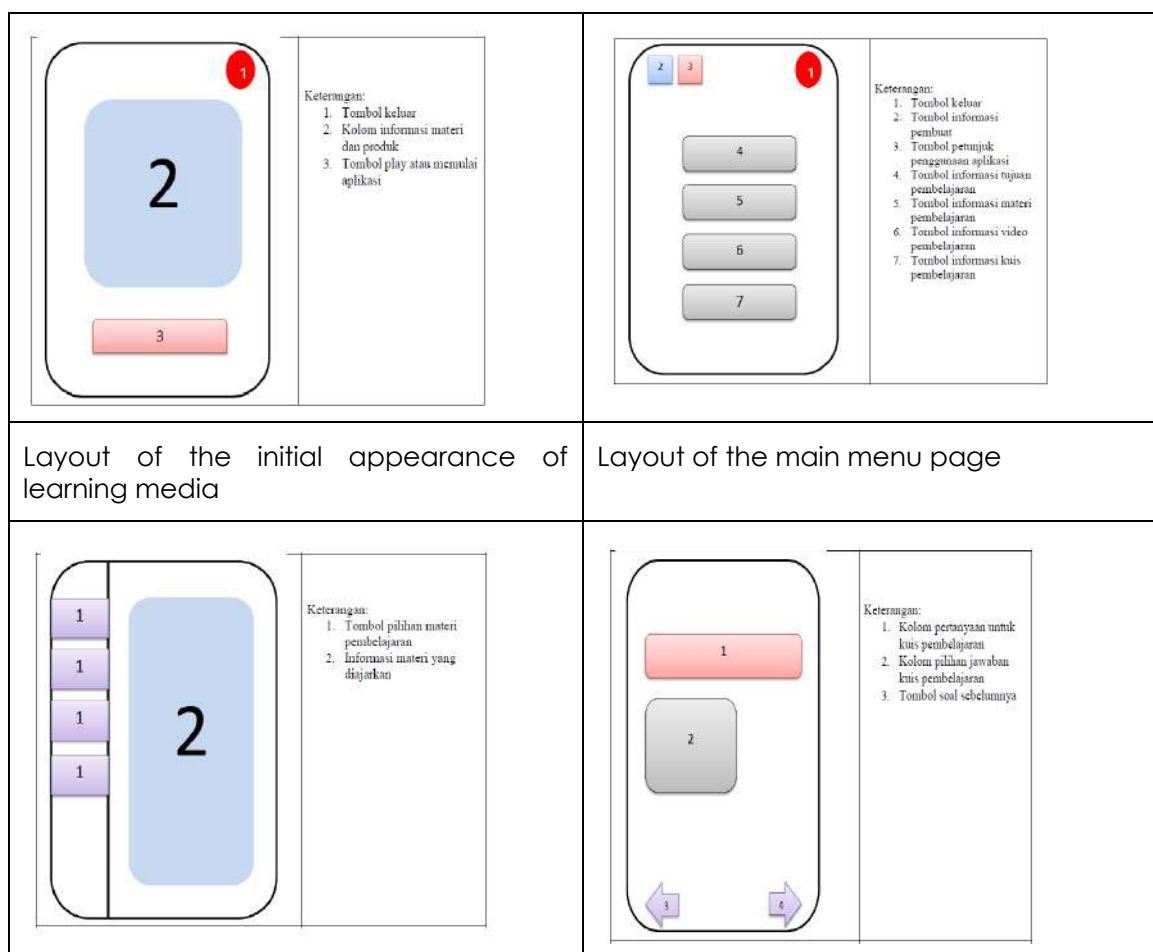
Learning material display layout	Learning quiz view layout

Figure 1. Layout of the application view

4.3.2. The Development Result of the Aplication

Based on the results of the layout design planning stage that has been made, it is then realized into game form with some adjustments to colors, text, images, buttons, etc. The figure 2 are shown the displays results of developing Android-based learning media for science subjects on ecosystem material.

Layout of the initial appearance of learning media	Layout of the main menu page display
Layout of Instruction display	Layout ofinstructional video display

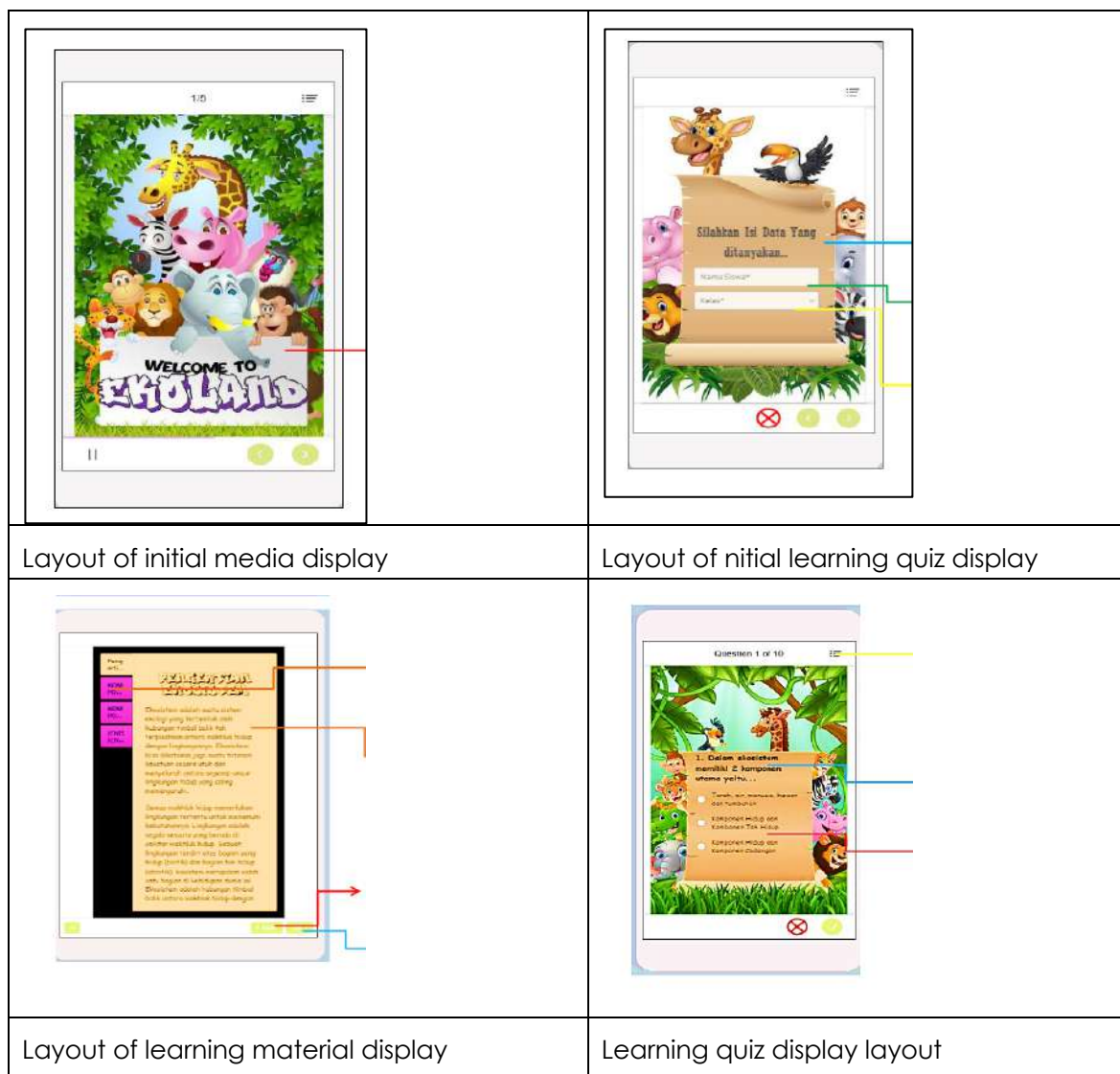|	
Layout of initial media display	Layout of nitial learning quiz display
Layout of learning material display	Learning quiz display layout

Figure 2. Initial display of learning media

4.4. Design Validation

After the learning media application has been made, the next step is to validate the product developed by giving the file for validation to an expert in the field of material, content experts, and educational practitioners to determine the feasibility of the product that has been made. The data analysis technique combines qualitative and quantitative analysis with the calculations used to determine whether or not the item is made using a Likert scale.

4.4.1. *Material Expert Validation*

Based on the validation that has been carried out, calculations are carried out using quantitative analysis techniques to determine the suitability of the learning media being developed. By calculating the evaluation of the validation sheet with a value range of 1-5. The scope of the assessment aspects includes material coverage, material accuracy, relevance, and presentation method. The table 1 are shown the summarizes results of calculating the feasibility of Ekoland learning media ecosystem material for class 5 by material experts.

Table 1. Analysis of Material Expert Validation Data

Aspects assessed	Score obtained	Maximum Score	Percentage score (%)	Description
Coverage of the material	22	25	88	Excellent
The accuracy of the material	17	25	72	Good
Relevance	22	30	73,33	Good
Presentation	14	20	70	Good

The table 1 showed that the average score obtained was 74.83% with the predicate "Feasible, needs revision". Ekoland learning media was considered valid in terms of material because the average results of material expert validation exceed 61%.

4.4.2. Media Expert Validation

They calculated the validation sheet's assessment using a scale of 1-5. The aspects assessed include appearance, content, language structure, and interactivity. The table 2 are shown a summary of the results calculation of the feasibility of Ekoland learning media ecosystem material for grade 5 by material experts.

Table 2. Analysis of Media Expert Validation Data

Aspects assessed	Score obtained	Maximum Score	Percentage score (%)	Description
Display	25	40	62,5	Enough
Content	16	20	80	Excellent
Grammar	11	15	73,33	Good
Interactivity	18	30	72	Good

From the results of validation by media, experts carried out on Ekoland learning media ecosystem material for grade 5. The table 2 showed the average result was 71.95%. Ekoland learning media from the material aspect was valid because the average validation result from media experts exceeds 61%.

In addition to providing numerical assessments, material validators also provide suggestions so that the Ekoland application developed is made better. The revision of Ekoland learning media is based on the criticisms from the validators in the table 3 below.

Table 3. Media Expert Validation Critique/ Suggestion

Validator	Critique/ Suggestion
Dr. Irawan Suprapto, M.Pd	1) The start page on the learning application takes too long to move to the next page; the timing should be improved.
	2) The "Play" button was changed to the "play" button and some unusable buttons were fixed.
	3) The background used in the learning application is too clear and full of images that eliminate learners' focus and should be changed to a slightly natural background.
	4) The use of colors should be more synchronized to make the writing visible.
	5) Use a font that can be read clearly, and the font size is enlarged so that it is easy to read.

4.4.3. Education Practitioner Validation

They calculate the validation sheet's assessment using a scale of 1-5. The aspects assessed include material accuracy, material coverage relevance, appearance, content, language structure, and interactivity. The table 4 showed the results calculation of the feasibility of Ekoland learning media ecosystem material for grade 5 by material experts.

Table 4. Analysis of Education Practitioner Expert Validation Data

Aspects assessed	Score obtained	Maximum Score	Percentage score (%)	Description
Coverage of the material	17	20	85	Excellent
The accuracy of the material	21	25	84	Excellent
Relevance	9	10	90	Excellent
Presentation	17	20	85	Excellent
Display	19	25	76	Good
Content	9	10	90	Excellent
Grammar	11	15	73,33	Good
Interactivity	18	20	90	Excellent

From the table 4 showed that the results of expert practitioner validation that has been carried out on Ecoland learning media ecosystem material for grade 5 was on the average result of 82.33%. Ekoland learning media in terms of material can be declared valid and very good because the average results of media expert validation are more than 61%.

4.4.4. Test of Validity

The process of validity testing is conducted to determine whether a question is considered valid or not valid by using correlation formulas. The validity processing of questions in this research is assisted by SPSS version 20 calculations. It could be categorized as a valid item if the calculated correlation coefficient (r) is greater than the critical value of the correlation coefficient (r-table) at a significance level of 0.05. The table 5 are shown the results of the validity test:

Table 5. Results Of Question Validity Test

No Soal	r hitung	r tabel 5%	Sig	Kriteria
1	0,503		0,039	VALID
2	0,625		0,007	VALID
3	0,823		0,000	VALID
4	0,640		0,006	VALID
5	0,503		0,040	VALID
6	0,806		0,000	VALID
7	0,806		0,000	VALID
8	0,806		0,000	VALID
9	0,759		0.000	VALID
10	0,640		0,006	VALID
11	0,548		0,023	VALID
12	0,640		0,006	VALID
13	0,639	0,482	0,006	VALID
14	0,548		0,023	VALID
15	0,615		0,023	VALID
16	0,584		0,014	VALID
17	0,663		0,004	VALID
18	0,590		0,013	VALID
19	0,591		0,013	VALID
20	0,548		0,023	VALID
21	0,806		0,000	VALID
22	0,503		0,040	VALID
23	0,557		0,020	VALID
24	0,495		0,043	VALID
25	0,503		0,040	VALID

The table 5 above showed the results of the validity test, it can be observed that out of 25 items tested on 5th-grade students, all 25 questions yielded valid results, indicating that every tested item is considered valid. This is evidenced by the calculated correlation coefficient (r) being greater than the critical value (r-table), signifying the validity of the questions.

4.4.5. Test of Reliability

Reliability testing is related to accuracy or consistency, interpreted as the confidence in the test questions to be used as a measure of students' abilities. The reliability of the questions can be observed through the Cronbach's Alpha values in the output column of the data processed using SPSS version 20 software. The calculation results of the reliability test are presented in the table 6 below.

Table 6. Results Of Reliability Test

Cronbach's Alpha	N of Items
0,947	25

Based on the results from the table 6, it could be conclude that the tested questions were reliable as they fall into the very high category. This is evidenced by the Cronbach's Alpha value of 0.947, which is classified as very high.

4.5 Design Revision

This stage is carried out because it is considered that the learning application made is still inadequate. Hence, it needs to be improved based on the results of the assessment in the form of quantitative and descriptive qualitative data provided by the validator. This figure 3, 4, 5, 6 and 7 showed the differences result of media on the application before and after revision:
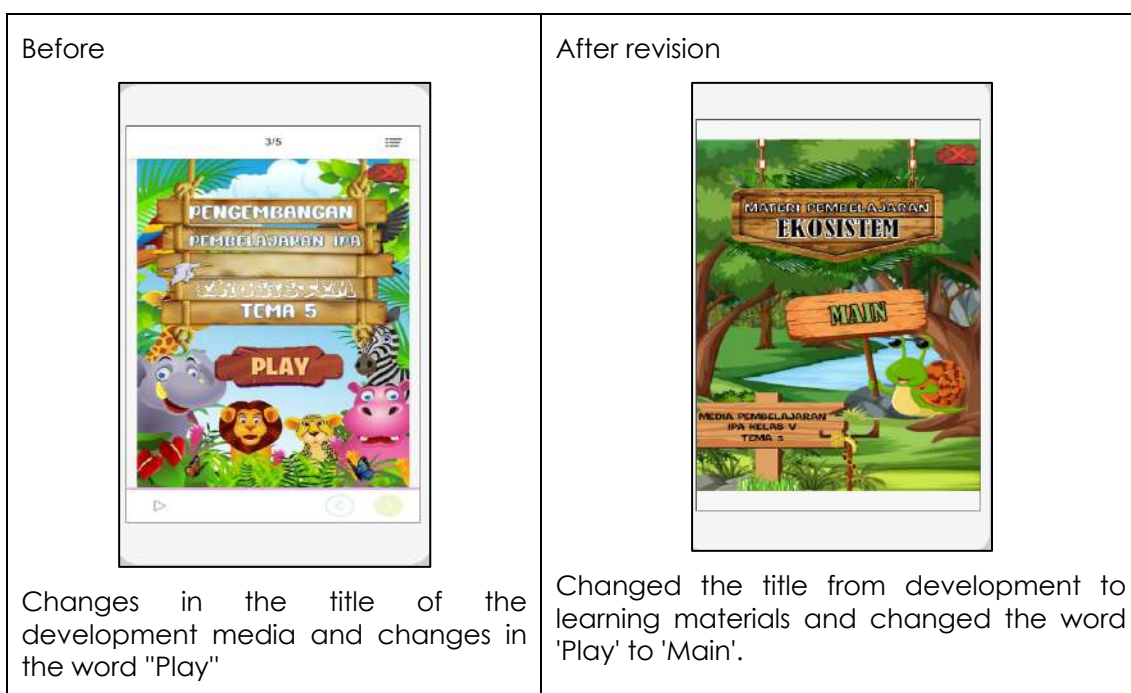
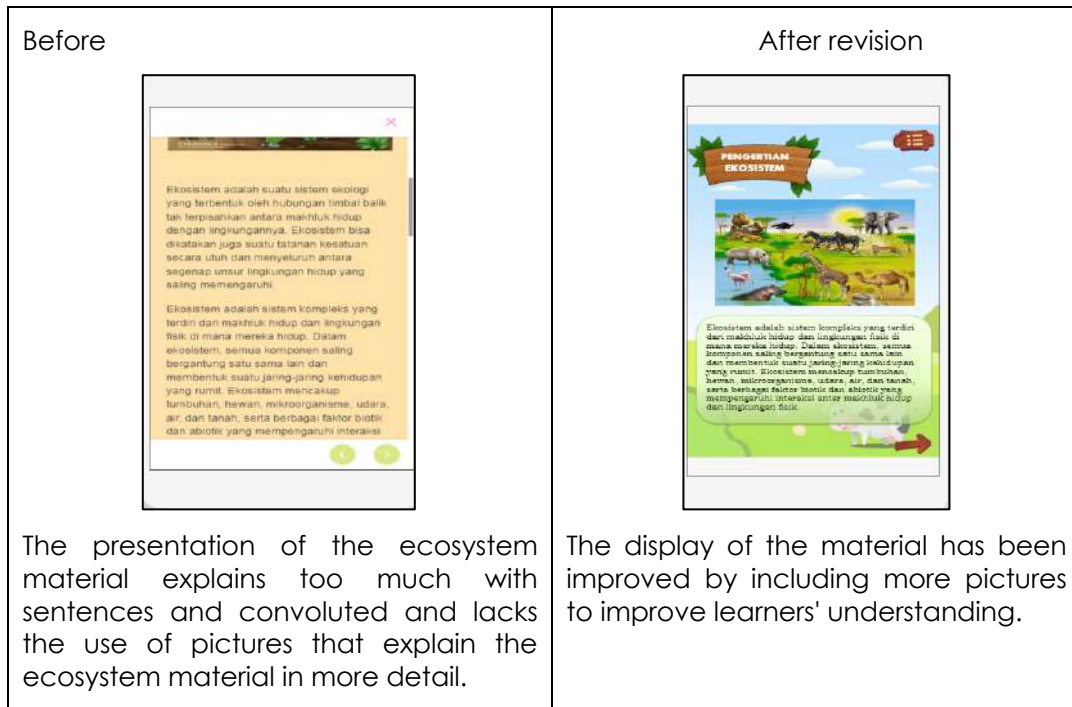| Before	After revision
Changes in the title of the development media and changes in the word "Play"	Changed the title from development to learning materials and changed the word 'Play' to 'Main'.

Figure 3. Media Expert Revision on Cover Page

Before	After revision
The presentation of the ecosystem material explains too much with sentences and convoluted and lacks the use of pictures that explain the ecosystem material in more detail.	The display of the material has been improved by including more pictures to improve learners' understanding.

Figure 4. Media Expert Revision on Material Page

Before	After revision
Too much use of backgrounds attracts learners' attention, diverting learners' focus from the menu presented. There is no sound in the media menu.	The background has been changed to be more natural so as not to distract learners, and the addition of sound on the menu options.
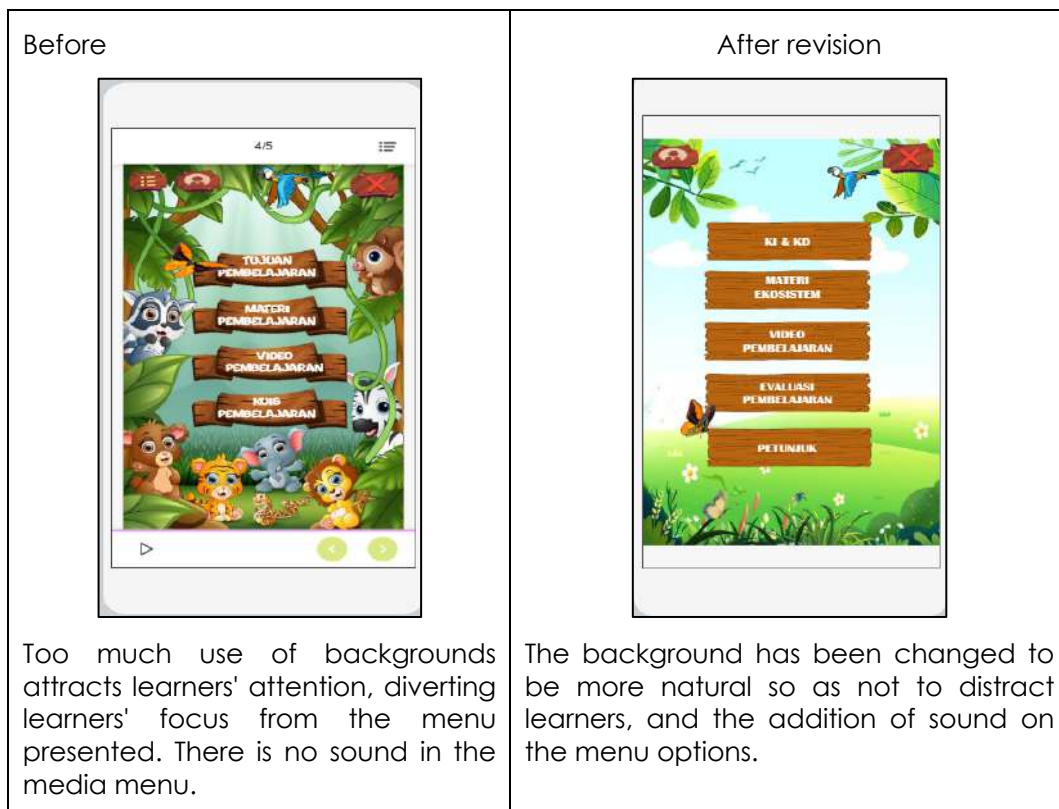
Figure 5. Media Expert Revision Main Menu Page

Before	After revision
The type and font size are less legible.	Changes to the typeface, ecosystem material menu, and display menu to be better understood by students.

Figure 6. Media Expert Revision on Material Menu Page

Before	After revision
Too much use of backgrounds attracts learners' attention, distracting learners' focus from the menu.	The background has been changed to be more natural, not to distract the learner's focus.
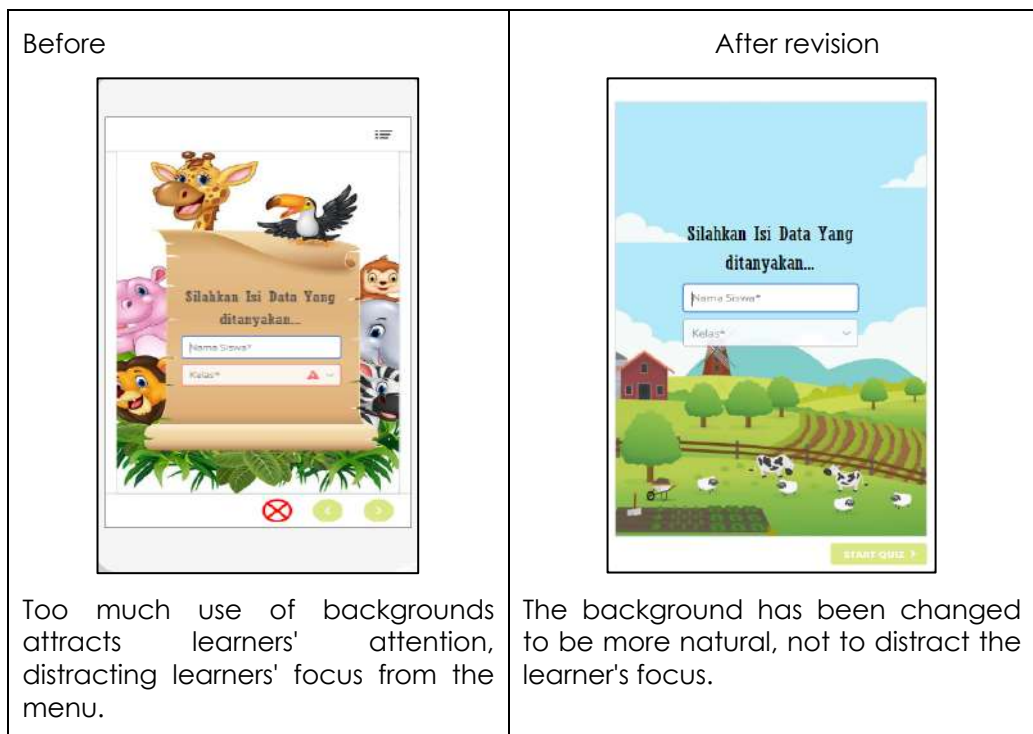
Figure 7. Media Expert Revision on Data User Page

4.6. Results of the Product Trial Stage

The trial of the 'Ekoland' learning media product was carried out on 15 randomly selected students out of 48 students from 5th grade students of Ibnu Rusyd Islamic Elementary School, North Lampung. The selection of trial subjects was chosen based on students who had the same background as the subject who would later become the subject of product use by thinking about the Android ownership of students and the good internet network conditions owned by the school. The experimental subjects were 15 students given the freedom to give

opinions, criticism, and input as well as provide an assessment of the 'Ekoland' learning media products developed. Based on the experiments that have been carried out, there are some shortcomings and opinions given by students. It was shown on the table 7.

Table 7. Product Trial Stage

Aspect	Input
Media display	The images and animations should be improved to attract better learning interest, as some animations are not clearly visible.
Font Size	The font size is good, but the font size for the image source is difficult to read.
Selection Buttons	Menu selection buttons and material choices are difficult to click and take a long time.
Audio and Visuals	The sound used in the media menu would be better filled with a louder voice, making it easy to hear.
Learning Material	The material in the media is very clear, but for questions, there is a description that reads in English; it is better to change it to Indonesian.

From the input and suggestions obtained from students on the table 7 above, there is a limited trial of Ekoland media products; product revisions will be made to improve the media. In the limited product trial stage, it was found that Ekoland media had an effect and improved the understanding of ecosystem material tested in the control experimental class, which could be understood more deeply at the testing data analysis stage.

4.7. Results of the Product Revision Phase

The next stage is the result of the design revision stage based on qualitative data obtained from the product trial stage based on 15 students who have used the learning media. From the experiment results, qualitative data was obtained from students through opinions and input. The data can be used as a reference to improve the 'Ekoland' learning media, but the expert validation results are still used as guidelines.

Revisions to the learning media are in the form of improvements to the sound or dubbing on the menu page that cannot be heard so that students can hear better. Then, the buttons that have not appropriately functioned are fixed so that the buttons can be selected easily. The next revision is to increase the font size of several pages that contain learning materials that are less clearly seen by students, and the last improvement is to improve the learning evaluation menu by changing the information on the question warning that students did not answer which was originally in English to Indonesian.

4.8. Results of the User Trial Stage

After revising the limited product trial with the subject used previously, the next stage is the trial use of Ekoland learning media on ecosystem material for grade 5. The subject of the trial use of ecoland learning media is grade 5 students at Ibnu Rusyd Islamic Elementary School, as many as 48 students. Usage testing is carried out to evaluate the suitability of Ekoland learning media with ecosystem material in appearance as well as the usefulness of using the developed media. The following are the results of the trial use of Ekoland learning media ecosystem material for grade 5.

4.8.1. Student Learning Outcome Data

Student learning outcomes is obtained from an initial test at the beginning of learning, namely by giving questions that are answered by students using learning methods that educators usually use when learning in class to get the initial value of the learning process, as for the posttest results given when learning has used the Ekoland learning media that has been developed. Therefore, we can know the effectiveness of the learning media products that have been developed. The following data on pretest and post-test results regarding the KKM value of students of 70 in class 5 are presented in the following table.

The average pretest and posttest scores increased by 32.25%, and 93.75% of students tested using the Ekoland learning application successfully achieved learning completeness tested using the classical test. This shows that the use of Ekoland learning application for ecosystem material in science lessons for grade 5 students is effective because students who pass more than 80%. Based on suggestions and testing in control and experimental classes that have been carried out at the Ekoland media product trial stage, product revisions will be made to improve the media. In the widespread product trial stage, it was found that Ekoland media had an effect and made a difference in improving the understanding of ecosystem material tested in experimental and control classes, which can be understood more deeply at the test data analysis stage.

4.8.2. Questionnaire Data on the Assessment of Learning Media Products by Students

The use of learning media by students to determine the level of practicality of Ekoland learning media ecosystem material by giving an assessment questionnaire to students. The table 8 below are shown the details of the results of the assessment questionnaire conducted on students.

Table 8. Analysis of Questionnaire Data of USage Test Subjects

Aspects assessed	Grade Acquisition (%)	Category
Ease of Ekoland learning media	85,28	Excellent
Quality of Ekoland learning media	86,97	Excellent
Learning material	86,97	Excellent
Sound and video quality in ecoland learning media	85,67	Excellent
Level of difficulty of learning evaluation of Ekoland learning media	85,06	Excellent
Benefits of Ekoland learning media	88,28	Excellent
Total average	**86,37**	**Excellent**

Based on the assessment and questionnaires given to students who have been carried out on Ekoland learning media ecosystem material for class V, the table 8 showed the average of the result was 86.37% from the percentage criteria of 61% -80% which shown decent results. Ekoland learning media in terms of material can be declared valid and very good because the average result of media expert validation is more than 61% based on the practicality test, so the Ekoland learning application is considered practical and can be continued.

4.8.3. Feedback From the Pilot Test

Ekoland learning media with ecosystem materials that have been tested on students get input and suggestions. Some summaries related to input and suggestions from trial participants using Ekoland learning media are shown on the table 9.

Table 9. Feedback and Suggestion Data of the Pilot Test Subjects

Aspect	Input
Media display	The learning media is excellent and exciting, with many pictures and animations that explain the material studied. However, the menu of the chosen material studied sometimes returns to the initial menu without being selected.
Font Size	The font size is excellent and easy to read, so it does not need to be changed again.
Selection Buttons	Selection buttons for the next menu and the previous button are sometimes missing on some material pages.
Audio and Visuals	The audio and visuals presented can be heard and seen well.
Learning Material	The material displayed is straightforward to understand by displaying many images and animations that make it easy to learn eco-system material.

4.9. Results of the Product Revision Stage

Based on the testing stage, getting input and suggestions given by the experts, it is used as a reference as a step to improving Ekoland learning media for Android-based ecosystem material using iSpring Suite as the final result of the development product. The development of the product revision stage was a critical step in the product development cycle aimed at improving the overall quality and performance of the product. In this stage, the product development team reviews the results of the previous revision stage to ensure that each change or improvement has been implemented effectively. This process involves testing, evaluation, and validation of the revisions made to ensure that the product meets the desired quality standards. Additionally, at this stage, the team can also identify potential additional improvements or changes based on feedback from testing or product usage. After the equivalent product trial stage, the results of the Ekoland learning media were obtained and could be presented on the figure 8 below.

Learning media as Ekoland application can be easily accessed using a smartphone or Android through the learning application connected to Google Drive. The visual aspects of the learning media have been enhanced to provide a more enjoyable and engaging learning experience for users. Additionally, interactive features have been added to increase user engagement in the learning process. All these improvements are made with the aim of enhancing the user experience in using Ekoland learning media, ensuring easy access, and providing added value in understanding the learning materials.

To supporting the data result, the final result of the development this application can be reached out on the link below:
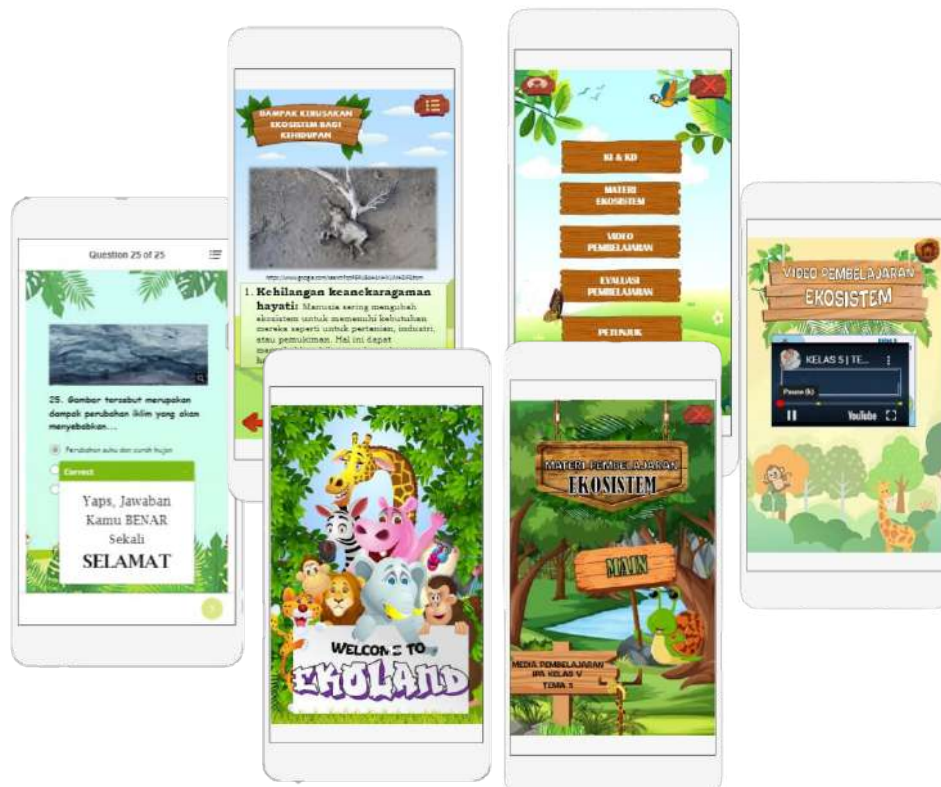
https://drive.google.com/drive/folders/17ap96GgeDNeJH2iCAp-DYRBY2XZl4rXg

Figure 8. Results of the Product

5. Discussion

Android is portable and can be taken anywhere, providing flexibility for students to learn according to their own schedules and environments (Razgallah et al., 2021). The portable and easily transportable nature of Android makes the development of Android-based learning media easily accessible and usable for students in any situation. This has prompted the development of Android-based learning media called Ekoland. Android-based learning media offers several significant advantages in the context of education (Videnovik et al., 2024). Android learning media also supports a personalized learning approach (Hakiki et al., 2022; Salina et al., 2020). In its development, the Ekoland learning media can enhance the quality of education by presenting learning materials tailored to technological advancements, making it an innovation in education in the era of technological onslaught. The developed Ekoland learning media involves ease of access, interactivity, personalization, diverse learning resources, and student progress monitoring. The use of Android technology in education can be a strategic step to support a more modern, inclusive, and effective learning approach. Developing learning media in line with technological advancements will facilitate teachers in sparking students' interest in learning by using elements that students commonly use in their daily lives, in this case, through the use of Android. Therefore, Android becomes a supportive and alternative tool that can be used as a relevant and user-friendly source of media for students.

Android devices are often equipped with various sensors, such as an accelerometer, GPS, and camera. These features can be utilized in educational applications to create a more profound and interactive learning experience (Bhatt & Furia, 2022). The development of Ekoland media as the utilization of Android use various features in the media. Ekoland employs various display features that enhance students' interest in learning, including animated animal movements that capture students' attention, presenting materials in an engaging writing style accompanied by images, and providing direct internet-connected instructional videos that facilitate students in understanding the lesson without the need to

search for additional materials. Based on the assessment from validators, the developed Ekoland learning application is considered suitable for use as a learning tool to enhance students' understanding of ecosystem material. The validator's results state that Ekoland, as a developed product, is equipped with various buttons, sounds, and sensors that engage students in increasing their interest in learning.

As stated from the result, on the developing this learning application should be suit on the needs of elementary school level learners. The development can be seen in terms of application and material. In the development of the application, font type, font size and images are needed to be crucial point that can attract the attention of application users at the elementary school level. The use of language also influences in the development of this application. Many factors must be adjusted to the target users of the Ekoland learning application. So that the final results of the application can be used in supporting learning and teaching activities in schools. The development of Android-based learning media, such as Ekoland, brings various benefits to the world of education. Android-based learning media supports a personalized learning approach, allowing students to learn according to their own learning styles and pace. The diversity of learning resources provided also enables the adjustment of learning materials according to individual needs, recognizing the uniqueness of each student. The use of Android technology in education is considered a strategic step as it provides students with the opportunity to develop technology skills and digital literacy, preparing them for the challenges of an increasingly digitally connected world. Through the utilization of Android features, such as sensors on devices, learning media can be designed to provide a more profound and interactive learning experience. This has a positive impact on students' understanding of learning materials and can enhance their learning outcomes. Therefore, the development of Android-based learning media, like Ekoland, offers significant advantages in promoting personalized learning, technological skills, and a more engaging educational experience for students.

Android-based learning applications can be designed to be interactive, engaging students in a more interesting learning experience. This interactivity may include experiments, simulations, and other multimedia activities (Sharma et al., 2021). By developing learning media, various aspects of learning can be significantly improved. Learning media can help convey difficult or abstract concepts in a more understandable way. The use of Android-based learning media can help students develop important technology skills and digital literacy in an increasingly interconnected digital world (Bhatt & Furia, 2022). The Ekoland learning media developed has been able to increase students' interest in learning science because it is easily accessible and understandable, providing visual aids. Developing Android-based learning media can be an alternative as a learning tool that students can use easily and optimally. Ekoland, as a developed learning media, can serve as an alternative for teachers in the learning process by utilizing technology that has been mastered and favored by many students, even at the elementary level. The use of Android-based learning media, such as Ekoland, also contributes to the development of students' technology skills and digital literacy in an increasingly interconnected digital era. Other advantages include easy access, interactivity, personalization, diverse learning resources, and monitoring student progress. The utilization of Android technology in education can be considered a strategic step to support a more modern, inclusive, and effective learning approach.

Ekoland, as a learning application developed specifically for Android devices, is designed to provide a more engaging and interactive learning experience for students. Its interactive features include experiments, simulations, and various other multimedia activities. By developing learning media like Ekoland, various aspects of learning can experience significant improvement. The crucial role of learning media lies in its ability to convey difficult or abstract concepts in a more understandable way. Recognizing the rapid development of students and significant technological advancements, the development of Android-based media can help parents reduce the negative impact of Android device usage on children. Installing Ekoland on students' Android devices can have a positive impact, turning the device that students love into an enjoyable learning resource by integrating various features. However, it is important for parents to accompany students during the learning process to

avoid excessive use of Android devices. Therefore, the development of Android-based learning media, such as Ekoland, brings significant benefits in improving accessibility, interactivity, personalization, and student engagement in the learning process.

6. Conclusion

The development of Ekoland learning media has been carried out and tested at Ibnu Rusyd using a nine-stage development model, resulting in Android-based learning media developed using iSpring Suite and named Ekoland. The Ekoland learning media developed received a material validator score of 74.83% with the predicate "Fit, needs revision." Media experts obtained a score of 71.95% with the predicate "Fit, needs revision." The final score was given by education practitioners with a score of 82.33% and the predicate "Very Fit, No Need for Revision." Ekoland media was tested on 48 respondents, with the result that 86.37% of students were able to use the learning media effectively. Students understood the use of the developed Ekoland learning media and considered it as an alternative to the existing learning media. Ekoland, as a learning media, can overcome boredom, increase interest in learning, and visualize abstract ecosystem science learning material that can be easily understood by students. Thus, it has a significant impact on addressing issues in learning and helping students achieve the relevant learning indicators. The weakness of this research is that the application cannot be widely published and utilized by students beyond the researcher's scope. According to Born and Gall (2003), the development of the research will be perfect if it could be published to the general public. This research is only limited to developing learning media and has not investigated the effectiveness of learning using the Ekoland learning media that was developed. In this way, researchers can continue research towards the effectiveness and application of Ekoland learning media in learning in ibn schools. From the data and results of this research, it could be concluded that the use of Ekoland learning media development products on ecosystem material with an Android base using iSpring Suite could improve the understanding of the students towards the materials. It could be said that the use of Ekoland learning media with an Android base has a positive impact on students in various aspects.

Limitation

During the research carried out in developing learning media products, researchers have obstacles in developing ecoland products. Researchers have difficulty in sharing the Ekoland application that has been developed with students. This is because the use of Android is a variety of types and forms, with limited Android memory. The development application that is formed is large enough so that if the Android used by students has full storage, researchers must delete and clean the Android so that free space is needed. The use of iSping suites makes it easier for researchers to develop interactive learning applications. However, the addition of video, images, and sound in the use of interesting media makes the resulting learning applications very large. The obstacles found by researchers in developing the Ekoland application product in increasing student interest in learning at school are in the form of a lack of understanding of class teachers in understanding Android devices. These class teachers are accustomed to providing conventional learning experience difficulties at the beginning during product trial tests. This causes researchers to provide understanding and teaching during the use of development products so that later, the products that have been developed in the form of a learning application called Ekoland can be used as an alternative to learning in schools.

Recommendation

From the results obtained, there were some recomendation that can researchers classify. This research are recommended for teachers that should be able to develop Android-based learning media by using *iSpring Suite* and *Website 2 APK Builder* as alternative media to help learn science and facilitate an effective student learning process. It also recommended for

the schools that should provide adequate facilities so teachers can develop interactive learning media that students can use well. Another recommendation were to parents, that they should supervise students using Ekoland media because Ekoland media needs to use smartphones or Androids to operate it in learning.

Acknowledgments

Conflict of Interest

We confirm that there are no known conflicts of interest associated with this publication, and there has been no significant financial support for this work that could have influenced its outcome. We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed.

References

Alamsyah, D. P., Parulian, J. M., & Herliana, A. (2023). Augmented reality android based: Education of modern and traditional instruments. *Procedia Computer Science*, *216*, 266–273. https://doi.org/10.1016/j.procs.2022.12.136

Andreani, W., & Ying, Y. (2019). "PowPow" interactive game in supporting English vocabulary learning for elementary students. *Procedia Computer Science*, *157*, 473–478. https://doi.org/10.1016/j.procs.2019.09.005

Armansyah, F., Sulton, S., & Sulthoni, S. (2019). Multimedia Interaktif Sebagai Media Visualisasi Dasar-Dasar Animasi [*Interactive Multimedia as Visualization Media for Fundamentals of Animation*]. *Jurnal Kajian Teknologi Pendidikan [Journal of Educational Technology Studies]*, *2*(3), 224–229. https://doi.org/10.17977/um038v2i32019p224

Bhatt, B. N., & Furia, C. A. (2022). Automated repair of resource leaks in Android applications. *Journal of Systems and Software*, *192*, 111417. https://doi.org/10.1016/j.jss.2022.111417

Booton, S. A., Kolancali, P., & Murphy, V. A. (2023). Touchscreen apps for child creativity: An evaluation of creativity apps designed for young children. *Computers & Education*, *201*, 104811. https://doi.org/10.1016/j.compedu.2023.104811

Byusa, E., Kampire, E., & Mwesigye, A. R. (2022). Game-based learning approach on students' motivation and understanding of chemistry concepts: A systematic review of literature. *Heliyon*, *8*(5), e09541. https://doi.org/10.1016/j.heliyon.2022.e09541

De Paula, B. (2021). Reflexivity, methodology and contexts in participatory digital media research: Making games with Latin American youth in London. *Learning, Media and Technology*, *46*(4), 435–450. https://doi.org/10.1080/17439884.2021.1901114

Dezuanni, M. (2018). Minecraft and children's digital making: Implications for media literacy education. *Learning, Media and Technology*, *43*(3), 236–249. https://doi.org/10.1080/17439884.2018.1472607

Ferdiman, B., Akbar, H. A., Faturrahman, M. R., & Maulana, F. I. (2023). Development of Augmented Reality Application in Physics through Newton's Laws and Object Interaction. *Procedia Computer Science*, *227*, 699–708. https://doi.org/10.1016/j.procs.2023.10.574

Fischer, F., Sommerhoff, D., & Keune, A. (2023). Perspectives on learning from the learning sciences. In *International Encyclopedia of Education(Fourth Edition)* (pp. 44–56). Elsevier. https://doi.org/10.1016/B978-0-12-818630-5.14007-2

Fitriati, F., & Megawati, F. (2021). iSpring Suite 9: Its Effect on EFL Learners in Comprehending Narrative Text. *Jurnal.Fkip-Uwgm.Ac.Id*, *3*(2), 1–10. https://doi.org/10.24903/bej.v3i2.771

Forsler, I., & Guyard, C. (2023). Screens, teens and their brains. Discourses about digital media, learning and cognitive development in popular science neuroeducation. *Learning, Media and Technology*, *1*(1), 1–14. https://doi.org/10.1080/17439884.2023.2230893

Hakiki, R., Muchson, M., Sulistina, O., & Febriana, A. (2022). The Development of Learning Media Based on Augmented Reality, Hologram, and Ludo Game on The Topic of Molecular Shapes. *International Journal of Interactive Mobile Technologies (iJIM)*, *16*(04), 70–84. https://doi.org/10.3991/ijim.v16i04.28989

Hanisah, Irhasyuarna, Y., & Yulinda, R. (2022). Pengembangan Media Pembelajaran Interaktif menggunakan ISpring Suite 10 pada Materi Reproduksi Tumbuhan untuk Mengukur Hasil Belajar [*Development of Interactive Learning Media using iSpring Suite 10 on the Topic of Plant Reproduction to Measure Learning Outcomes*]. *JUPEIS : Jurnal Pendidikan Dan Ilmu Sosial [Journal of Education and Social Science]*, *1*(3), 6–16. https://doi.org/10.55784/jupeis.vol1.iss3.68

Kahne, J., & Bowyer, B. (2019). Can media literacy education increase digital engagement in politics? *Learning, Media and Technology*, *44*(2), 211–224. https://doi.org/10.1080/17439884.2019.1601108

Laseinde, O. T., & Dada, D. (2023). Enhancing teaching and learning in STEM Labs: The development of an android-based virtual reality platform. *Materials Today: Proceedings*, S2214785323046825. https://doi.org/10.1016/j.matpr.2023.09.020

Latif, J. J. K., Triputra, A. A., Kesuma, M. A., & Maulana, F. I. (2023). Design and Development a Virtual Planetarium Learning Media Using Augmented Reality. *Procedia Computer Science*, *227*, 726–733. https://doi.org/10.1016/j.procs.2023.10.577

Nurhasanah, Y., Pinandoyo, D., Alamsyah, M. R., Prasetyo, E., & Zukri, N. R. (2023). The Development of a Coliform Detection Game As A Part of Android – Based Virtual Food Safety Laboratory to Support Online Learning. *Procedia Computer Science*, *227*, 1002–1011. https://doi.org/10.1016/j.procs.2023.10.609

Potter, J. (2023). Micro studies in macro digital ecosystems: AI dystopias, assemblages, and qualitative research in challenging times. *Learning, Media and Technology*, *48*(3), 369–371. https://doi.org/10.1080/17439884.2023.2235988

Privitera, A. J., Ng, S. H. S., & Chen, S. H. A. (2023). Defining the Science of Learning: A scoping review. *Trends in Neuroscience and Education*, *32*, 100206. https://doi.org/10.1016/j.tine.2023.100206

Qiu, Y., Pan, H., Kalantari, Z., Giusti, M., & Che, S. (2023). The natural focus: Combining deep learning and eye-tracking to understand public perceptions of urban ecosystem aesthetics. *Ecological Indicators*, *156*, 111181. https://doi.org/10.1016/j.ecolind.2023.111181

Razgallah, A., Khoury, R., Hallé, S., & Khanmohammadi, K. (2021). A survey of malware detection in Android apps: Recommendations and perspectives for future research. *Computer Science Review*, *39*, 100358. https://doi.org/10.1016/j.cosrev.2020.100358

Rohmaini, L., Netriwati, N., Komarudin, K., Nendra, F., & Qiftiyah, M. (2020). Pengembangan Modul Pembelajaran Matematika Berbasis Etnomatematika Berbantuan Wingeom Berdasarkan Langkah Borg and Gall [*Development of Mathematics Learning Modules Based on Ethnomathematics with Wingeom Assistance According to Borg and Gall's Steps*]. *Teorema: Teori Dan Riset Matematika [Theory and Research of Mathematics]*, *5*(2), 176. https://doi.org/10.25157/teorema.v5i2.3649

Rohmani, R., Apriza, B., & Mahendra, Y. (2021). Pengembangan gim kuis edukasi suplemen buku ajar pengantar dasar IPA berbasis website [*Development of an educational quiz game supplement for the basic introduction to science textbooks based on a website*]. *JINoP: Jurnal Inovasi Pembelajaran [Journal of Learning Inovation]*, *7*(2), 194–208. https://doi.org/10.22219/jinop.v7i2.18576

Salina, Tahira, Sunarti, Syarif, S., Ahmad, M., Manapa, E. S., & Jibril. (2020). Application mattampu as fetal growth education media during pregnancy based on android. *Enfermería Clínica*, *30*, 602–605. https://doi.org/10.1016/j.enfcli.2019.07.170

Sari, A. C., Fadillah, A. M., Jonathan, J., & David Prabowo, M. R. (2019). Interactive Gamification Learning Media Application For Blind Children Using Android Smartphone in Indonesia. *Procedia Computer Science*, *157*, 589–595. https://doi.org/10.1016/j.procs.2019.09.018

Sharma, S., Krishna, C. R., & Kumar, R. (2021). RansomDroid: Forensic analysis and detection of Android Ransomware using unsupervised machine learning technique. *Forensic Science International: Digital Investigation*, *37*, 301168. https://doi.org/10.1016/j.fsidi.2021.301168

Sugiyono. (2016). *Penelitian, Metode Kuantitatif, Kualitatif dan R&D[Research, Quantitative Methods, Qualitative Methods, and Research & Development (R&D).]* (23rd ed.). Alfabeta, CV.

Sulistyorini, S., & Listiadi, A. (2022). Pengembangan Media Pembelajaran ISpring Suite 10 Berbasis Android pada Materi Jurnal Penyesuaian di SMK [*Development of iSpring Suite 10 Learning Media Based on Android for Adjusting Journal Material in Vocational High School*]. *EDUKATIF : JURNAL ILMU PENDIDIKAN [Journal of Educational Science]*, *4*(2), 2116–2126. https://doi.org/10.31004/edukatif.v4i2.2288

Taylor, K. H., Takeuchi, L., & Stevens, R. (2018). Mapping the daily media round: Novel methods for understanding families' mobile technology use. *Learning, Media and Technology*, *43*(1), 70–84. https://doi.org/10.1080/17439884.2017.1391286

Videnovik, M., Madevska Bogdanova, A., & Trajkovik, V. (2023). Game-based learning approach in computer science in primary education: A systematic review. *Entertainment Computing*, *48*, 100616. https://doi.org/10.1016/j.entcom.2023.100616

Widyawati, C., Katminingsih, Y., & Widodo, S. (2022). Pengembangan Media Pembelajaran Interaktif Matematika Menggunakan iSpring Suite 10 Pada Materi Aritmatika Sosial [*Development of Interactive Mathematics Learning Media Using iSpring Suite 10 on Social Arithmetic Material*]. *Seminar Nasional Pendidikan Matematika [National Seminar of Mathematic Education] 2022*, *1*(1), 1–7. http://dx.doi.org/10.31000/cpu.v0i0.6863